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Preface

We celebrate this year Hradec Economic Days international scientific conference's 20th anniversary and commemorate its beginning in 2003. Important for establishing and further development of the conference was the initial idea, but also its specific form and protagonists on the side of the organizers and participants. The first Hradec Economic Days conference (HED) took place in 2003 under the title: Banking Sector and Regional Development. The meeting took place in two conference tracks: Finance and Banking session and Regional Development and Business Support. The conference was organized by the Department of Economics and Management of the Faculty of Informatics and Management of the University of Hradec Králové (FIM UHK) in cooperation with the regional branch of the Czech National Bank in Hradec Králové and the Banking Institute of the University of Prague. As the first invited speakers gave their speech prof. Jan Frait (a member of the Czech National Bank Board), assoc. prof. František Jirásek (rector of the Banking Institute of the University of Prague) and prof. Stanislav Polouček (head of the Department of Finance of the Commercial Business Faculty of the University of Silesia in Karviná). It was the Organizing Committee, especially Ing. Jaroslava Ditrichová, Ing. Pavel Jedlička (editor of proceedings 2003-2020), and Ing. Veronika Jašíková who contributed to the organization of the first HED conference and its successful development in the following years.

The number of participants and contributions gradually grew with the next years. While the proceedings of the first HED conference in 2003 contained 32 contributions, the proceedings of HED in 2007 had to be divided into two separate parts. Proceedings held a total of 170 contributions which dealt from different perspectives with the current problems of business development and development of regions in six separate conference tracks. The number of contributions went over the two hundred mark in 2008. The next milestone was reached at the 9th HED in 2011 where more than half of the participants were from abroad. Also, two new tracks have been added: Mathematical Models in Economics and Economics of Tourism. There was also a significant increase in the Macroeconomic Contexts of Regional Development track contributions. The next important event was the 11th HED in 2013 which was held under the auspices of the Governor of the Czech National Bank.

Inclusion of the HED proceedings 2005-2011 into the Web of Science Conference Proceedings Citation Index database was an important milestone, recognition, and great incentive for the next years for the whole organizational team. It also increased the prestige of the conference and the interest of colleagues from home and abroad in HED participation. Our proceedings were since then on a yearly basis evaluated and included in the Web of Science database. Over 300 contributions were published in five volumes of the reviewed proceedings at the 12th HED in 2014 conference. The next step in the HED development was in 2018 a cooperation with the Wrocław University of Economics, the Cracow University of Economics, and the University of South Bohemia Technology Transfer Office. We especially thank prof. Anna Cierniak-Emerych, prof. Krzysztof Firlej, and dr. Růžena Štemberková. The leitmotiv of the conference was the industry 4.0 concept. MDPI publishing from Switzerland became our journal publishing partner and sponsor of the best paper award.

We substantially improved the composition of the program committee in the following 17th year of HED in 2019. The committee ranks were joined by academics from the USA, China, Malaysia, Spain, Croatia, Slovakia, Romania, Poland, and the Czech Republic. The HED in 2019 was also held under the auspices of the Czech National Bank and included a panel discussion on the topic of 100 years of the Czech crown. The HED 2020 conference was subtitled Innovation and the upcoming challenges of developed and developing economies. It aimed to promote the idea of communication and cooperation between scientists from different disciplines and practitioners. The form and course of the HED 2020 and HED 2021 conferences were influenced by a global pandemic. Nevertheless, we managed to hold continuity, expertise, and even improve when we started issuing the DOI for all articles.

The aim of the conference HED 2022, as in previous years, holds. We aim to present the results of scientific research activities in the fields of economics, business economics, and management, to create a regular platform for meeting experts from such disciplines, strengthen interdisciplinary relations, and establish personal contacts important for the submission of joint research projects and to create space for the presentation and publication of young members of an academic community. We are honored that other institutions such as the Wrocław University of Economics, the Cracow University of Economics, and the University of South Bohemia participate in this activity with us for a long time. Proceedings from the conference HED 2022 contain 95 contributions in English. The authors of the conference papers were academics and other professionals from the Czech Republic, Poland, China, Slovakia, Romania, Turkey, Ukraine, Norway, United Kingdom, Latvia, Pakistan, Hungary, and Russia.

Even though the HED 2022 conference again had to face organizational challenges, we managed to hold a face2face conference with high-quality articles, workshops focused on practice and academia interconnection, and foremostly keynote speakers:
- Petr KRÁL as Executive Director of the Czech National Bank, Czech Republic,
- Morten IRGENS as Dean of the School of Economics, Innovation, and Technology, Norway.

HED 2022 workshop and overall conference reach were supported by the Centre for Investment, Development and Innovation, and the Hradec Králové region. The final recognition belongs to the HED secretary dr. Ivan Soukal, editor dr. Jan Mačí, our organization and scientific committee, and especially all participants of the HED conference for their contributions and favor.

Hradec Králove, March 22, 2022

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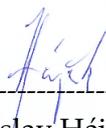
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CONTENT

Facebook as a Marketing Tool: A Chance for Local Food Producers?

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Abstract: Local family farmers doing business in the same place for centuries and doing business through social media are seemingly incompatible. However, it is a fact that social networks, especially Facebook, are currently changing established social practices. The present study aims to identify patterns of entrepreneurial behavior of local farmers and the opportunities offered by Facebook sales. The research sample includes ten farms selected on the basis of the number of Facebook followers, Facebook page activities and own food production. Selected farms are based in Poland and the Czech Republic and are engaged in plant and animal production. The study provided new insights into the use of Facebook as a marketing tool. Specifically, it dealt with the frequency and content of local producers' marketing communication, the sales channels used, and the nature of the social relationship between farmers and local customers.

Keywords: social media; Facebook; business model; marketing; local food production

JEL Classification: Q13; A14; M31

1. Introduction

Nowadays, business marketing activities are increasingly moving on the Internet. Digital transformation has a strong influence on the economy, marketing as well as consumer behaviors in all industries, including family farmers. Kotler et al. (2017) indicate that changes in technology and consumer behavior led to the transformation from traditional marketing into digital marketing – Marketing 4.0.

The new marketing foundations are based on social networks, circular economy, the economy of sharing as well as content marketing. Moreover, the mobile internet access has changed market behavior, enabling social interactions, comparing and giving opinions on purchases from anywhere in the world. Social media are a tool supporting this attitude which has a huge impact on consumers' purchasing decisions. Social media removes geographic and demographic barriers, enabling people to connect and communicate, while companies can act innovatively through this collaboration (Kotler et al., 2017). In addition, the power of social media is underlined by its popularity in society.

Globally, more than half of the world population is an active social media user (4.20 billion people) with a constantly increasing trend (+13.2%, Jan. 2021 vs. Jan. 2020) (Kemp, 2021). That is why, not only consumers can benefit from the use of social media, but most of all, enterprises may build their brand easily and use tools to profit and grow in the industry (Sarkar & Ghosal, 2018).

2. Use of Social Media in Local Food Systems

Social media have become a communication tool supporting and maintaining relations with customers (Karjaluoto et al., 2015). Popularity and accessibility of Facebook with 2,740 billion active users (Kemp, 2021) makes this social network a good opportunity for increasing exposure to targeted customers (Sarkar & Ghosal, 2018). Moreover, according Brink (2017) the social platforms such as Facebook are less expensive than traditional marketing processes. These factors make Facebook an attractive tool for micro as well as small and medium-sized enterprises (SMEs).

SMEs, compared to large companies, have limited resources resulting in obstacles to creating marketing campaigns. Thus, Facebook and other social media tools are an opportunity for SMEs to make their businesses visible and promote relationships with customers, which may consequently influence sales and revenues. One sector that is beneficial from the use of social media is food production performing locally in short supply chains. Local food systems (LFS) are trending in agribusiness and gaining recently in popularity (Bareja-Wawryszuk, 2020a).

LFS can be considered as systems identified with the production region, striving to optimize the economic results achieved by limited intermediaries in food chains, systems using sustainable production and distribution methods, and supporting direct social relations (Feenstra, 1997). The growing popularity of LFS is associated with a crisis of confidence in the mass agri-food industry, and concerns about the use of genetic modification or food preservatives. The pandemic and difficulties in food supply had also a significant impact on the development of LFS (Bareja-Wawryszuk, 2020b). Moreover, public awareness of the natural environment and care for its sustainability is increasing, which contradicts the industrial approach to the agribusiness sector (Blouin et al., 2009). LFS are regarded as community-driven where social direct relations play a crucial role. Thus, the usefulness and possibilities of Facebook match the needs of local producers' performance, making Facebook an appropriate tool for marketing and selling processes.

The above literary background introduces the purpose of the presented article. This is to assess the potential of using Facebook as a marketing tool for local food producers. More precisely, we aim, to illustrate the business behavior of local farmers on Facebook based on presented case studies. Namely to answer questions: For what sales purposes this social network is used? What content is communicated on farmers Facebook pages? How customers react to this communication?

3. Methodology

The study is based on the analysis of online environment, specifically presentations of local food producers on Facebook social network. This kind of analysis conducted in online environment is a part of so-called Internet mediated research (Hewson, 2008). At the same time, social media offer widely accessible, up-to-date, and available digital information (Lai & To, 2015). When analyzing content, we have used methodology close to Lai and To (2015) grounded theory approach and with its hybrid nature we were able quantitatively analyze qualitative social media content as business practices, farmer´s opinions or responses of local customers. Subsequently, we were able to identify main behavior patterns in business communication of local producers.

Research study focuses on local food producers located in the Czech Republic and Poland to illustrate use of Facebook as a business channel. The following restrictive conditions were set for the selection in the sample: (1) the producers are engaged in agricultural production, (2) with functional Facebook pages and (3) the number of followers of the page is more than 250, (4) the page owners take an active approach to site administration. When selecting local producers for analysis the keyword farm (i.e., "gospodarstwo" in Polish, and "farma" in Czech language) was used.

Table 1. The main characteristics of selected local farms Facebook pages

Farm name / Facebook page name (country)	N	Business Scope	Number of Followers	Review score / number	On-page Shopping
Cud Malina, Gospodarstwo ekologiczne / Bioowoce (PL)	72	Organic fruits, production of juices and syrups	1,461	5.0 / 12	Yes
Doktor Miodek Gospodarstwo Pszczelarskie / DoktorMiodek (PL)	60	Production and distribution of natural honey	2,251	5.0 / 26	Yes
Tradycje Natury – Eko Gospodarstwo Ogrodnicze / Tradycje Natury (PL)	42	Organic production of milk, fruit, and vegetables. Online selling and transportation.	1,382	5.0 / 7	Yes
Malinowy Chrusniak – Gospodarstwo Ekologiczne / Malinowy Chrusniak (PL)	40	Organic cheese production and sales	4,253	0 / 0	Yes
Gospodarstwo Rolne S_49 / S49wiejskijaja (PL)	35	Free-range laying hens, fresh, tasty and healthy eggs, no chemicals or GMOs.	256	5.0 / 6	Yes
Farma Polák / ceskebrambory.cz (CZ)	11	Vegetable production, mainly potatoes, onion, cabbage, and cauliflower	1,100	n/a	No
Rodinná farma Aujeský / farmaaujesky (CZ)	45	Fruit and vegetables, door-to-door delivery of boxes with fresh products	11,817	4.9 / 54	No
Farma Matějka / farma-matejka-prodej-mleka-ze-dvora (CZ)	39	Production and sales of milk and beef meat	736	5.0 / 4	No
Farma SOKOL / farmasokolzrampuse (CZ)	83	Meat and milk products	7,861	4.7 / 47	Yes
Farma Pod Zvičinou / kozi.farma.uhlejov	51	Goat milk and cheese	652	5.0 / 14	Yes

3.2. Data Set

The data set contained all posts published by the sampled farms in the period from January 1, 2021 to January 10, 2022. The data from the Facebook pages were collected with use of the script developed in Python programming language. The data includes the ID of the published post, the date of publication, the text of the post, the number of reactions

(reaction types as like, love, ha-ha, wow, angry, and sad), the number of comments and the number of shares. The data were collected during a ten-day period in January 2022.

The data set comprised 472 posts published by local producers, 249 on Polish side and 229. The total posts included 23,418 words and 133,742 characters (without spaces).

3.3. Data Processing

The data processing was conducted in MS Excel worksheet. In our study, we used the metrics of absolute engagement; relative engagement and engagement rate. The absolute engagement was expressed as a simple sum of reactions, comments and shares from all posts published in the examined period; the relative engagement metric as an absolute engagement in relation to the number of published posts, and the engagement rate as the ratio of relative engagement linked to the number of farm Facebook page followers.

In this study, we have used abovementioned metric because several reasons: at first, the overall publishing activity of farms; at second, the absolute engagement of page visitors is relatively low; and at third, the algorithm for displaying posts has changed, posts are no longer displayed to all page followers, but only a fraction of them, depending on how active they are with respect to the page. The traditional engagement rate (Bachmann 2019; Bonsón et al., 2015) is calculated as the number of responses (absolute engagement) in relation to the product of published posts and number of page followers.

4. Results

4.1. Characteristics of Polish Farms´ Business Communication

Looking at the quantitative results of Polish farms, it is clear that the significant differences between the monitored farms exist. While the absolute engagement at Bioowoce was 1,191 pts., at Tradycje Natura it was only 91 pts. The highest relative engagement was achieved by Malinowy Chrusniak (20.1 points). Detailed results of all Polish farms included in the sample are available in Table 2.

Table 2. The Facebook pages of Polish local producers and their reach to the public

Farm	N	Reactions		Comments		Shares		Engagement		
		Abs.[1]	Rel.[2]	Abs.[1]	Rel.[2]	Abs.[1]	Rel.[2]	Abs.[1]	Rel.[2]	Rate
Bioowoce	72	924	12.8	117	1.6	150	2.1	1,191	16.5	81.5
Doktor Miodek	60	909	15.1	93	1.6	25	0.4	1,027	17.1	45.6
Tradycje Natury	42	89	2.1	2	0.04	0	0.0	91	2.2	6.6
Malinowy Chrusniak	40	722	18.1	70	1.8	13	0.3	805	20.1	18.9
S49wiejskijaja	35	317	9.1	42	1.2	0	0.0	359	10.3	140.2

Note: [1] reactions, comments, shares or engagement of the posts published in 2021, [2] per post

In addition to engagement, it is also necessary to monitor an engagement rate, i.e. engagement related to the number of followers, expressed as a percentage. Here, the highest engagement rate is achieved by the Polish egg producer S49wiejskijaja. The engagement rate metric is certainly the most effective for measuring the reach of a Facebook page for existing visitors, i.e. the organic reach of your own contributions. In this way, you can also compare Facebook pages with a significantly different number of followers.

For the subsequent qualitative analysis of effective corporate communication, the five posts with high absolute engagement were selected. These posts have been translated and are provided in Table 3.

Table 3. Qualitative analysis of Polish local farms Facebook communication

Farm	Type of post	Extraction from the post text
Doktor Miodek	Competition	WORLD COMPETITION !!! 🎁⛄ Ideal presentation at Mikołajki 🎁 Set of 4 different modes: large-fashioned mode, grilled mode, liophilized raspberry mode, lyophilized bean mode - packed in a present box 🎁. 📣To take the appropriate action: ☆ like our funpage on facebook …
Bioowoce		Species of Polish bumblebees. Flower meadows
Malinowy Chrusniak	Special offer (free shipping)	Dear, during the Holy Week, FREE SHIPPING !!! The time is special now, because the upcoming Holy Night Celebration prompts us to take care of the uniqueness of the Christmas breakfast. The time of the pandemic, however, is a time of isolation for at least many of us. So if you do not want to visit crowded places this last week, we decided to prepare the possibility of ordering with free delivery from our online store. There is only one condition, that the purchases amount to a minimum of PLN 100.
Bioowoce	Story documenting job of the farmer and at the same time organic nature of this production	It is 1.00 after midnight. I just came back from spraying bio currants; (… with tansy and horsetail. I sprayed with a beer (fortified Kolmes), provided by my wife, and I'll tell you this: Conventional farmers (those who sprinkle hard chemicals) have it poorly. They splash such hard shit that they can't drink anything because they can twist. I smell a bit from the pickles;), but I'm just finishing the second beer and going to take a bath :)
Doktor Miodek	Presentation of a new product in the assortment	Juices from our organic currants and raspberries at cudmalina.com.pl. 🐝Bee Bee already in our offer 😍🐝 What are these little compact balls? Do you know Do you like Do you use? 🤍 Bread is nothing but the staple food of bees. Bread is made of pollen, transported to the hive by bees, then mixed with bees' saliva and honey. After being whipped in cells, it undergoes lactic fermentation. Bread is a rich source of: 🤍 carbohydrates, 🤍 proteins - more than in pollen, … (cont.) DOKTORMIODEK.PL

Obviously, the abovementioned table indicates that in addition to traditional marketing communication focused on discounts and new product presentations, local producers try to attract their customers by emphasizing the purely organic or healthy origin of their production or directly documenting farm life and the farmer's work.

4.2. Characteristics of Czech Farms´ Business Communication

Generally speaking, the quantitative results of Czech farms were very similar to their Polish counterparts. Although the engagement rate was slightly higher for Czech farms, there are also significant differences between individual farms. Two farms – České brambory.cz

(potato farm) and Kozí farma Úhlejov (goat farm) gained a higher than 100% engagement rate. Detailed results of Czech farms are available in Table 4.

Table 4. The Facebook pages of Czech local producers and their reach to the public

Farm	N	Reactions		Comments		Shares		Engagement		
		Abs.[1]	Rel.[2]	Abs.[1]	Rel.[2]	Abs.[1]	Rel.[2]	Abs.[1]	Rel.[2]	Rate
České brambory.cz	11	1,245	113.2	63	5.7	9	0.8	1,317	119.7	119.7
Farma Aujeský	45	5,398	120.0	205	4.6	162	3.6	5,765	128.1	48.8
Farma Matějka – prodej mléka ze dvora	39	374	9.6	19	0.5	2	0.05	395	10.1	53.7
Farma Sokol z Rampuše	83	547	6.6	0.3	1.8	12	0.1	582	7.0	7.4
Kozí farma Úhlejov	51	817	16.0	38	0.75	5	0.1	860	16.9	131.9

Note: [1] reactions, comments, shares or engagement of the posts published in 2021, [2] per post

The qualitative content of the posts with the highest interest is illustrated by the examples given in Table 5. Also, in the Czech Republic, local producers emphasize the high quality of their products ("premium honey of the highest quality). At the same time, they focus on the national origin of the products (Czech honey, Czech potatoes) or certification (certified product - fresh goat cheese).

Table 5. Qualitative analysis of Czech local farms Facebook communication

Farm	Type of post	Extraction from the post text
Farma Aujeský	Product offer	🍯 CZECH HONEY 🍯 Premium honey of highest quality 👆🐝 Make an order in our e-shop 🛍♡ → http://www.farmaaujesky.cz/med/ 🛒
Farma Sokol	Poetry of the farm work	I like such days. When a man can see that some piece of work is done.
České brambory.cz	Product offer, opening hours	Even in winter time we have our Czech potatoes 🥔 a nd onion for you ready. At the moment, we offer these potato varieties: Bernina, Belana, Marabel a Antonie. Also, you can buy other Czech products in our shop cz 🥟🧇🥒🥨🍵🍤 From 1.2. we are open again in these time Mo-Fr 8-16.30 and Sa 8-12.00. We are looking forvard to your visit ... 🛒
Farma Matějka	Product offer, contact details	Hello, we are a farm near Pardubice and we offer the sale of beef from the door. If you are interested, call the listed phone number: 739 293 182. We look forward to Farm Matějka selling milk from the yard
Kozí farma Úhlejov (goat farm)	New certified product offer (taking pictures for regional food catalogue)	Some time ago we had an unconventional afternoon on the farm. And who created this here? Goats, goat cheeses and an amazing photographer. 📷 Take a look with us. And why is that? The LAG commissioned photography of our products and products for its needs. We have a certified product - Fresh goat cheese in whey. So try fresh homemade, natural and you ☺. We have to wait for the most beautiful photos in the company's regional food catalog. We thank them.

5. Discussion

The presented study analyzed the communication of local food producers on Facebook. Based on these selected case studies, it was possible to document the frequency and content

of producers' communication, the sales channels used, and the nature of the social relations between farmers and local customers.

5.1. Communication Frequency and Content

The frequency of the posts published was relatively low for the examined farms. On average, the farmers published approximately one post per week. It can therefore be concluded that the Facebook page works for farmers either as a supplement or replacement for their website. Such approach can be summarized by words: When I am on Facebook I am available online so everyone can find more information about me. My main business communication with customers but still takes place live (and offline) with people I know personally.

In terms of content, the contributions focused on traditional marketing communication, i.e., emphasizing product qualities, price advantages or distribution methods. At the same time, however, they emphasized their organic or national origin, the hard work of the farmer or the interconnection of agricultural products with beautiful nature. From a formal point of view, it was found that the communication of selected companies was at a relatively high level, emoticons were used, attractive infographics were created and professional photos of local products were published.

5.2. Selling/Distribution Channels

Facebook presentations of local food producers included detailed information about the location of the farm, contact details, redirection to the producer's website or the direct use of the Facebook selling platform (see Figure 1). In this way, local producers give customers and the possibility not only to shop online, but also to possess a content about the producer, distribution channels and products itself. Thus, Facebook may also perform the function of information point and first interaction step between consumer and producer.

5.3. Formation of Social Relationships, Customer Feedback

Facebook as such is a social network, which means that it primarily serves to establish social contacts. Therefore, it can be assumed that the presence of local producers on Facebook will also be the basis for forming social relationships with customers. However, the results of the study do not meet this assumption. Overall, the number of customer comments was very low and there was almost no social interaction. On the other hand, customers provide some feedback to farmers. The study showed that the comments below the posts can be divided into two groups. First group comments concern availability of particular products, distribution channels or questions about production techniques. While second group of comments, admire the product, farm or other post content.
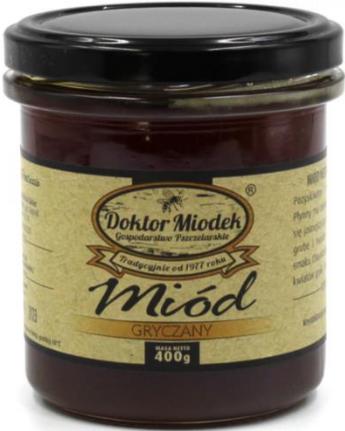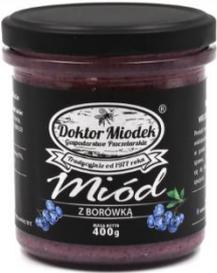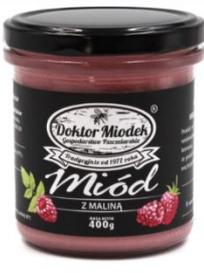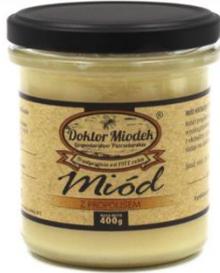
Figure 1. Online shopping platform on Facebook: Doktor Miodek farm

6. Conclusion and Implications

Facebook represents a good chance for local food producers not only to make their products visible but also to distribute them more easily to their customers. At the same time, it is a valuable source of information about local needs for local farmers, not only in relation to the required product, but also due to the method of distribution. At the same time, Facebook is also a cheap and easy-to-use platform. This field of research would certainly deserve more attention, both in view of the higher sample of companies surveyed and the focus on certain specific aspects of small business. This can be, for example, the area of product quality or the long-term sustainability of a small business.

Conflict of interest: none

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Labor Market Policy in the Slovak Republic and Hungary during the COVID-19 Pandemic

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Abstract: The first and second waves of the COVID-19 pandemic have serious impacts on the economies, social systems and labor markets of individual European countries. Although, not all the countries were equally affected by the pandemic, the EU members applied similar economic measures to combat the effect of COVID-19. In Hungary and Slovakia, the financial aid was directed particularly to employers and employees affected by the emergency situation. The aim of the article is to present the implemented public intervention to offset the negative effects of coronavirus pandemic, compare the effectiveness of the national strategies of the Slovak Republic and Hungary on the labor market and their success to cope with the pandemic. The results show that the measures taken by the Slovak government were not nearly as effective as those which were introduced by its southern neighbor. Furthermore, we can state that the number of unemployed people has increased significantly in the service sector.

Keywords: COVID-19; EU funds; unemployment rate; Hungary; Slovak Republic

JEL Classification: E24; J08; O11

1. Introduction

The first noticeable signs of the COVID-19 pandemic appeared in Europe in March 2020. Most of European countries were unprepared to face the effects of the global epidemic situation. Coping with the socio-economic impacts of coronavirus crisis was particularly difficult for the Lagging Regions of the EU.

There are two basic types of Lagging Regions in the EU: low-growth regions and low-income regions. The low-growth regions are less developed and transition regions with GDP per capita (PPS per inhabitant) below the EU average in 2013. This means all the less developed regions in Greece, Italy, Portugal or Spain. The low-income regions include regions with GDP per capita below 50% of the EU average in 2013. The second group covers several less developed regions of Bulgaria, Romania and regions in the Visegrad Group countries (V4) i.e., the Czech Republic, Hungary, Poland and the Slovak Republic (IBRD, 2019). "The inequalities may persist and even increase if left unaddressed during pandemics (Wade, 2020) leading to stark COVID-19-related health and economic disparities." (Antipova, 2021)

In this article, we will deal with the evaluation of effectiveness of the implemented anti-pandemic measures in Slovak Republic and Hungary, so in two V4 countries. We will also evaluate consequences of the COVID-19 crisis on the labor market of these EU member states. The choice of studied countries was intentional, because both of them experienced controversial developments during the years 2020 and 2021.

In March 2020, the Government of the Slovak Republic introduced several anti-pandemic measures to mitigate negative social and economic impacts of COVID-19. In Slovakia, the package of protective measures was co-financed by the European Social Fund (ESF). The different types of support measures were implemented as a part of the Regional Operational Programme of the country. First, a "pandemic nursing benefit" was introduced, which was a special allowance to care for a family member in an unusual situation. A "pandemic sickness benefit" was also created and it was determined for sickness-insured people who were recognized as incapable for work due to quarantine measures or isolation. On March 31, 2020, the "First-Aid" package of economic measures was approved. The purpose of the measures was to help employees, businesses (especially large and micro enterprises) and self-employed during the months of nationwide lockdown. The package of measures was co-financed by European Social Fund. In November 2020, the "First Aid Plus" scheme was launched, which extended the original set of economic measures (Buchel et. al., 2020).

Table 1. "First Aid" Schemes in Slovak Republic (Buchel et al., 2020)

Scheme	Eligible Claimant	Target Group	Conditions	Contribution
1	Employer or self-employed as employer	Employee	Employers who were forced to shut down their operations based on the measures of the Slovak Public Health Authority; employers with furloughed workers.	80% of the employee's average salary (max. €1,100)
2	Self-employed person	Self-employed person	Drop in revenues of at least 20% [10%]	From €180 [€90] to €540 [€270], depending on the extent of revenue drop
3A	Employer or self-employed as employer	Employee	Activity affected by economic slowdown; employers with furloughed workers	Up to 80% of the employee's average salary (max. €880)
3B			Employers that recorded a drop in revenues of at least 20% [10%]	From €180 [€90] to €540 [€270] per worker, depending on the extent of revenue drop, up to 80% of the average employee's wage
4A	Self-employed person	Self-employed person	- - - - -	Flat contribution of €210 [€105]
4B	Single-member private LLC.	Single-member private LLC.		

Unlike other countries, Hungary didn´t want to ask for external help to solve the problems caused by COVID-19. For this reason, the Hungarian government was looking for solutions, which could be implemented primarily from its own resources. The basic emergency economic protecting measures were the following.

1. The obligation to pay capital and interest on loans taken out by private individuals and businesses were suspended until the end of 2020. The condition was that the loans had to be taken out before March 18, 2020. The moratorium on payments applied to all credit agreements, loan agreements and financial leasing contract. The amount of the original

installment of the previously taken loan couldn´t increase. The APR (annual percentage rate) of new consumer loans were maximized at the central bank prime rate plus 5 percent. It was valid for loans taken out from March 19, 2020. Short-term business loans were extended until June 2020 (PwC, 2020).

2. Economic stimulus measures were introduced in the sectors already affected by the coronavirus pandemic, mainly in tourism and hospitality, media and cultural services, sports and passenger transport. The economic stimulus measures included the following. Companies (employers) operating in these areas were exempted from paying contribution in full. Also, employee´s contributions were significantly reduced by June 30, 2020. They essentially didn´t have to pay pension contributions, and health insurance contributions were reduced to the statutory minimum (it means 4% health insurance contributions in kind). Their employees could also receive tax discount.

3. Until the end of June 2020, small entrepreneurs were exempted from paying the itemized tax on low-tax enterprises. The government has granted a deferral of small businesses´ pre-March tax arrears. Executions for tax arrears were suspended and it was enough to pay the outstanding tax arrears after the end of the emergency situation.

4. The home child care fees, the childcare allowance and childcare allowance benefits were extended for the duration of the emergency.

5. According to another measure commercial lease agreements couldn´t be terminated and rents couldn´t be raised.

6. Jobseekers have become eligible for an interest-free adult student loan. The state took over 95% of the tuition fees for IT trainings. The government also made employment rules more flexible (Koronavirus, 2020a).

The aim of the present study is to outline the impact of the listed measures on the Slovak and Hungarian labor markets, and to illustrate the economic effects and consequences of the COVID-19 pandemic.

2. Methodology

In the work titled "Labor Market Policy in the Slovak Republic and Hungary during the COVID-19 Pandemic" we compare two Central European countries, concretely Hungary and Slovakia. The effectiveness of the anti-pandemic measures can be evaluated through the unemployment situation and the number of operating companies. To illustrate the effects of the COVID-19 pandemic on the labor market of the Slovak Republic and Hungary, the development of the unemployment rate of these states was analyzed. We have collected information from the data collections of the FinStat, the Statistical Office of the Slovak Republic, the Hungarian Central Statistical Office, the Central Office of Labour, Social Affairs and Family and the Eurostat. The collected data is about the unemployment rate in the mentioned two countries, number of unemployed populations according to the level of their education, regions and the sectors where they previously worked, populations' data and about the number of closed economic entities. Moreover, we need to mention that we have analyzed the collected data during the time period 2015 and 2020. Our main goal was to

analyze and check what kind of effects did the coronavirus had on the unemployment rate in the studied countries. So, we think this 5-year period can perfectly show us the difference between the 2 periods, the years before the pandemic and the years after the virusʹ appearance.

In our work we have used quantitative even qualitative methods. As qualitative method, we have studied the literature of other specialists around Europe. Also, we have collected what kind of reactions and support the studied countries provide to their population in case to help them in the difficult times. After processing the relevant domestic and foreign literature sources, we used comparative research method and descriptive statistical methods to process data. The following indicators of descriptive statistics were used: mean, standard deviation. Moreover, we have used Difference-in-Differences method, with which we demonstrate the changes in unemployment rate during the analyzed time period in Hungary and Slovakia. Due to this method, we confirmed the stated hypotheses correctness.

3. Results

In our research paper we study the unemployment rate change in Slovakia and Hungary as a reaction for the pandemic caused by COVID-19 or the so-called coronavirus. On the following pages we are going to study 2 statements, whether they are correct or not. The following statements are:

S1: The unemployment rate has shown a significant rise after the appearance of the COVID-19 virus and the it followed pandemic in 2019. Moreover, the unemployment rate increased (2020-2021) or decreased (2015-2019) more significantly in Slovakia compared to the other analyzed country, Hungary.

S2: In the tertiary sector, concretely in accommodation and food services the number of unemployed people has increased by an important percentage after the appearance of the virus in Slovakia and Hungary.

3.1. The Analyzed Countries

Slovakia is situated in Central Europe, with population of 5.4 million people. Slovakia was established in 1993, so we can say it is a relatively new country. Slovakia is part of the European Union from 2004 and of the Eurozone from 2009. These two facts have influenced the countryʹs economy in a significant way. Slovakia became more attractive in the eyes of the investors because of the convenient location, relatively cheap workforce, high educational level and the usage of Euro. The coronavirus or the COVID-19 has appeared in the Slovak Republic on 6th March 2020. Since this moment the life of the countryʹs population has changed rapidly (Public Health Office of the Slovak Republic, 2020).

Hungary is Slovakiaʹs neighboring country from the south. Its population is 10 million people, so we can state itʹs almost the double of Slovakiaʹs. Hungary has become the part of the European Union in the same time as Slovakia in 2004. However, in Hungary the national currency is the Hungarian Forint. In Hungary, the first COVID-19 infected patient was registered on the 4th March 2020 (Koronavirus, 2020b).

"The impact of the pandemic is especially a forced constraint in the business sector and a reduction in consumer demand. Due to the above factors, employers began to compensate for cost reductions through mass redundancies in their companies. According to a report prepared by the Institute of Social Policy of the Slovak Republic, the month-on-month comparison of unemployment shows that only in August 2020 a slight decrease in the unemployment rate was recorded." (Svabova et al., 2021)

3.2. Unemployment

The unemployment rate during the analyzed time period in Slovakia and Hungary has shown a very similar trend. Comparing the data on the unemployment rate in the selected countries, the results were as follows. In the last decade a stabile decline of the unemployment rate was observed in Slovakia and Hungary. However, year 2020 has brought a change. At the outset of the epidemic the percentage of people without work increased. In 2020 in Slovakia the unemployment rate has increased by 0.9% compared to the previous year and in Hungary by 0.8% (Figure 1).
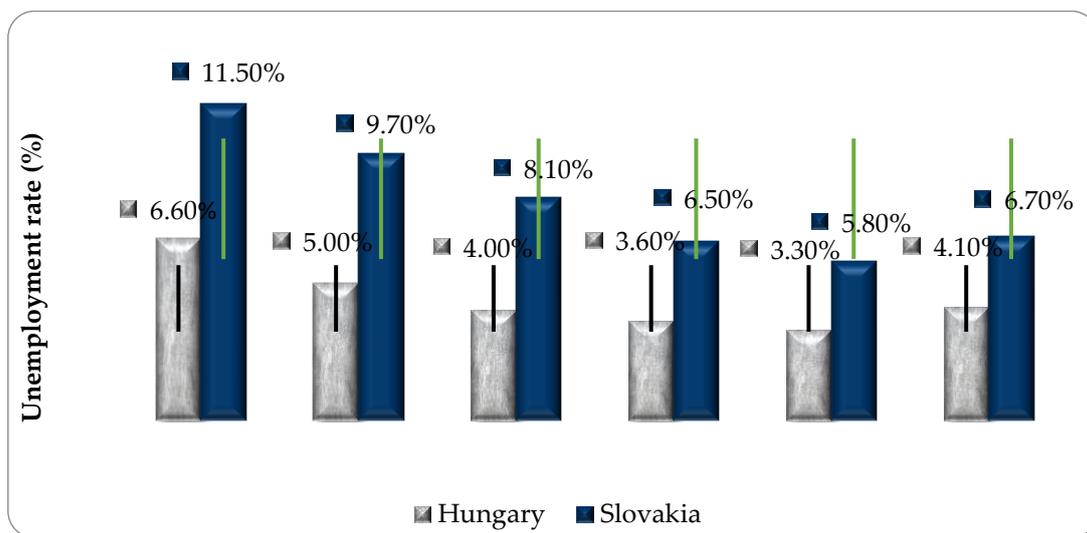
Figure 1. Unemployment Rate – Slovakia, Hungary (Eurostat, 2021)

The standard deviation calculated from the data on unemployment rates between 2015 and 2020 was 1.103% (Hungary) and 1.996% (Slovak Republic). The number of unemployed has risen up intensively in Slovakia during the pandemic. This suggests that anti-covid measures which aim was to stabilize the Slovak labor market were less successful. However, it is important to mention that the data on the unemployment rate in Hungary were lower even before the epidemic. We can say that statement no.1 was correct, since can observe a remarkable rise after 2019 and unemployment increased more significantly in Slovak economy.

Table 2. presents us the changes in unemployment rate in the analyzed time periods with the help of Difference-in-Differences method. Thanks to this method we can observe again that the unemployment rate in the analyzed countries has decreased till 2019. However, in 2020, after the appearance of the COVID-19 virus in Europe the unemployment rate has

started to increase. What is extremely interesting for us, that in Slovakia the unemployment rate has always decreased (2016-2019) and increased (2020-2021) with a significantly higher rate than in Hungary.

Table 2. Difference-in-Differences Slovakia, Hungary (HCSO, 2021c; STATdat, 2021b).

Year	Figures (%)	Slovakia	Hungary
2016	before	11.5	6.60
	after	9.70	5.00
	difference	*-1.80*	*-1.60*
2017	before	9.70	5.00
	after	8.10	4.00
	difference	*-1.60*	*-1.00*
2018	before	8.10	4.00
	after	6.60	3.60
	difference	*-1.50*	*-0.40*
2019	before	6.60	3.60
	after	5.80	3.30
	difference	*-0.80*	*-0.30*
2020	before	5.80	3.30
	after	6.70	4.10
	difference	*0.90*	*0.80*
2021	before	6.70	4.10
	after	6.80	4.10
	difference	*0.10*	*0.00*

According to Figure 2, we can see how the number of unemployed population (per 1,000 people) has changed in the selected sectors. What is extremely interesting for us, the unemployment rate in the service sector has increase after 2020 (72.0) to 96.4, what could be caused by the strict state lockdowns, restrictions in 2020 during the COVID-19 pandemic. The population of the EU was not allowed to use some services and go to the street. This regulation has slowed down the national, as well the international economy. In Hungary, the number of unemployment population has doubled in the sector of accommodation and food services from 8.6 to 16.0. In the sector of accommodation and food service, the number of unemployed people has not increased steadily in comparison of the regions of the Slovak republic. At the end of 2020, in the accommodation and food service sector the highest unemployment rate has been reached in districts of Nitra, Trenčín, Trnava, Bratislava and Košice. Therefore, the mentioned districts have been more affected by anti-pandemic measures. The density of unemployed people in the analyzed sector calculated with Dual Indicator was 1.31. This means that the average amount of unemployed population in the regions with high unemployment rate in the accommodation and food services is almost one and a half times higher than in the regions with a low unemployment rate. What is very interesting the unemployment has been rising even in the industrial sector. While in 2019, 42 people were unemployed from 1,000 in 2020 their number has increased, and 57.6 lost their jobs. It was not very different even in the car industrial sector neither. In 2018, it has been 4.0 while in 2020 it has reached even 6.1 per 1,000 people.
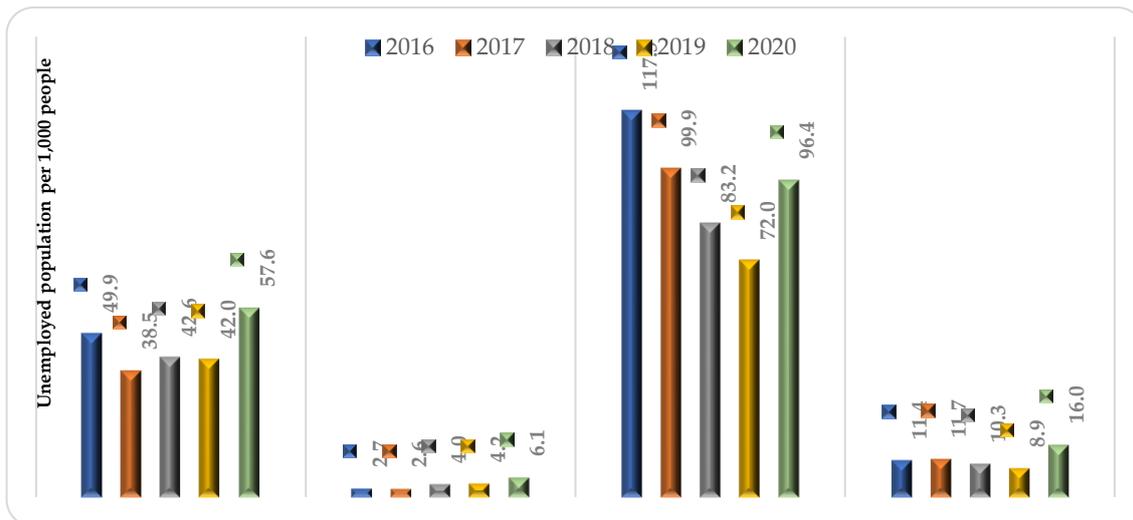
Figure 2. Unemployment in Sectors – Hungary (HCSO, 2021c)

We have analyzed the same sectors even in Slovakia (Figure 3). In Slovakia, the studied two sectors in the first years showed a declining tendency in the number of unemployed people. However, as in the case of Hungary even here, in Slovakia we can observe a significant rise in the year 2020, when the COVID-19 virus has appeared in the country. In 2019, 34.4 people were unemployed in the industrial sector and in the next year it has reached even 45.6 people from 1,000. A lot people had to lose their jobs in the industrial sector, since the process of production has been minimalized or even stopped. In the sector of accommodation and services in 2019, 6.5 people got unemployed from 1,000, while in 2020 it has risen to 12. Hotels, restaurants and bar were closed for longer weeks and months, what has caused very high losses in the annual income and profit.
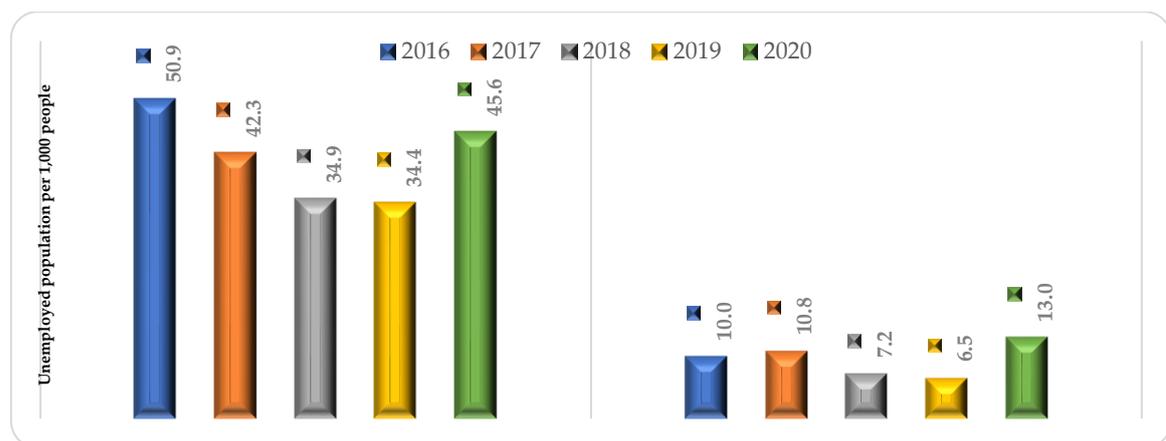
Figure 3. Unemployment in Sectors- Slovakia (STATdat, 2021b)

Moreover, due to the mentioned damages companies had to minimalize the number of their stuff as well. This has caused a rise in the country´s annual unemployment rate.

We can say, that the second statement (In the tertiary sector, concretely in accommodation and food services the number of unemployed people has increased by an important percentage after the appearance of the virus in Slovakia and Hungary.) was correct

as well. In 2020, we could observe a significant rise compared to the previous year in the case of Hungary and Slovakia as well.

4. Discussion

The COVID-19 epidemic caused a severe global economic crisis. In Hungary and Slovakia, the negative effects of the pandemic included declining GDP and FDI flows, a rapid increase in the number of unemployed, the almost complete cessation of the tourism and gastronomy sector, and supply chain slowdown in several industries.

According to a study conducted by Svabova et al. (2021), the Slovak economy was very strongly affected by the consequences of the pandemic. The positive development on the labor market was disrupted in March, 2020. The study (Svabova et al., 2021) showed that the number of unemployed people increased by on average 2,875 people (16.19%) monthly, covering the period of the years 2013-2020. Also, there was a monthly increase in the number of all available jobseekers in Slovakia. Data of the Slovak Statistical Office show that the number of registered job applicants in 2020 in Slovakia increased by 37.40% compared to 2019 (STATdat, 2021). Data of FinStat showed that more than 16,000 companies closed down at the end of 2020 due to the epidemic (FinStat, 2021). As Štalmachová et al. (2021) suggested the economic downturn and high unemployment ranked the Slovak Republic among the worst affected countries in European Union.

Túróczi et al. (2020) explained, the coronavirus reached the Hungarian economy in a stable financial situation and in a growth phase. The economy was in remarkably good condition, close to full employment. The public debt generally declined, the competitiveness of the national economy improved and the investment rate was high (Túróczi et al., 2020). However, the epidemic has changed the situation. The unemployment rate increased by 0.8 percentage point compared to the corresponding period last year. The growth of unemployment continued in the first quarter of 2021. The unemployment rate according to the Central Statistical Office of Hungary was higher by 0.9 percentage point year-on-year (HCSO, 2021a). In 2019, the total number of ceased corporations was 101,737. In 2020, business closures across Hungary were increasing as a result of the coronavirus. The number of ceased corporations increased by 9,377 (HCSO, 2021b). Tóth et al. (2021) in their survey proved that the pandemic has triggered harmful labor market processes. The number of employees decreased in almost all sectors of the Hungarian economy and in the economy of the EU, too. The study also showed that some areas were severely affected. The coronavirus pandemic caused decline in consumption and generated high inflation, which primarily affected sectors that require physical interaction (e.g., wholesale and retail trade, transport, tourism, sector of accommodation and food service activities). Businesses operating in these sectors laid-off a significant portion of their workers, causing a large rise in unemployment (Tóth et al., 2021). Although, the situation was similar in Hungary and Slovakia, the Hungarian economy was less affected by the epidemic. For example, the unemployment rate rose in both countries, however the growth dynamics was slower in Hungary than in Slovakia. Based on the results of the study, the measures taken by the Slovak government were not nearly as effective as those which were introduced by its southern neighbor.

As Goreczky (2020) suggested although no one is fully aware of all the consequences of the pandemic yet, it is important to outline some basic lessons and connections that are already known. This information can serve as a guide of reference for decision-makers in individual countries in a similarly complex global situation. Túróczi et al. (2020) explained, supporting and protecting businesses will be even more important. The future of national economies depends primarily on the innovative products, services, processes and systems created by enterprising persons (Túróczi et al., 2020). During the pandemic, the interests of companies and workers seemed to be conflicting, but in reality, they both struggled with existential concerns. On the other hand, even in times of crisis, we should not forget the importance of employees. Hajduová and Sebestyén (2021) showed that the employees play a very important role in achieving company growth. They are considered to be a decisive factor of success in this area. The role of managers is also being enhanced, as they must be able to provide appropriate incentives for workers even in time of crisis (Hajduová & Sebestyén, 2021).

Finally, the coronavirus epidemic has not only caused damage but also offers a chance to rethink the economic ambitions for the near future. In the future we would like to continue our research about the problematic of the rising unemployment rate after the appearance of COVID-19 pandemic, since we perfectly know, that it is a very actual and important issue. Concretely, we would like to concentrate on the diversity of the unemployment rate in various regions of the analyzed countries, on the educational level of the unemployed and employed people and on the most sectors, which were the most influenced by the happenings. Finally, we cannot forget about financial support provided by the EU of from national funds. We will analyze their placement, implementation and long-term sustainability.

Conflict of interest: none

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Differences in Financial Management in Vehicle Industry from the Aspect of the COVID-19 Crisis

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Abstract: The automotive industry is a key Slovak employer. Due to its strong economic links to many other industrial sectors, it has an important multiplier effect on the economy. The automotive sector is one of the areas that has been impacted quite heavily by the Covid-19 pandemic. Our research aimed to compare the development of selected financial indicators, to analyze the asset and financial structure of selected companies operating in the vehicle sector in Slovakia, and to determine the effectiveness of financial management from the aspect of the pandemic. We examined the following indicators for the three largest players in the Slovak market: Return on Assets, Return on Equity, and Net Profit Margin. By applying the IN05 model bankruptcy possibilities were predicted for automotive companies. According to the study, Volkswagen Slovakia, a. s. managed its asset and financial structure the most effective and used its assets and also equity the most effective in the automotive industry in 2020. Only, the highest net profit generated from revenue gained in the period of was not produced by this company in 2020. Therefore, Volkswagen Slovakia, a. s. occupies the best position in terms of efficiency of financial management in the automotive market.

Keywords: vehicle industry; financial management; profitability indicators

JEL Classification: L62; G32; G33

1. Introduction

The vehicle industry is the most important pillar of the Slovak industry employing, directly and indirectly, more than 275,000 workers. The automotive industry has a strong tradition in Slovakia. Over the past 20 years, it has been an important source of foreign direct investment as well as industrial innovation. Slovakia belongs to the 20 biggest car producers in the world with an annual production of more than one million cars per year. Share of automotive industry makes 50% on total industrial production in 2021. 13% of the GDP of Slovakia is produced by the automotive industry (Sario, 2021). Covid-19 restrictions could have a significant impact on the financial position of companies in the vehicle industry. This article analyses the main differences in financial management between the key players of the Slovak automotive industry.

This study aimed to analyze and describe financial management by using profitability indicators, to analyze an asset and financial structure and to predict bankruptcy possibilities for automotive companies, and to determine the effectiveness of financial management from the aspect of the pandemic. The most important automotive enterprises in Slovakia are

Volkswagen Slovakia, a. s., Kia Slovakia s. r. o. and the youngest one Jaguar Land Rover Slovakia s. r. o. These 3 enterprises represent an important role as employers. In 2020 Volkswagen Slovakia, a. s. directly employed 11,473 employees. In 2020 Kia Slovakia s. r. o. directly employed 3,520 employees. In 2020 Jaguar Land Rover Slovakia s. r. o. directly employed 2,200 employees (Finstat, 2021). Their position in the market is so important for the Slovak economy that they used to be supported by the government. Financial support as a tax holiday or contribution to support job creation has been used by these enterprises and that is the fact why they fall under intense financial supervision (Finstat, 2021). Operating revenue including the sale of non-current assets and securities of sample is presented in Table 1.

Table 1. Operating revenue in 2018-2020 [€] (Finstat, 2021)

Operating revenue	2020	2019	2018
Volkswagen Slovakia, a. s.	9,754,823,000	10,390,134,000	10,380,075,000
Kia Slovakia s. r. o.	4,574,703,000	5,594,522,000	5,185,639,000
Jaguar Land Rover Slovakia s. r. o.	269,613,450	279,386,211	186,783,465

Financial management enables planning and managing financial flows more accurately. It enables the acquisition and allocates the financial resources of the company. Financial management enables us to decide responsibly on business investments and to ensure the necessary financial stability (Kajanová, 2018). The important part of financial management is an asset and financial structure. The challenge for management is how much of the asset base should be obtained through equity funding and how much through debt funding. Asset structure represents the proportion of various types of assets held by a firm as shown in the balance sheet. The financial structure is the proportion of liabilities and equities that a company uses to finance its assets. Capital structure is therefore part of a financial structure (Kasajová et al., 2018). Financial management focuses on decisions with a tendency to obtain the necessary capital. The asset structure is managed to maximize its market value (Čulková & Taušová, 2017). Profitability is the best measure of a company, without it, it cannot grow, and if it doesn't grow, then its stock will trend downward. Increasing profits show that a company can pay dividends and that the share price will trend upward. Creditors will loan money at a cheaper rate to a profitable company than to an unprofitable one. The common profitability measures compare profits with sales, assets, or equity: net profit margin, return on assets and return on equity. Although most financial services publish these ratios for most companies, they can be calculated independently by using net profit and total revenue from the Income Statement of a company's financial report, and total assets and stockholders' equity from the Balance Sheet (Komorník & Majerčáková, 2015). Return on assets (ROA) presents the overall efficiency of the inserted capital using regardless of the source of coverage. The indicator is released about the amount of profit-generated assets. Effective asset use is one of the key points of business success (Rajchlová, 2016). ROA is used as a profitability indicator because it eliminates the impact of capital structure and the effects of the tax shield (Kuč & Kaličanin, 2021). Return on equity (ROE) presents the profitability of capital inserted by shareholders or business owners. ROE is a key indicator based on which

investors decide to pick stocks. Value investors tend to pick the company that generates high ROE over the long term (Frazzini et al., 2018). Net profit margin represents the company's ability to achieve profit at a given sales amount (Husna & Desiyanti, 2016). Financial indicators provide relevant information that can help to determine whether it is likely that companies lead to bankruptcy or will have other financial problems in the future (Amandola et al., 2017). Financial indicators are capable to signalize the future bankruptcy of a company. It is demonstrated by the fact that even experienced companies regardless of their age may commit a failure process in which financial problems or performance decreases are not observable in the last financial report before bankruptcy (Lukason & Laitinen, 2019). Not only financial indicators are capable to signalize bankruptcy. The bankruptcy prediction model as Neumaiers IN05 index was developed in this paper. Neumaier's models are frequently used on data from the Central and Eastern Europe region (Papík et al., 2020). Due to the inclusion of financial data of Slovak automotive enterprises in this manuscript, the regional model of Neumaier's has been used.

In the Slovak automobile sector, research has not previously been done to compare the asset and financial structure and profitability indicators to determine the enterprise with the most effective financial management. Application of bankruptcy prediction model shows in numbers probability of company's financial solvency. In 2015 Sandu did similar research in the Romanian automotive industry with the focus on reputation importance concerning profit-generating (Sandu, 2015). She analyzed the relation between return on assets and reputation for seven reputable automotive companies. In 2016 Rybárová et al. researched the Slovak construction industry with the focus on the solvency of this sector by using the Altman Z-score bankruptcy model (Rybárová et al., 2016). The main contribution of this study is a comparison of financial management of 3 key enterprises of the automotive industry in Slovakia.

The research question is what are the differences in financial management between Kia Slovakia s. r. o., Jaguar Land Rover s. r. o. and Volkswagen Slovakia a. s. from the aspect of the COVID-19 crisis? We want to compare an attitude in financial management in the vehicle industry in the period of the COVID-19 crisis and to explore which attitude seems to be the best way.

The paper is structured as follows: in the introduction was carried out a literature review and were introduced basic research goals, in section 2 are introduced the data used in the analysis and the methodology. In the next step are presented results, which are discussed in section 4. Section 4 draws some conclusions as well.

2. Methodology

The analysis has been performed by using the data from the statistical database FinStat.sk, which monitors enterprises' income and business activities in the Slovak Republic and is the only source of microeconomic data based on harmonized bookkeeping principles. This database provides accounting information that has been necessary for our research. The Finstat database processes the number of data sources. Finstat analyzes the accounting resources of each company. Finstat cooperates with reliable resources such as Commercial

Register, Trade Register, Register of Financial Statements, Register Bankruptcies, Lists of Insurance Borrowers, and Judicial Decisions (Finstat, 2021).

The research question is what are the differences in financial management between Kia Slovakia s. r. o., Jaguar Land Rover s. r. o. and Volkswagen Slovakia a. s. from the aspect of the COVID-19 crisis? These 3 enterprises have been chosen because they are key representants of the Slovak vehicle sector (Sario, 2021). The financial statements of these 3 enterprises have been used as resources for our research. We have analyzed financial statements for determining differences in asset and financial structure, calculating profitability indicators and bankruptcy IN05 index.

Financial statements and data from them of automotive companies in Slovakia in 2020 have been collected to fulfill the aim of the study. For comparison of 3 different size enterprises, it has been done vertical common-size analysis (Corporate Finance Institute, 2021). Therefore, the application of vertical common-size analysis might determine the structure of assets, liabilities, and equities. The database Finstat provides already calculated profitability indicators for every vehicle company in 2020 and this paper's results of indicators have been compared. In this study profitability indicators have been used: ROA, ROE, and net profit margin. The calculation for profitability indicators is expressed in Table 2.

Table 2. Profitability indicators formula (Kabát et al., 2013)

Profitability indicators
$ROA = \dfrac{Net\ Profit}{Total\ Asset}$
$ROE = \dfrac{Net\ Profit}{Total\ Equity}$
$Net\ Profit\ Margin = \dfrac{Net\ Profit}{Total\ Revenue}$

Return on Asset (ROA) is the net profit expressed as a percentage of the total asset. A higher ROA number means better utilization of the company's assets. Return on Equity (ROE) is net profit expressed as a percentage of the total equity. ROE expresses how profitably the company is using the owners/shareholders' funds to yield profits. Net profit margin is the percentage of profit a company produces from its total revenue. It measures the amount of net profit a company obtains per euro of revenue gained (Kabát et al., 2013).

Five-factor IN05 model is frequently used on data from Central and Eastern Europe region. Calculation of IN05 model is expressed in following form (1):

$$IN05 = 0.13 \times A + 0.04 \times B + 3.97 \times C + 0.21 \times D + 0.09 \times E \qquad (1)$$

Individual variables used to calculate the IN05 index are shown in Table 3.

Table 3. IN05 model variables (Neumaier & Neumaierová, 2005)

Variable	Formula
A	total assets/total liabilities;
B	earnings before interest and taxes/interest paid;

C	earnings before interest and taxes/total assets;
D	revenues/total assets;
E	current assets/current liabilities;

If the value of IN05 > 1.6, the financial position of a company is favorable. The interval between 0.9 and 1.6 represents a grey zone which means that a company stagnates. If IN05 < 0.9, a company does not produce a value and could go bankrupt.

Based on numerous results of the IN05 model the probability of bankruptcy for each company will be predicted. This study firstly has analyzed and described financial management by using profitability indicators, it has analyzed asset and financial structure and predicted bankruptcy possibilities for automotive companies. Based on research results this study has compared the effectiveness of companies' financial management and thus deduced the conclusion, which company from our research sample applied the most effective financial management in the Covid-19 crisis.

3. Results

Balance sheet common-size analysis was performed to determine the percentage ratio in the asset structure and financial structure. The common-size analysis enables to compare different size companies. The result for Kia Slovakia s. r. o. asset structure is presented in Figure 1. The result for Kia Slovakia s. r. o. financial structure is presented in Figure 2.
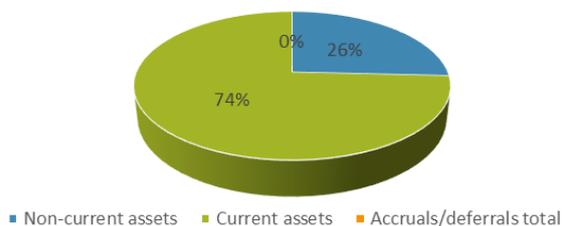
Figure 1. Kia – Asset structure (Finstat, 2021)   **Figure 2.** Kia -Financial structure (Finstat, 2021)
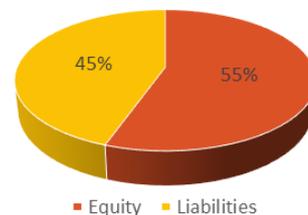
In 2020, Kia had a strategic approach to asset management. Non-current assets accounted for only 25.79% of all assets. Kia focused more on current assets, which accounted for up to 74.19%, with the largest item current receivables 52.77%. Sources of asset coverage distributed 55.44% of equity and at the level of 44.56% liabilities. The highest items among external sources were current liabilities 18.96% and bank loans 11.75%. Compared to 2019, bank loans increased significantly from 0.32% to 11.75%.

Volkswagen Slovakia, a.s. - Asset structure 2020

53% 47%

■ Non-current assets ■ Current assets
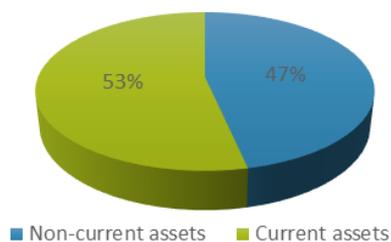
Volkswagen Slovakia, a.s. - Financial structure 2020

54% 46%

■ Equity ■ Liabilities
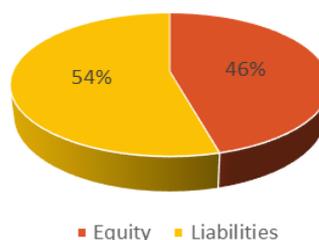
Figure 3. Volksw. – Asset structure (Finstat, 2021)   **Figure 4.** Volksw. – Financial structure (Finstat, 2021)

The result for Volkswagen Slovakia, a. s. asset structure is presented in Figure 3. The result for Kia Slovakia s. r. o. financial structure is presented in Figure 4.

In 2020, Volkswagen managed its non-current assets at 46.60%. Current assets accounted for 53.40%, of which the largest item was current receivables 29.72%, but a significant part was also financial accounts 14.86%. Volkswagen had assets covered by 45.81% of equity and 54.19% of liabilities. The highest items among external sources were current liabilities 49.78%.

The result for Jaguar Land Rover s. r. o. asset structure is presented in Figure 5. The result for Jaguar Land Rover s. r. o. financial structure is presented in Figure 6.

Jaguar Land Rover Slovakia s.r.o. - Asset structure 2020

6%

94%

■ Non-current assets ■ Current assets

Jaguar Land Rover Slovakia s.r.o. - Financial structure 2020

8%

37% 55%

■ Equity ■ Liabilities ■ Accruals/deferrals
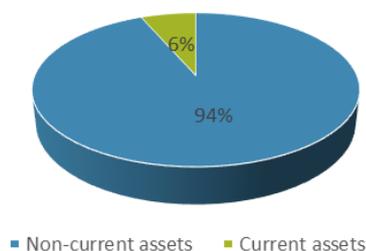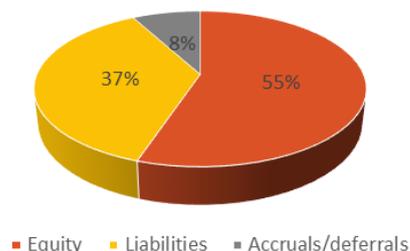
Figure 5. Jaguar L. R. – Asset structure (Finstat, 2021)   **Figure 6.** Jaguar L. R. – Financial structure (Finstat, 2021)

In 2020, Jaguar Land Rover managed its non-current assets at 93.51%. Current assets were at the level of 6.49%, current receivables achieved 5.55%. Jaguar Land Rover had 55.11% of equity and 36.97% of liabilities. Accruals and deferrals created 7.91%. As in competing companies, current liabilities accounted for the highest level 32.51%.

The results for the ROA indicator in the period from 2018 to 2020 are aggregated according to individual vehicle companies and are presented in Figure 7.
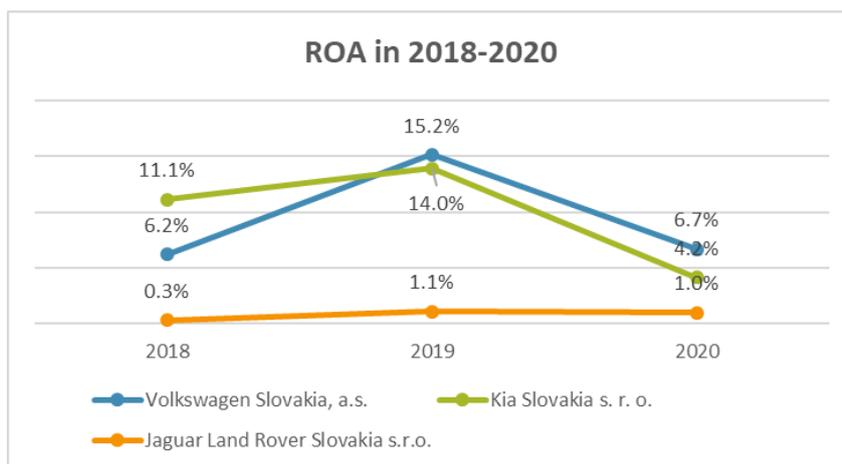
Figure 7. ROA growth in vehicle sector 2018-2020

The ROA indicator expresses the net profit as a percentage of the total asset. A higher ROA number means better utilization of the company's assets. Based on results in Figure 7 there is a significant depression of ROA indicator from 2019 to 2020 in Volkswagen Slovakia, a. s. and Kia Slovakia s. r. o. In terms of the ROA indicator in 2020, Volkswagen performed best at 6.7%. In other words, every 1 euro of assets produced 6.7 cents of net profit. Kia produced 4.2 cents of net profit for every 1 euro of assets. In comparison, Jaguar Land Rover produced only 1 cent of net profit for every 1 euro of assets but we should notice that only Jaguar Land Rover achieved the approximately constant level of ROA from 2018 to 2020.

The results for the ROE indicator in the period from 2018 to 2020 are aggregated according to individual vehicle companies and are presented in Figure 8.
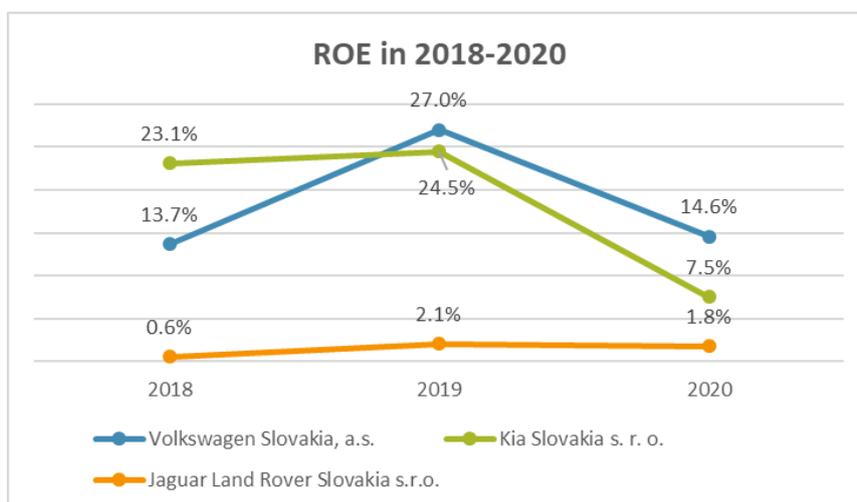
Figure 8. ROE growth in vehicle sector 2018-2020

Net profit margin in 2018-2020
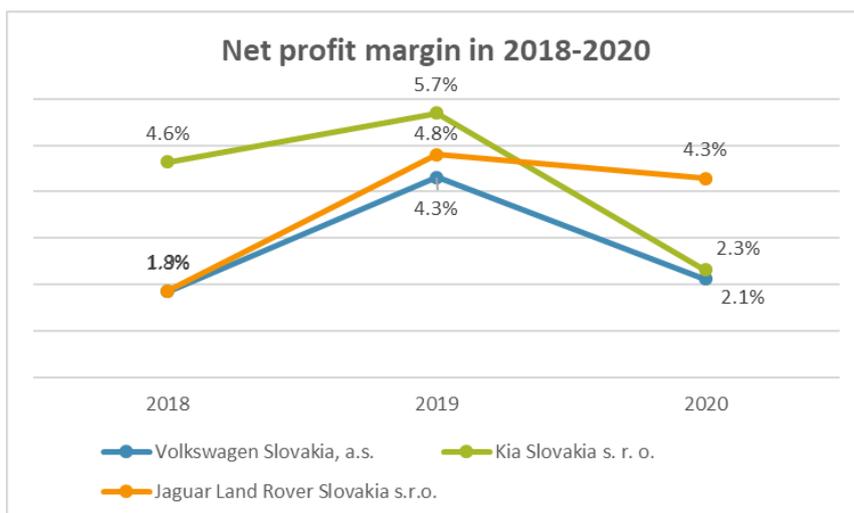
Figure 9. Net profit margin growth in vehicle sector 2018-2020

The ROE indicator expresses net profit as a percentage of the total equity. Based on results in Figure 8 there is a significant depression of ROE indicator from 2019 to 2020 in Volkswagen Slovakia, a. s. and Kia Slovakia s. r. o. In terms of the ROE indicator in 2020, Volkswagen performed best at 14.6%. In other words, every 1 euro of assets produces 14.6 cents of net profit. Kia produced 7.5 cents of net profit for every 1 euro of equity. In comparison, Jaguar Land Rover produced only 1.8 cents of net profit for every 1 euro of assets but we should notice that only Jaguar Land Rover achieved the approximately constant level of ROE from 2018 to 2020. The results for the net profit margin indicator in the period from 2018 to 2020 are aggregated according to individual vehicle companies and are presented in Figure 9.

Net profit margin is the percentage of net profit a company produces from its total revenue. It measures the amount of net profit a company obtains per euro of revenue gained. there is a significant depression of net profit margin indicator from 2019 to 2020 in Volkswagen Slovakia, a. s. and Kia Slovakia s. r. o. The net profit margin of Jaguar Land Rover in 2020 decreased only moderately. In terms of the net profit margin indicator in 2020, Jaguar Land Rover performed best at 4.3%. In other words, every 1 euro of total revenue produced 4.3 cents of net profit. Kia Slovakia s. r. o. produced 2.3 cents of net profit for every 1 euro of total revenue. In comparison, Volkswagen Slovakia, a. s. produced only 2.1 cents of net profit for every 1 euro of total revenue.

The results for the IN05 model in 2020 are aggregated according to individual vehicle companies and are presented in Figure 10.
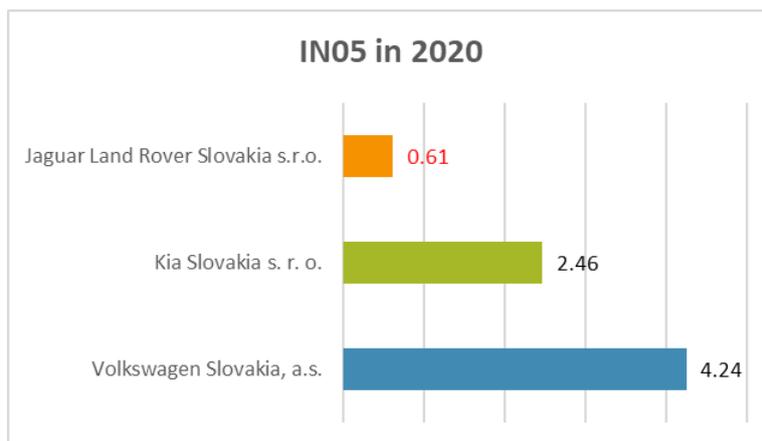
Figure 10. IN05 model in vehicle sector in 2020

Based on numerous results of the IN05 model the probability of bankruptcy for each company could be predicted. Volkswagen achieved a score of 4.24 and Kia achieved 2.46. According to IN05, Volkswagen and Kia created value, on the other hand, Jaguar Land Rover with 0.61 is described as a company that did not create value.

4. Discussion

The one part of the research was focused on the asset and financial structure of 3 vehicle companies and the differences between them. Kia Motors Europe sales fell 17% year-on-year in 2020. The company recorded a decrease in sales in 2020 due to a lockdown in various countries, including Slovakia, which affected the profitability in 2020. Profit also decreased due to currency fluctuations RUB against the EUR (Kia Motors Slovakia, 2020). In 2020, Kia had a strategic approach to asset management. Non-current assets accounted for only 25.79% of all assets. Kia focused more on current assets, which accounted for up to 74.19%. Sources of asset coverage distributed 55.44% of equity and at the level of 44.56% liabilities. Kia's approach to asset structure management is strongly current assets oriented. Current assets help stakeholders to decide how cash-rich a company is. Liquidation of the current assets affects cash balances. Current assets help in day-to-day business operational activities. We consider the approach to financial structure management as conservative with a high degree of uncertainty avoidance. When they exceed their resources, the company is more stable, more independent, and has a greater ability to survive a potential crisis. In the event of a crisis, such a company has the opportunity to lend an additional loan. Based on the Finstat database there is an obvious impact of the pandemic. Compared to 2019, current assets increased from 69.31% to 74.19% and bank loans increased significantly from 0.32% to 11.75%.

The business year 2020 was significantly affected by the extraordinary situation caused by the Covid-19 pandemic. The very volatile first half of the year was marked by a five-week interruption of production. Emphasis was placed on strictly reducing costs, increasing efficiency, as well as ensuring sufficient liquidity. Volkswagen managed to stabilize the production program, maintain jobs and achieve a financial result almost at the level of the year 2019 (Volkswagen Slovakia, 2020). In 2020, Volkswagen managed its non-current assets

at 46.60%. Current assets accounted for 53.40%. Volkswagen had assets covered by 45.81% of equity and 54.19% of liabilities. Volkswagen's approach to asset structure management is mostly current assets oriented, which supports cash flow. Liabilities exceeded own resources, which is healthy for the company because foreign capital is cheaper than own. Bank loans accounted for 0.00% so there is an opportunity to lend additional money. Based on the Finstat database there is an obvious impact of the pandemic. Compared to 2019, current receivables increased from 24.93% to 29.72% and current liabilities increased significantly from 32.77% to 49.78%. Based on these results a transformation process was getting longer, this fact harm to the business. On the other hand, current liabilities are the cheapest option to lend money without interest.

The Jaguar Land Rover's production was suspended from March 20 to May 11, 2020. The Company's management has considered the potential impacts of COVID-19 on its activities and business and has concluded that they do not have a material effect on the Company's going concern assumption (Jaguar Land Rover Slovakia, 2020). In 2020, Jaguar Land Rover managed its non-current assets at 93.51%. Current assets were at the level of 6.49%, current receivables achieved 5.55%. Jaguar Land Rover had 55.11% of equity and 36.97% of liabilities. Accruals and deferrals created 7.91%. As in competing companies, current liabilities accounted for the highest level 32.51%. Bank loans accounted for 0.00%. Jaguar Land Rover has only been operating on the Slovak market since the end of 2015. In the balance sheet, there are many items at the level of a start-up company. Based on the Finstat database and financial statements there is not an obvious impact of the pandemic. The start of Jaguar Land Rover production was in October 2018 so this enterprise is still represented as starting foreign direct investment.

Return on assets is an indicator of how well a company utilizes its assets in terms of profitability. Based on results in Figure 7 there is a significant depression of ROA indicator from 2019 to 2020 in Volkswagen Slovakia, a. s. and Kia Slovakia s. r. o. The depression of ROA was caused by total asset growth in 2020. In terms of the ROA indicator in 2020, Volkswagen performed best at 6.7%. Kia performed 4.2% and Jaguar Land Rover performed only 1%. Volkswagen Slovakia, a. s. used its assets the most effective in 2020.

Return on equity is the measure of a company's net income divided by its shareholders' equity. Based on results in Figure 8 there is a significant depression of ROE indicator from 2019 to 2020 in Volkswagen Slovakia, a. s. and Kia Slovakia s. r. o. The depression of ROE was caused by a huge increase in total equity. The optimal ROE level in the vehicle industry achieves approximately 14%. In terms of the ROE indicator in 2020, Volkswagen performed best at 14.6%. Kia performed 7.5% and Jaguar Land Rover performed only 1.8% of ROE. Volkswagen Slovakia, a. s. used its equity the most effective from 2019 to 2020.

Net profit margin is the percentage of net profit a company produces from its total revenue. There was a significant depression of net profit margin indicator from 2019 to 2020 in Volkswagen Slovakia, a. s. and Kia Slovakia s. r. o. The net profit margin of Jaguar Land Rover in 2020 decreased only moderately. In terms of the net profit margin indicator in 2020,

Jaguar Land Rover performed best at 4.3%. Kia Slovakia s. r. o. performed 2.3% Volkswagen Slovakia, a. s. performed only 2.1% of net profit margin. The reason was increased expenses.

According to IN05, Volkswagen and Kia created value, on the other hand, Jaguar Land Rover with 0.61 is described as a company that did not create value. This is due to the large volume of assets to the revenue ratio, which is normal for a start-up company.

Future research directions may also be highlighted in an impact of government financial support on the asset and financial structure of key enterprises in the vehicle industry. The limitation of this study was a small sized sample.

5. Conclusions

The vehicle industry is the most important pillar of the Slovak economy. The automotive industry has a strong tradition in Slovakia. Over the past 20 years, it has been an important source of foreign direct investment as well as industrial innovation. Slovakia belongs to the 20 biggest car producers in the world with an annual production of more than one million cars per year (Sario, 2021). Covid-19 restrictions had a significant impact on the financial position of companies in the vehicle industry. This article analyzed the main differences in financial management between the key players of the Slovak automotive industry.

This study aimed to analyze and describe financial management by using profitability indicators, to analyze an asset and financial structure, and to predict bankruptcy possibilities for automotive companies.

Generally, the results of this study showed that Volkswagen Slovakia, a. s. and Kia Slovakia s. r. o. produced effective financial management during the Covid-19 crisis. Jaguar Land Rover s. r. o. produced financial management at lower effectiveness. This is due to the start-up company numbers in financial statements. Based on this study in the period of a pandemic the Volkswagen Slovakia, a. s. managed its asset and financial structure the most effective and used its assets and also equity the most effective in the automotive industry. Only, the highest net profit generated from revenue gained in the period of was not produced by this company in 2020. Therefore, Volkswagen Slovakia, a. s. takes the best position in terms of financial management efficiency in the automotive market.

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European Grouping of Territorial Cooperation NOVUM – An Example of Polish-Czech Cross-border Cooperation

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Abstract. The European Grouping of Territorial Cooperation NOVUM (EGTC NOVUM) was established in 2015 and conducts its activities in the Polish-Czech borderland. The main aim of NOVUM is to intensify, facilitate and promote Polish-Czech cross-border cooperation aimed at the strengthening of economic and social cohesion of the area of operation of the Grouping (EUWT NOVUM, 2018). Since the beginning of its existence, the Grouping has implemented many of its own projects aimed at increasing cooperation and cohesion in the Czech-Polish border area. The grouping also deals with creating cross-border partnerships and searching for partners who can successfully realize projects. The aim of this article is to analyze the activities of the Grouping and to show how its activities influence the Czech-Polish cross-border cooperation. It analyses projects that contribute most to the Czech-Polish cooperation.

Keywords: EGTC NOVUM; cross-border cooperation; European projects; European Union

JEL Classification: R5; P25

1. Introduction

The European Union has created the European grouping of territorial cooperation (EGTC) as a legal instrument to facilitate cross-border cooperation. EGTCs conduct their activities based on Regulation (EC) No 1082/2006 of the European Parliament and of the Council of 5 July 2006 on a European grouping of territorial cooperation (EGTC) (The European Parliament…,2019), which allows for the creation of cooperation units by public entities from different Member States. In addition, it provides these entities with a Community legal framework. Thus, it can be generally written that European groupings of territorial cooperation are legal entities created by Member States, local and regional authorities and other entities governed by public law. Such an entity is of course created on the territory of the European Union and allows for the establishment of formal cooperation groups by public entities from different Member States.

It should be noted that the first EGTC, Eurométropole Lille-Kortrijk-Tournai, was created in January 2008. It enables cooperation between significantly different authorities from three different administrative levels in Belgium and France. The official headquarters are in France and the French authorities have accepted the EC Regulation as a basic right, allowing them to employ staff in accordance with Belgian law (Mędza, 2015).

The European Grouping of Territorial Cooperation NOVUM (EGTC NOVUM) was established in 2015. The Convention and Statute of the Grouping were signed in September of that year, while its legal personality was established in December. NOVUM operates in the Polish-Czech borderland. Its founders and members are institutions from the Czech Republic and Poland. There are five regional authorities: one from Poland – Dolnośląskie Voivodship (Region) and four from Czech Republic (Hradec Králové Region, Liberec Region, Olomouc Region and Pardubice Region), as well as two Polish-Czech Euroregions: Nysa and Glacensis. NOVUM was established in order to intensify, facilitate and promote Polish-Czech cross-border cooperation aimed at the strengthening of economic and social cohesion of the area of operation of the Grouping (EUWT NOVUM, 2015). NOVUM conducts its activities based on the Strategy of integrated cooperation of the Czech-Polish border 2014-2020. The main areas of activities are: economic cooperation, transport, environmental protection, health protection, spatial planning and administrative problems (UMWD,2014).

The literature emphasizes that the creation of EGTC NOVUM increases the economic attractiveness of the Polish-Czech borderland area and that this grouping, as a new subject of European Union law, advances the Polish-Czech cross-border cooperation in the implementation of the European Union's regional policy (Adamczuk, 2016). It is also pointed out that the Polish-Czech borderland has become a model example of the most innovative cross-border cooperation. The first Euroregions in Poland were created here, followed by the European Grouping of Territorial Cooperation (EGTC). For example, December 2016 marked the twentieth anniversary of the Polish-Czech Euroregion Glacensis. However, there is still untapped potential. Overcoming difficulties in contacts and effective implementation of new forms of cooperation may increase the chances for development of this region (Skorupska, 2014).

The aim of the article is to show how EGTC NOVUM activities contribute to the strengthening of cooperation in the Czech-Polish border region. How the realized projects influence the cross-border cooperation. What is their impact on achieving the assumed strategic objectives of cooperation. We will also analyze the activities realized outside the projects. The grouping undertakes many projects which contribute to the development of Polish-Czech cooperation.

2. Research Methodology

NOVUM EGTC operates in the Lower Silesian Voivodship on the Polish side and in four countries on the Czech side, i.e. Kralovehradecky, Liberecky, Pardubicky and Olomoucky. Altogether, this gives an area of more than 37.6 thousand km2, where nearly 5.1 million people live. The creation of EGTC NOVUM created an area of comparable size on both the Polish and Czech sides, inhabited by a similar number of people. The disproportion between the "big" Polish region and the "small" Czech one was thus eliminated.

During the nearly 6 years of its operation, the Grouping implemented 11 projects. Of these, one was financed from national resources and the rest from the European Union budget. One project was financed by the Polish Ministry of Foreign Affairs. Two projects

were implemented under the Interreg Central Europe Program and eight under the Intrreg V-A Czech Republic-Poland. A detailed list of projects is presented below.

Table 1. Population and area of EUWT NOVUM (CZSO, Regional Office Hradec Králové: Statistical yearbook of the Královéhradecký region, Regional statistics, Hradec Králové (2017); CZSO, Regional Office Liberec: Statistical yearbook of the Liberecký region, Regional statistics, Liberec (2017); CZSO, Regional Office Olomouc: Statistical yearbook of the Olomoucký region, Regional statistics, Olomouc (2017); CZSO, Regional Office Pardubice: Statistical yearbook of the Pardubický region, Regional statistics, Pardubice (2017).

Region	Population (persons)	Area (km2)
Dolnośląskie	2,930,710	19,947
Hradec Králové	550,804	4,759
Liberec	440,636	3,163
Olomouc	517,087	4,519
Pardubice	633,698	5,271
Total	5,072,935	37,659

1. 01.08.2016-30.11.2016: Project "Along the trail of common heritage". Funding source: Polish-Czech Forum of the Ministry of Foreign Affairs of The Republic of Poland. Subsidy value: PLN 23,210.00.

2. 01.06.2016-31.05.2017: Project "Motorway S3/D11 our joint priority". Funding source: Interreg V-A Czech Republic-Poland. Subsidy value EUR: 7,388.35.

3. 01.06.2018-30.11.2018: Project "15 years together". Funding source: Interreg V-A Czech Republic-Poland. Subsidy value EUR: 16,669.11.

4. 01.06.2017-31.05.2020: Project "Boosting energy efficiency in Central European cities through smart energy management". Funding source: Interreg Central Europe. Subsidy value: EUR 107,185.59.

5. 01.01.2018-31.12.2020: Project "We solve problems together". Funding source: Interreg V-A Czech Republic-Poland. Subsidy value EUR: 280,700.54.

6. 01.01.2018-31.12.2020: Project "How do your emergency services work?". Funding source: Interreg V-A Czech Republic-Poland. Subsidy value EUR: 84,377.29.

7. 01.01.2018-31.12.2020: Project "Akcent@Net". Funding source: Interreg V-A Czech Republic-Poland. Subsidy value EUR: 45,800.93.

8. 01.01.2019-30.06.2022: Project "Education knows no boundaries". Funding source: Interreg V-A Czech Republic-Poland. Subsidy value EUR: 125,950.00.

9. 01.01.2019-31.03.2021: Project "Spa 4 Development". Funding source: Interreg V-A Czech Republic-Poland. Subsidy value EUR: 80,493.40.

10. 01.04.2020-31.03.2022: Project "Capitalizing and exploiting energy efficiency solutions throughout cooperation in central European cities (TARGET-CE)". Funding source: Interreg Central Europe. Subsidy value EUR: 102,895.00.

11. 01.07.2021-30.06.2023: Project "In contact-Cross-border cooperation despite obstacles". Funding source: Interreg Central Europe. Subsidy value EUR: 85,859.00

In total, the Group managed to obtain over 980 thousand euro. This shows great activity in the field of raising external funds. Thanks to obtaining these funds it is possible to achieve statutory goals.

3. Results

In this part of the study, selected projects implemented by the Grouping will be analyzed in detail. All the projects are important for the realization of the Grouping's objectives. They all contribute to the strengthening of Polish-Czech cooperation in the cross-border area. Their realization has contributed to the achievement of concrete results. The European grouping of territorial cooperation is a cross-border entity and therefore it can realize cross-border cooperation projects on its own. Novum used this opportunity and realized project "We solve problems together". The project was focused on solving the defined system problems of cross-border cooperation on the Czech-Polish border. The main aim of the project was to increase intensity of co-operation between key institutions in the field of Polish-Czech cross-border co-operation, to create for them a co-operation network, communication channels and a platform for meetings of specialists in given fields.

For these purposes 6 thematic groups of EGTC NOVUM served in different spheres of cooperation: economic cooperation, environmental protection, health and safety, administrative problems, transport and planning and spatial development. Each of these groups met at least twice a year. In addition, conferences and training sessions were organized in the areas mentioned above. Within the economic cooperation group, two conferences were held as training conferences for entrepreneurs. In the area of environmental protection, 6 training conferences were organized for employees of offices responsible for issuing decisions on water management, air protection and waste management (including transboundary movements of waste). The topics of the conferences also included issues related to access to information on the environment. In the area of health protection and safety, conferences were organized on the issues of crisis management in the cross-border area. In the field of spatial planning and management, trainings were organized for the municipalities of the first border strip on the Polish side and municipalities with extended competence as well as other municipalities neighboring Poland. The scope of the conference included a comparison of spatial planning systems on the local level. In the second stage, an analysis of selected local spatial development plans in bordering municipalities was carried out together with a workshop attempt to identify conflicts and develop a common development framework. Three conferences on transboundary connections between Poland and the Czech Republic were organized within the Transport Group.

The effect of the works of the group on administrative problems was creation of the expert opinion "Map of competences of Polish and Czech self-government". Subsequently, 4 conferences for representatives of local self-government units were organized to present the results achieved. In total, more than 1,200 people participated in all training courses and conferences within the project. The beginning of 2020, due to the outbreak of the coronavirus pandemic, brought new challenges. This was influenced by the closure of borders and restrictions on movement. It was decided to create an information point for cross-border

workers. There are several thousand Poles working in the Czech Republic, who used to cross the border every day to work. The closing of the borders prevented them from performing their work duties. 4 May 2020. The Polish government allowed people working in the Czech Republic to cross the border. However, the employees did not have the necessary knowledge when and under what conditions they could cross the border. The aim of the created information point was to provide reliable knowledge about legal regulations in force on both sides of the border. Information was collected from public institutions such as border guards, police, sanitary, etc. Its service will be handled by one of the employees. Every day he was on duty by telephone and provided information by e-mail. In addition, a database was created on the project website, which contained the necessary regulations. Employees accessing it had the opportunity to familiarize themselves with all the information that enables them to work on the other side of the border. Webinars were also organized, during which experts from various fields answered questions of those interested. In the following months, the scope of activities of the information point was extended. Its services were used not only by cross-border workers, but by all persons interested in traveling to a neighboring country. Another very important project for the Group was the project "How do your emergency services work?". The project partners were ambulance services from the Czech-Polish border area. Within the framework of the project, we managed to organize two conferences. Exchange placements of medical employees took place. Within the framework of the project, medical workers from Poland and the Czech Republic had the opportunity to go for an internship, during which they could familiarize themselves with the functioning and specifics of daily work in emergency rooms in the neighboring country, including the equipment of emergency services. An important element of the internship was the opportunity to draw attention to the differences in the functioning of emergency medical services on both sides of the border. Joint exercises of emergency medical services were held. This activity included organization of two joint exercises of emergency medical services from Czech Republic and Poland. They were carried out in a schedule of two-day actions of rescue teams in simulated conditions - at night and during the day. Task stations were organized where paramedics could demonstrate their skills and knowledge of medical rescue, while improving their qualifications. Thanks to the participation of Polish and Czech medical rescue teams, the exercises contributed to establishing closer contacts and improving coordination in the management of medical teams in the Polish-Czech borderland. Another activity was training of paramedics. The action included the organization of four two-day trainings for medical personnel, two in Poland and two in the Czech Republic. The subject of the trainings was, among others, providing help in life and health threatening situations, joint cooperation in providing pre-hospital care by paramedics in selected cases (sudden cardiac arrest, serious injuries, etc.). The intensive course time included lectures, demonstrations, discussions and exercise stations. The main element of knowledge transfer was exercises in small groups (up to eight people), using simulated scenarios on manikins adapted to perform advanced resuscitation procedures (e.g. intravenous access, instrumental ventilation, intubation, defibrillation). The trainings were ended with obtaining a certificate. A total of 750 people benefited from all activities implemented under the project. During the project

implementation, the most important problems related to providing medical assistance in border regions were discussed. It was emphasized that the most important problem is the lack of an intergovernmental agreement between Poland and the Czech Republic concerning medical rescue services. The lack of an agreement means that ambulances from one country cannot provide assistance on the other side of the border. The group has set itself the goal of getting this agreement signed. Meetings were organized with members of parliament from Poland and the Czech Republic, as well as with representatives of ministries of health.

A project that is also worth mentioning in more detail is the Spa for development. The project was mostly implemented during the period of restrictions imposed by the pandemic. However, the pandemic has increased the interest of tourists in practicing tourism on a more local level. Tourists want to spend their vacations close to home, but still abroad. They had no knowledge of the available tourist facilities on the other side of the border. They also often did not know that such spas existed at all. In the framework of the project an atlas of Polish and Czech spas was created. People interested in visiting a spa can learn about its offer and accommodation facilities. The project was also very useful for spa managers. They gained knowledge on how health resorts in the other country function. They exchanged information on how to organize public transport in the area of the spa, how to manage green areas or how to provide qualified personnel. They also discussed how public authorities support spas when they are closed due to a pandemic.

4. Conclusions

In conclusion, it should be stated that EGTC NOVUM is an important instrument of cross-border cooperation between Poland and the Czech Republic. Its activity has a significant impact on strengthening cooperation between entities in the area of its operation. Thanks to its projects, NOVUM has become one of the most active players in Czech-Polish cooperation. The activities of the Grouping were also very important when the covid-19 pandemic occurred. They affected the daily lives of many people. Thanks to the activities undertaken by the Group, it was possible to facilitate daily life. Currently, the information activity is continued under the In Touch project. An Information Center was created where all the necessary information is gathered for those who want to visit a neighboring country. Special information packages were created. They cover e.g. transport, education, health care or education. In the case of transport, there is information on the road management system, places where one can find information on impediments on the roads, closed border crossings or the system of road fees.

On the other hand, the implementation of a project addressed to medical rescuers made it possible to identify a very important barrier hampering everyday work in border regions. The lack of a Polish-Czech intergovernmental agreement on paramedic rescue causes very frequent complications in providing assistance to injured people. The group has taken steps to ensure that such an agreement is signed as soon as possible. The realization of this project showed how important the problem is the need for cooperation between emergency services in border areas. The specificity of the area results from the fact that it is often easier and faster to get help from the other country. All this influenced the decision on the need to continue

this cooperation. At present, a project is being developed in which all the ambulance services in the Czech-Polish border area will cooperate. There are also plans to create a transregional training center for paramedics.

In addition to the two projects discussed in detail, the results of other projects should also be mentioned. These have enabled cooperation to be established between spa communities, between teachers or the learning of the neighboring language.

Another very important area of the Group's work is assisting those interested in cooperating. The restrictions caused by the pandemic have made it difficult to establish direct partnerships. The Grouping plays the role of an entity that searches for a partner on the other side of the border for entities interested in collaborating. Thanks to this activity it has been possible to establish many partnerships. Consequently, several projects have been prepared.

Also some more general conclusions can be drawn. Six years have already passed since the creation of the Group. This period has shown how good a decision it was to create it. Many projects have been successfully completed. Many people have participated in the activities carried out by the Grouping. They benefited from conferences, trainings and webinars. Implemented projects perfectly fit into the existing gap in cooperation. Their implementation has shown the necessity of long-term cooperation. The grouping became one of the most active entities of the Polish-Czech cross-border cooperation. Its activities were also noticed by the Committee of the Regions. The project How do you rescue at your place was recognized as an example of good practice in the area of cooperation between emergency services.

Conflict of interest: none

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Attitudes Towards Work in Visegrad Group Countries

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Abstract: The aim of this study is to examine the similarities and differences in the attitudes of people living in the Visegrad Group (V4) countries towards work. In the introduction to the study, we briefly discuss the establishment of the Visegrad Group and the peculiarities of the labor market in Slovakia, the Czech Republic, Hungary and Poland. Our research was based on secondary data. We examined some questions of the European Values Survey related to the world of work and then compared the results in the four countries analyzed. The database contains a total of 6,109 responses from V4 countries. The hypotheses we formulated were tested using the Chi-square test in IBM SPSS statistical software. The country of the respondents was an independent variable in the analysis, and a dependent variable was the importance of work in people's lives, agreement with three job-related statements, and people's opinion about income equality. In the final chapter of the study, we summarize the conclusions drawn from the results.

Keywords: labor force; labor market; work; Visegrad Group; V4 countries

JEL Classification: E24; J20; J21

Introduction

The Visegrad Group was established through the political cooperation signed during the regime change of the 1990s. Václav Havel, President of the Czechoslovak Republic, Hungarian Prime Minister József Antall and Polish President Lech Walesa signed the Visegrad Declaration on 15 February 1991 in Visegrad. This day was the historic day of the meeting of the Polish, Czech and Hungarian kings in the Visegrad castle in 1335. In the statement, politicians agreed that the three countries (now four since the split of Czechoslovakia in 1993) will work closely together on the road to European integration. Since then, V4 has become a recognized political "brand," and in the international literature, in international diplomacy, these four countries are called the Visegrad Four (Bernek, 2018).

Since the early 1990s, the Visegrad Group countries have opened up their economies and investors have shown increasing interest in locating foreign capital investment (FDI) in these areas (Dorozynski & Kuna-Marszalek, 2016).

The V4s achieved their goal formed in the 1990s, because they became members of the EU in 2004, and in 1999 the Czech Republic, Poland and Hungary became members of NATO. Slovakia became a member of NATO five years later (Bernek, 2018).

In the literature, several authors mention the similarities and differences between the economies of the V4 countries. The economic situation of the V4s was already diverse at the time of the countries' accession to the European Union. This has been further strengthened

by the use of EU's Structural and Cohesion Funds. Cohesion between countries is growing nowadays, but more emphasis should be placed on country-specific challenges in the future (Poland: poverty, Hungary: early school leaving, Slovakia: poor R&D sector). There is a need to strengthen economic cooperation, harmonize national development priorities and develop cross-border cooperation (Káposzta & Nagy, 2015). According to Lipták (2018), in the labor markets of the V4 countries, the so-called anomalies are observed sometimes. Regional disparities already existed at the time of the change of regime, and have only increased since then. In the Visegrad Group countries, a long-term and lasting labor market solution could be a system of employment policy specifically tailored to these countries.

Morvay (2012) describes that the most commonly used rates in characterizing labor markets are the employment rate, the unemployment rate, and the inactivity rate. These three indicators (Table 1.) describe the evolution of labor market developments over time, focusing on closely related characteristics. The International Labor Organization also classifies people into these three groups for the purpose of compiling labor market statistics: the employed, the unemployed, and the economically inactive. The economically active population (also known as the labor force) is the sum of the employed and the unemployed. Inactive persons are those who are neither employed nor unemployed (Eurostat, 2021a). Unemployment rate is one of the most important macroeconomic indicators (Mura et al., 2020) that is often used to measure the health of an economy. Unemployment affects not only a country's economy but also the social and physical well-being of individuals (Machová et al., 2020). According to Kopackova (2019), in the cities of the V4 countries, education and retraining, investment, innovation, and the promotion of local products can be tools to reduce unemployment.

Table 1. Employment rate and unemployment rate 2017-2020 in Visegrad Group countries (Eurostat, 2021b; Eurostat, 2021c).

Country	Employment rate (from 20 to 64 years)				Unemployment rate (from 20 to 64 years)			
	2017	2018	2019	2020	2017	2018	2019	2020
Czech Republic	78.5	79.9	80.3	79.7	2.8	2.2	2.0	2.5
Hungary	73.3	74.4	75.3	75.0	3.9	3.5	3.2	4.0
Poland	70.9	72.2	73.0	73.6	4.8	3.8	3.2	3.1
Slovakia	71.1	72.4	73.4	72.5	7.9	6.4	5.6	6.6

In the table, it is interesting that between 2017 and 2019, employment and unemployment increased in all Visegrad Group countries, and since the outbreak of the COVID-19 pandemic in Europe in 2020, employment has decreased and unemployment has increased in all countries except Poland. Poland has been able to further increase employment and reduce unemployment. Czech et al. (2020) in their study pointed out that although there is a high degree of uncertainty in the economic forecasts, the year 2020 is expected to affect the economies of the V4 countries in an unprecedented way. It was predicted that this would be reflected, among other things, in the rise in the unemployment rate, but as can be seen in the table, this was not the case in Poland.

2. Methodology

The aim of our research was to examine whether there is a difference in attitudes to work in the Visegrad countries. For this, we used the results of the European Values Survey (EVS/WVS, 2021). The survey includes a number of questions, we examined differences and similarities between countries in some of the questions that concerned the world of work. The database contains a total of 6,109 responses from Slovakia, Hungary, Poland and the Czech Republic.

The database was downloaded to the IBM SPSS Statistics software platform, where the details associated with each variable were already set. Of the variables we examined, the country of the respondents was a nominal variable and the others were all ordinal. The selection of the statistical analysis needed to test our hypotheses was based on the book of Sajtos and Mitev (2007). Based on this, if both variables examined are non-metric (nominal or ordinal), a cross-tabulation analysis should be used. To test the hypotheses, we performed a Chi-square test. The hypotheses we set up were as follows:

H1: In the Visegrad Group countries, work is of varying importance in the lives of the respondents.

H2: There is varying degrees of agreement in the Visegrad Group countries with the statement that people who do not work turn lazy.

H3: There is varying degrees of agreement in the Visegrad Group countries with the statement that work is a duty towards society.

H4: There is varying degrees of agreement in the Visegrad Group countries with the statement that work should come first, even if it means less spare time.

H5: Income equality is of varying importance in the Visegrad Group countries.

3. Results

Before presenting the results, we would like to briefly discuss what the European Values Survey really is, which served as a starting point for our research.

3.1. European Values Survey

The European Values Survey (EVS) is a large-scale, transnational and longitudinal research program that examines fundamental human values. The research provides insight into the respondents 'ideas, beliefs, preferences, attitudes, values, and opinions. The research project sheds light on how Europeans think about life, family, work, religion, politics and society. The European Values Survey was launched in 1981. The first survey involved thousands of citizens of the then EU member states using standardized questionnaires. The survey is repeated every nine years (European Values Survey, online). The database on which our secondary research is based was developed by the collaboration of EVS and World Values Survey (WVS). The database can be downloaded from the GESIS (Leibniz Insitute for the Social Sciences) website (EVS/WVS, 2021).

3.2. Work Related Questions in the Research

The first job-related question from the European Values Survey that we examined was about the importance of work in respondents 'lives (Figure 1).
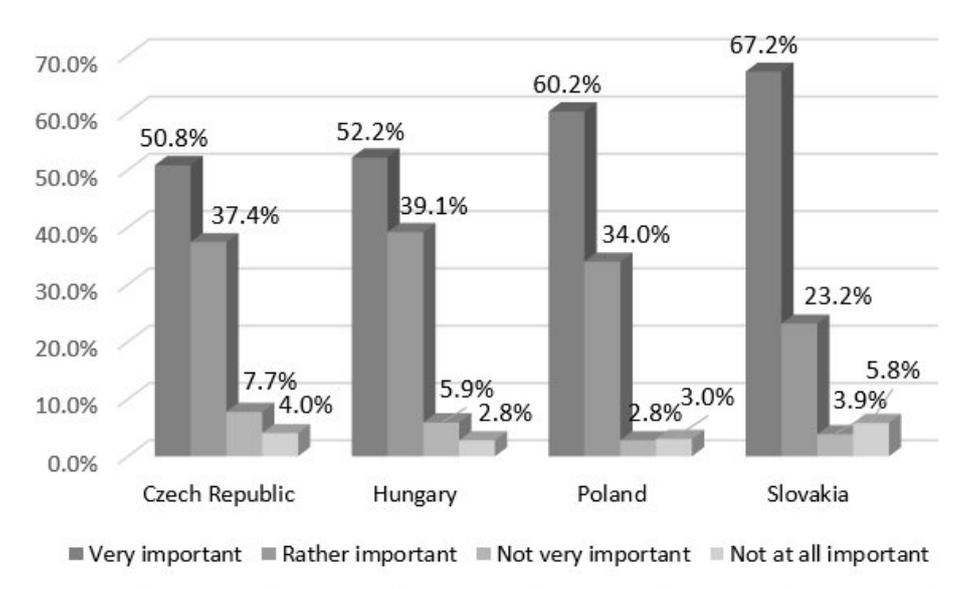
Figure 1. Importance of work in respondents' life

According to the results of the survey, in each of the V4 countries, the majority are those for whom work is very important or rather important. In the Czech Republic and Hungary, slightly more than half of the respondents indicated that work was very important to them. In Poland, the proportion has already reached 60%, and in Slovakia it has exceeded two-thirds. The proportion of those who consider work very important was the highest in Hungary, but it is also the country with the highest proportion of those for whom work is not important at all (5.8%). However, this is not yet enough to determine if the difference is significant. To determine this, a Chi-square test was performed (Table 2).

Table 2. Chi-Square Test: V4 countries and importance of work in respondents' life

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	173.680a	9	0.000
Likelihood Ratio	178.187	9	0.000
Linear-by-Linear Association	52.554	1	0.000
N of Valid Cases	5,984		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 51.81.			

Based on the results of the analysis, the difference between the two variables is significant, so we reject the null hypothesis (i.e., that there is no relationship between the variables) and accept hypothesis H1.

The second work-related question, which we examined in Visegrad Group countries, dealt with the extent to which respondents agree with the statement that people who don't work turn lazy (Figure 2).

The strongest agreement with the statement is highest in Slovakia (45.5%). This is followed by Hungary and the Czech Republic. In Poland, only one third of those strongly agree. Almost half of Polish respondents, although not strongly, agree that those who do not work turn lazy.

In this question, we also performed the Chi-square test (Table 3) to determine if the difference between countries was significant.
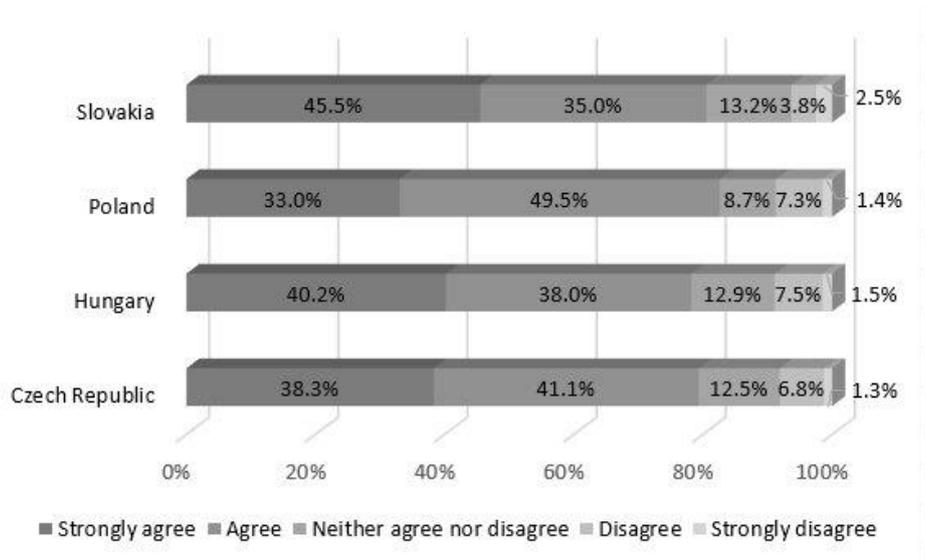
Figure 2. Agreement with the statement: People who don't work turn lazy

Table 3. Chi-Square Test: V4 countries and agreement with the statement that people who don't work turn lazy

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	111.856a	12	0.000
Likelihood Ratio	113.631	12	0.000
Linear-by-Linear Association	3.154	1	0.076
N of Valid Cases	6,039		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 22.02.			

The result of the analysis is significant in this case as well, so the null hypothesis is rejected and hypothesis H2 is accepted.

The third question examined the extent to which respondents agree with the statement that work is a duty towards society (Figure 3).
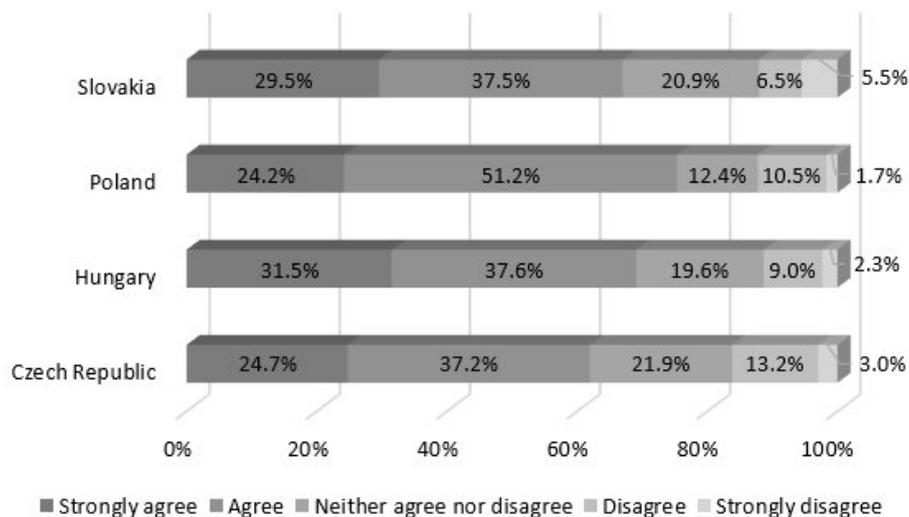
Figure 3. Agreement with the statement: Work is a duty towards society

The proportion of those who agreed with the statement was high in each of the countries examined. Of the four countries surveyed, Polish respondents agreed most strongly that work is a duty to society. They were followed by respondents from Hungary, Slovakia and then the Czech Republic. The proportion of those who disagree with the statement was highest among Czech respondents.

We also performed the Chi-square test for this question (Table 4).

Table 4. Chi-Square Test: V4 countries and agreement with the statement that work is a duty towards society

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	186.170a	12	0.000
Likelihood Ratio	185.083	12	0.000
Linear-by-Linear Association	9.960	1	0.002
N of Valid Cases	6,039		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 42.00.			

The difference between the countries also became significant in the analysis, so we again rejected the null hypothesis and accepted hypothesis H3.

EVS and WVS research has also examined the degree of agreement in each country that work is the first even if it means less spare time for the individual (Figure 4).
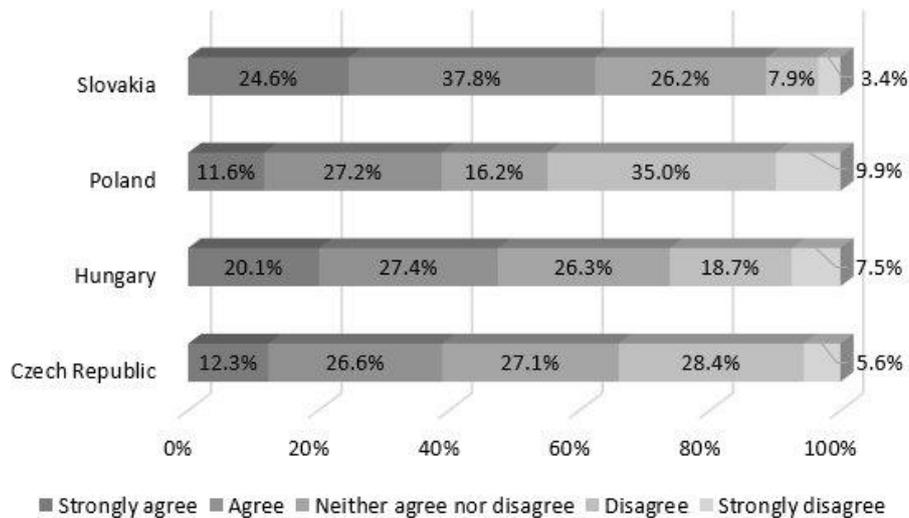
Figure 4. Agreement with the statement: Work should come first even if it means less spare time

Respondents in Slovakia and Hungary agree with this statement to the greatest extent. The proportion of those who disagree with the statement is the highest in Poland. Almost half of Polish respondents (strongly disagree: 9.9%, disagree: 35.0%) believe that it is not worth putting work ahead while reducing leisure time. There is a balanced proportion of Czechs who agree, cannot decide or disagree.

Despite the fact that the difference between the countries was already noticeable on the figure, we again performed the Chi-square test (Table 5.).

Since the result of the test is significant in this case as well, the null hypothesis is rejected and hypothesis H4 is accepted.

Table 5. Chi-Square Test: V4 countries and agreement with the statement that work should come first even if it means less spare time

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	504.103a	12	0.000
Likelihood Ratio	537.623	12	0.000
Linear-by-Linear Association	64.688	1	0.000
N of Valid Cases	6,051		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 87.47.			

	Czech Republic	Hungary	Poland	Slovakia
■ Incomes should be made more equal	15.9%	15.2%	6.3%	10.2%
■ 2	7.1%	4.8%	3.0%	9.3%
■ 3	9.6%	9.2%	2.3%	14.4%
■ 4	8.8%	6.4%	2.6%	11.9%
■ 5	16.0%	13.8%	8.6%	16.6%
■ 6	8.5%	6.7%	5.5%	11.8%
■ 7	11.0%	10.1%	12.3%	9.0%
■ 8	10.5%	11.6%	23.7%	7.1%
■ 9	4.2%	4.4%	12.8%	2.8%
■ We need larger income differences as incentives	8.2%	17.9%	22.8%	6.8%
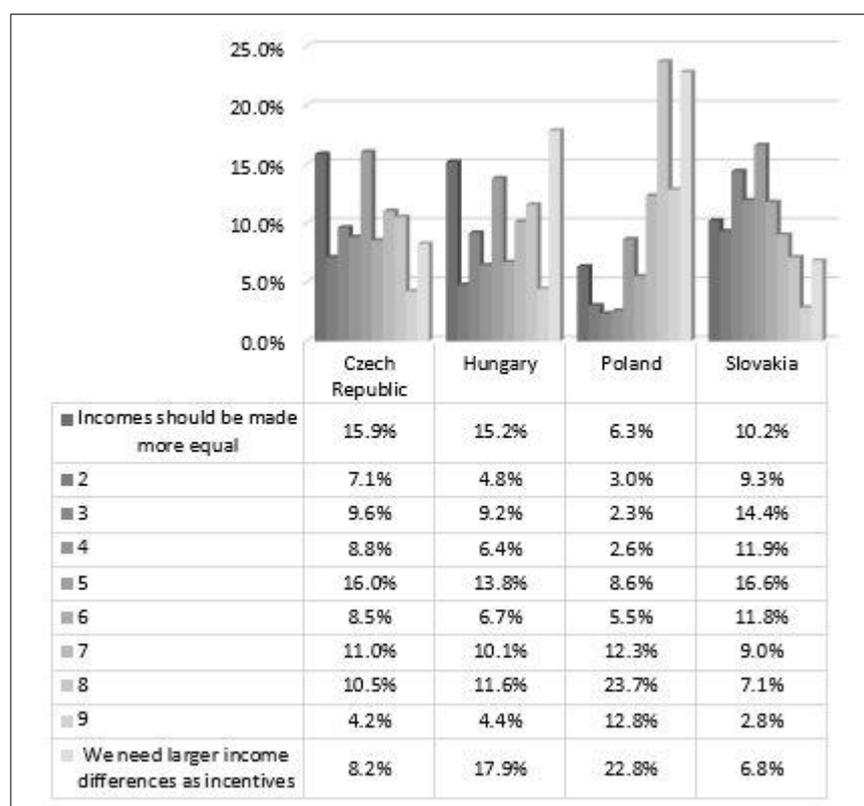
Figure 5. Importance of income equality

Table 6. Descriptive statistics: V4 countries and income equality

Country	N	Mean	Median	Std. Deviation
Czech Republic	1,758	5.07	5.00	2.804
Hungary	1,494	5.69	6.00	3.084
Poland	1,332	7.25	8.00	2.602
Slovakia	1,409	4.87	5.00	2.536

The fifth question concerned income equality (Figure 5). Respondents were asked to indicate on a scale of one to ten how important they considered income equality to be. Value 1 meant that incomes should be more equal, and value 10 meant that greater income differences would be needed as an incentive.

Respondents in the countries surveyed differed on this issue. Almost a quarter of Polish respondents believe that a larger income gap is needed as an incentive. In Poland, higher values received more nominations. In Hungary, too, the proportion of those who marked 10 was relatively high (17.9%), but almost the same number (15.2%) were those who

marked 1, i.e. the need for greater income equality. The proportions were similarly distributed in the Czech Republic and Slovakia. To better interpret the results, we examined some indicators (Table 6): mean, median, and standard deviation.

It is clear from the table above that in the case of Polish respondents, income disparities are most needed. This is supported by both mean and median values. Respondents in Hungary also received above-average (above 5) mean and median values. Respondents in Slovakia and the Czech Republic have similar results, and they consider income equality to be moderately important.

To determine if the difference between countries was significant, we performed the Chi-square test (Table 7).

Table 7. Chi-Square Test: V4 countries and importance of income equality

	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	910.630a	27	0.000
Likelihood Ratio	914.672	27	0.000
Linear-by-Linear Association	48.485	1	0.000
N of Valid Cases	5,993		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 78.01.

As with the other hypotheses, the test result is significant here, which means that the null hypothesis can be rejected and hypothesis H5 accepted.

4. Discussion

The statistical analyzes presented in the previous chapter confirmed that there is a significant difference in the attitudes towards work in the five questions we selected in the EVS and WVS surveys in the Visegrad Group countries. All hypotheses (H1, H2, H3, H4 and H5) were accepted.

The first question assessed the importance of work in the lives of respondents. Most of the Slovaks were those for whom work was very important, but if we add up the strongly agreeing and rather agreeing answers, Poland and Hungary also reach 90%. Work is the least important for Czechs in the Visegrad Group countries (strongly agree: 50.8%, rather agree: 37.4%).

The second question assessed the extent to which respondents agree that people who do not work turn lazy. The proportion of those who strongly agreed with this was also the highest among Slovaks (45.5%). Here, however, it is important to point out that if we look at the proportion of strongly agreeing and agreeing respondents, the other three countries are not left behind (Slovakia: 80.5%, Poland: 82.5%, Hungary: 78.2%, Czech Republic: 79.4%). Based on this, there is no difference in the V4 countries in whether they agree that people who are not working turn lazy, but in whether they strongly agree with it.

In the third question, respondents had to express their agreement that work is a duty towards society. Respondents in Hungary (31.5%) and Slovakia (29.5%) strongly agreed with the statement to the greatest extent. If we add up the proportion of those who strongly agree or agree, the results for Hungary (69.1%), Slovakia (67.0%) and Poland (75.4%) are similar. The Czechs still have the lowest proportion (61.9%).

In the fourth question, respondents had to decide how much they agreed with the statement that work should be the first even if it means less spare time. The proportion of respondents who strongly agree with the statement was again the highest among Slovak respondents. If we add up the proportions of those who strongly agree or agree, Slovakia (62.4%) leads the way compared to the other three countries (Hungary: 47.5%, Czech Republic: 38.9%, Poland: 38.8%). It is also worth summarizing the proportion of respondents who disagree or strongly disagree with this statement, as in the case of Poland this proportion (44.9%) exceeds the proportion of those who agree. Based on this, Poles do not like to prioritize work if it means less spare time. In the Czech Republic, this cannot be decided unequivocally, as the proportion of strongly disagreeing or disagreeing respondents (34.0%) is almost the same as agreeing. In the V4 countries, therefore, Slovakia and Hungary are the countries where respondents are most likely to prioritize work at the expense of leisure time.

The fifth question examined the importance of income equality. Equal income is most important for respondents in Slovakia and the Czech Republic. According to respondents in Poland, larger income differences are needed for incentives.

5. Conclusions

According to the results, among the Visegrad Group countries, Slovakia is the one where people take work "most seriously". They consider work to be very important in their lives and strong agreement with the statements examined was almost always the highest in their case. Based on the results, on the other hand, among the Visegrad Group countries respondents in the Czech Republic consider work to be the least important in their lives and they do not really like (along with Poles) to prioritize work if it means less spare time.

Lipták (2018) drew attention to the fact that the labor market of the Visegrad countries moves in four different directions, the differences between them can be clearly observed. In the labor market of the V4 countries, Mura et al. (2021) examined the emotional intelligence of employees, based on their research findings, there is no difference between these countries.

The limitation of our research was that our data are secondary, the research of EVS and WVS does not only measure work-related attitudes, so the number of questions related to this is relatively low. A possible future direction for our secondary research could be to make a cross-country comparison. This is conceivable by comparing the results of other European regions, but even by examining the results of countries on other continents.

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The HR Management Changes Related to the COVID-19 Pandemic in Chemical Industry

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Abstract: A new viral disease called COVID-19, caused by coronavirus SARS-CoV-2, appeared in China at the end of 2019. The virus quickly spread round the world. In March 2020, the World Health Organization announced a pandemic. Therefore, the Czech Republic started introducing anti-epidemic preventive measures. The impacts of the measures had a nation-wide character and affected the society, particularly entrepreneurial entities. Companies were forced to reduce or interrupt their activities. A lot of companies introduced alternative work methods to reduce interpersonal contact. Working from home started to prevail where the situation allowed it. As the time passed, the pandemic started to have different economic impacts on different branches of the economy. They were mostly considered negative, but the measures also brought some positive impacts, for example, faster digitalization of the labour market. The aim of this paper is to map the situation in the period of COVID-19 pandemic in the area of human resources in the Czech Republic, focusing on the chemical industry. The paper includes the outcomes of a research performed through electronic questioning at seven chemical companies. The research is focused on changes in the corporate HR management caused by the impacts of the coronavirus crisis.

Keywords: HR management; labour market; COVID-19; pandemic

JEL Classification: J21; M54

1. Introduction

The development of information technologies and the advancing digitalization in individual branches of the economy have been changing the labour market in the last few years. The coronavirus pandemic also contributed to the labour market changes. Digitalization significantly accelerated within this period. To prevent spreading of the coronavirus, the interpersonal contact was limited as much as possible. Therefore, some companies made it possible for their employees to work from home (Zamfir & Aldea, 2020). However, the pandemic also had some negative impacts on the labour market both in the Czech Republic and globally in several waves (Hedvicakova & Kozubikova, 2021; Lee et al., 2020). Although the government made efforts to support companies within the coronavirus crisis, a lot of them had to reduce or stop their activities as a result of the decreased demand and imposed preventive measures, and to make some employees redundant.

COVID-19 – A new viral disease causing the infected persons pneumonia appeared in the Chinese city of Wu-chan in December 2019. However, neither the disease agent nor the

modes of its transmission were known. The disease was later named COVID-19, whose agent is the new coronavirus SARS-CoV-2.

The disease quickly spread to other countries, and at the beginning of March 2020 the World Health Organization (2019) announced the spread of the coronavirus as pandemic. The Czech Republic registered the first case of the disease on 1 March 2020 (National Institute of Public Health, 2020). The measures taken against the pandemic significantly limited social, but mainly entrepreneurial activities. People who had to go into quarantine or lost their jobs also showed depressions and distress, particularly due to the social media disinformation (Xiong et al., 2020). The only available way how to reduce the pandemic is vaccination, which prevents a severe clinical course of COVID-19. The first vaccine registered in the EU was Comirnaty, developed by BioNTech (Germany) and Pfizer (U.S.A.). It was registered on 21 December 2020 (European Medicines Agency, 2020).

Unemployment during the coronavirus crisis – Unemployment in the Czech Republic grew from below 3% before the pandemic to 3.7% in October 2020, and together with the recovery in the summer of 2021 it got back to the pre-epidemic figures (see Table 1).

Table 1. Quarterly unemployment rates in the Czech Republic (Czech Statistical Office, 2021a)

Indicator	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021
Employment rate (%)	58.2	58	57.5	57.6	58.5*
General unemployment rate (%)	2.9	3.0	3.4	3.0	2.7*
Economic activity rate (%)	59.9	59.8	59.5	59.4	60.2*

*Preliminary figures

The unemployment grew very little only, mainly thanks to the support program of Antivirus, which provided employers with financial support, and they then were not forced to reduce their staff (Hovorkova, 2020a; Hedvicakova & Kozubikova, 2021).

During the crisis, a lot of companies limited their operation and only employed the necessary staff. They were mainly their experienced employees providing best performance. This led to the fact that the unemployed included more and more people requiring a part-time job, people whose employment contract for a definite time had expired, and graduates with little or no job experience (Hedvicakova & Kozubikova, 2021; Lee, Schmidt-Klau & Verick, 2020). Another affected group was represented by women, particularly those who had to take care of their children or some other persons in connection with the school lockdown and limited social services. Although 55+ people have the necessary experience, they also suffered from a pandemic impact as some of them had great difficulty adapting quickly to the increasing usage of modern technologies. Another group endangered by the pandemic was represented by self-employed persons who had to close their trades due to the anti-crisis measures. These people became unemployed, or they switched to regular jobs. Together with the restrictions applied on entering the country, there were also fewer foreign and agency workers among the employed. These are risk groups that are threatened first within any crisis, and the situation was not different during the coronavirus crisis. However, this was not true for all labour sectors. For example, the market suffers from the lack of experts from technical and medical branches regardless of the crisis (Hovorkova, 2020b; Hedvicakova & Kozubikova, 2021).

The negative impact of the pandemic showed mainly in the tourist industry and gastronomy. A lot of people employed in this area lose their jobs and look for jobs in another industry. In view of quite a large number of unemployed looking for jobs in another area of business, we can expect an increased interest in requalification courses.

State support during the coronavirus crisis – The spread of coronavirus and the adopted preventive measures have a negative impact on the employment and labour market in the Czech Republic. Therefore, the government have created a programme called Antivirus, which is to mitigate the negative impacts on the employment. The basic aim of the Antivirus Programme was partial or full compensation for overall labour costs in the form of compensation for wages belonging to employees for the period of obstacles to work caused by quarantine, extraordinary measures, anti-crisis measures relating to the spread of COVID-19 infection both in the Czech Republic and abroad, and by the accompanying economic problems of the employers. The Antivirus Programme provided the affected employers with a financial contribution. By 1 August 2021, the Antivirus Programme had supported 1,073,133 employees in total. The wage compensation was paid, on average, for more than 4 months, and the programme helped to maintain jobs for 37% employees in the private sector. The total number of supported persons included more men (55.5%) than women, and more than 22% of the supported employees belonged to the groups threatened by unemployment. This is why it is possible to assume that they would have become unemployed without this support (Ministry of Labour and Social Affairs of the Czech Republic, 2021a). Antivirus A and later Antivirus Plus covered wage compensations amounting to 80% and later 100% of the wages and salaries up to the maximum amount of CZK 39,000 and CZK 50,000, respectively, including levies in the case of the employee's quarantine and in the case of business lockdown or restriction due to the extraordinary measures (Ministry of Labour and Social Affairs of the Czech Republic, 2021a). Antivirus B served for covering the wage compensations in the case of a drop in sales or loss of inputs during a manufacturing process of 60% of the paid wage compensations, including the compulsory levies up to CZK 29,000. Antivirus C represented another form of support in the form of remission of social insurance payments (Ministry of Labour and Social Affairs of the Czech Republic, 2021a). As of 1 July 2021, the Antivirus Programme was partially replaced by a contribution for the period of partial work, which can be activated in the period of an economic crisis, natural disasters, a cyberattack, an epidemic, etc. At the same time, it is possible to limit its scope of operation to a region, a sector, or to a defined group of employers (Ministry of Labour and Social Affairs of the Czech Republic, 2021a; Hedvicakova & Kozubikova, 2021).

Another support the government provided employees with arrived at the time of the school lockdown. School first closed at the beginning of March 2020 and then in the middle of October 2020. This caused problems to employees with children who had to stay at home. Therefore, the government offered the employees who could not perform their jobs due to childcare at the time of the school lockdown support in the form of a care-giver's allowance. The care-giver's allowance is provided on condition that the child is not more than 10 years

old, or the person they take care of is more than 10 years old and dependent on someone else's care.

Labour Market Changes – The labour market has been changing rapidly since the arrival of the coronavirus pandemic. In the pre-pandemic period, the market suffered from the lack of job applicants, and it was not easy for companies to get new employees. This is why applicants were often offered higher salaries and more fringe benefits, which resulted in the fact that people were not afraid to change jobs frequently. The crisis changed this. Resulting from the growing uncertainty on the labour market, employees became more loyal, and their priority was to keep the current job. Together with the recovery of business activities, the situation returned to pre-pandemic condition, and the supply of jobs started to exceed the demand significantly. As at 31 October 2021, the Labour Offices registered 251,689 people looking for work and, on the other hand, 352,454 job openings (Ministry of Labour and Social Affairs of the Czech Republic, 2021b).

Work environment changes – If a company wants to keep the employees at the time after a crisis, they should listen to their employees and create for them good working conditions. Employees mostly require flexibility in the workplace, which helps them create a work/life balance. One of the solutions is remote work, which became widespread within the coronavirus crisis. However, it cannot be introduced everywhere. In jobs, where it is not possible to work from home, the company can offer their employees flexibility in the form of flexitime, which allows workers to alter workday start and finish times. In addition, it is also important than the employer pays attention to employee education, as the skill requirements are changing continuously, particularly in digital technologies, which started to be used more often during the crisis.

The crisis accelerated the spread of the way of working that had not been used very often by companies in the Czech Republic, which is working from home, a so-called home office. It is mainly used by administrative staff or ICT jobs. A home office has benefits both for the employees, and for their employers. An employee that does not have to travel to work saves time and also has the possibility of harmonizing their private and work lives. Benefits on the part of an employer include savings in some costs, e.g. the office costs or travel costs. Czech companies had not applied this method of work very widely, and so it is necessary for the employees and the employers to get used to it. People must learn how to be disciplined at work. What was also necessary was proper functioning of technologies employees need for their work and online communication (Hodkova, 2020). Digitalization also affected job auctions and subsequent training of new employees, called onboarding. It is mainly applied to administrative jobs or jobs where employees work from home (Halbrstat, 2020).

Sector of economy affected by the coronavirus – Anti-pandemic measures had different impacts in different sectors of the economy. For example, the banks increased the number of cash deposit machines, some of their branches are stopping to use cash to reduce interpersonal contacts (Kucera, 2020). Some other interesting changes can be seen in health care. Health insurance companies have started to pay for examination over the phone or a video call. It made it possible to solve some cases without the patient having to wait for the

examination in the waiting room, where the risk of infection was increased during the epidemic (Nguyenova, 2020).

Apparently, the coronavirus pandemic has affected, positively or negatively, all the economic sectors. The preventive measures relating to the pandemic had negative impacts on the tourism and gastronomy above all, but also on some other branches of business connected with tourism. Table 2 shows the development of the number of guests staying at accommodation facilities in the given months, where you can see the dramatic impact on the tourist industry.

Table 2. Number of guests at mass accommodation facilities (Czech Statistical Office, 2021b)

Indicator	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021
No. of overnight stays	4,699,269	3,172,659	1,036,474	5,964,357	662,954	281,894	1,568,453	6,707,895

The other adversely affected industries included and still include the automotive industry and civil engineering. There are also fewer job openings in administration and banking. By contrast, the areas doing well include information technologies, trade, and delivery services. E-shopping has seen a dramatic increase in the popularity, which was mainly caused by the fact that people can get their goods comfortably and safely without going to the shops. Compared to the pre-pandemic period, there was an increase of 40% (E15.cz, 2021).

Although the chemical industry has not been affected by the pandemic as significantly as some other industries, some chemical industry sectors have been affected more than others. For example, the oil industry faced the oversupply and low demand caused by a drop in transportation resulting from the anti-pandemic measures. Table 3 provides an overview of the industrial production in the given period.

Table 3. Year-on-year industrial production index (Czech Statistical Office, 2021c)

Indicator	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021
Industrial production index (%)	96.8	96.5	77.2	96.4	101.7	103.2	130.0	99.3
Chemical industry production index CZ-NACE C20	83.2	93.4	110.8	104.4	110.8	104.4	121.9	105.2
Automotive industry production index	94.3	93.5	53.9	98.4	109.9	108.9	178.9	76.3

A disadvantage of the chemical industry is the fact that it is not possible to simply stop manufacturing, which was the main reason for the excessive supply in the oil industry. An adverse situation has also affected sectors connected with the automotive industry and electrical engineering, which have suffered from manufacturing interruptions and the low demand (Accenture, 2020). In spite of this fact, most chemical companies did not intend to reduce their staff. Compared to the affected sectors, but also to the chemical industry before the arrival of the pandemic (Vlcek & Kostalova, 2020; Kostalova & Bednarikova, 2019), the situation was more favourable in the sector manufacturing medical supplies, particularly

disinfectants, medicaments, and protective aids that were important for coping with the coronavirus (Jandusova, 2021).

It would be interesting to analyze deeply the impact on different sectors of economy. The aim of this paper is to map the situation in the period of COVID-19 pandemic in the area of human resources in the Czech Republic, focusing on the chemical industry. It is the first part of the research in this area across the economic sectors.

2. Methodology

The primary research was based on the literature review involving professional publications dealing with the COVID-19 epidemic and also on a research into the web pages of the Czech Statistical Office and Labour Offices in individual regions according to the area of business.

The research was focused on the chemical industry, and it was conducted through electronic questionnaires in May 2021, i.e. at the end of the third wave of the pandemic. The electronic questionnaires were sent to seven companies belonging to AGROFERT, a.s. and ORLEN Unipetrol, a.s. holdings, CZ NACE C20, two the most important owners in Czech chemical industry sector. Six of the companies returned completed questionnaires, which makes a response rate of 85.7%. The companies requested research anonymity, and so the research evaluation information does not refer to the respective companies. In addition to the questionnaire survey, there was also a workshop on the given topic. This workshop was held in October 2021 and involved HR managers from chemical companies. Their opinions on the given topic are mentioned in the paper, too. Based on the first survey in this area there will be prepared extensive research in chemical industry and in other areas of business to compare the impact.

3. Results

The first part of the questionnaire was focussed on changes in the area of recruitment and selection of new employees. Only one of our respondents interrupted these activities for a short time. The other companies did not make any changes, and these activities were conducted continuously, even though in a modified way. Only one company ran all interviews online, three of them ran them online partially only, and two of them did not make any changes.

The question concerning staff reduction relating to the coronavirus crisis was replied identically by all the companies. They all declared that none of their employees were made redundant.

The support programme of Antivirus was used by for companies. Two of them also mentioned the particular type of programme they used. Two of them used Antivirus A and A Plus for partial coverage of the costs relating to isolation, not for solving partial unemployment.

The next part of the questionnaire dealt with hygienic measures introduced by the companies. We also wanted to know how this fact affected the corporate processes. Standard hygienic measures implemented by the companies mainly related to wearing face masks and respirators in the workplace and availability of disinfectants for all employees. Other

frequently implemented measures included a stricter regime or new rules in dining rooms (e.g. alternation of employees in dining rooms), testing of employees and external visitors, cancellation of training and mass events and introduction of home offices, which enabled alternation of employees in offices, and also reduced the number of people in an office. Two of the questioned companies had meetings through videoconferences only, limited employee recruitment, external visits, employee gathering, and limited the number of employees in shifts without threatening production. One company declared that implementation of these measures was very costly.

All the companies provided their employees with a home office. It was applied to the posts of accountants, IT specialists, sales representatives, purchasers, administrative workers, lawyers, dealers, auditors, economists, HR managers, and managers. As for the percentage of employees working from home, the companies replied differently: one company said that the number of employees using a home office cannot be specified. The others answered as follows: 4%, 10% (two companies), 15-20%, max. 50%. The researched companies applied a home office for different periods of time. Four companies introduced a home office in March 2020 and used it until May 2021. One company introduced a home office for some employees for the period from March 2020 until April 2021, but the company employees can still use this way of work on an individual basis. Another company declared that their employees had the possibility of working from home for the entire period of the state of emergency.

The research aimed to identify whether the coronavirus situation changed communication within the company, i.e. whether face-to-face communication declined and communication moved rather to the online environment. Face-to-face communication moved towards online communication in all the questioned companies. Five companies limited face-to-face communication partially. Only one company stopped communicating face to face completely and used solely online communication. Four companies intend to continue communicating online even after cancellation of the preventive measures. One of them expressed their intention to use online communication partially only (for example, for some trainings). The other two companies plan to return to face-to-face communication.

Utilization of online communication in training was confirmed in the round-table discussion by one of the HR managers. She stated that their company had transferred training to the online regime and that they were going to maintain this model in the future as well. They have made webinars for some trainings, e.g. OSH (Occupational Safety and Health). Their employees are obliged to watch the webinar and train themselves.

Limited face-to-face communication can result in mental problems in employees. This is why we wanted to know if the working environment and the employees' mental health had changed due to the limited face-to-face communication. One company declared that their employees' mental health rather had not changed. Mental health of the employees in the other five companies was rather affected by the limited interpersonal contact. Three of them stated that working from home is not suitable for everyone, and after a longer time spent in a home office, they were happy to be back in their working environment at the company.

The question about the sickness rate in the company relating to COVID-19 and about the number of people going into quarantine was answered as follows: one company stated that the number can only be estimated. In total, there had been about 160 employees tested positive for COVID-19, and 300-350 employees had been in quarantine, which makes about 1/3 of the company staff. The second company declared about 16%, and an employee had stayed at home in the case of suspected COVID-19 in the family until confirmation of the situation. The third company saw a year-on-year increase in the sickness rate of 1%. The pandemic did not bring a significant change in the number of absent employees. The fourth company stated that the sickness rate averaged 10.5% in the first quarter of 2021, while 273 persons went into quarantine (without COVID-19) in the entire period of the pandemic. The fifth company declared the sickness rate of about 4.5%, i.e. there was a year-on-year increase of about 1%. However, this cannot be specified precisely, as mainly the technical-economic staff did not take sick leave in the case of light symptoms, even if they were in quarantine, but they had a home office. The last researched company estimates about one hundred employees. The employee sickness rate affected labour force scheduling in four companies. Four of them suffered a lot, the other two less. The labour force scheduling in the last two companies stayed rather unaffected.

The research also paid attention to any potential changes in the demand for the products of the questioned companies. Their answers were balanced. The product demand grew in two companies, it stayed the same in the other two, and it went down in the last two. One company stated that the demand for fuels for travelling had decreased by 80% and the demand for the other products went down by 20%. We also wanted to know whether it was more difficult to distribute products abroad as a result of the implemented government measures. Two companies do not export their products abroad. Three companies found it more difficult to distribute their products internationally. One company even declared that it was significantly more complicated. Product distribution was not more difficult during the epidemic for one company only.

4. Discussion

The research shows that most of the questioned companies from the Czech chemical industry did not have to dramatically change the care of employees and the way of personnel work. The impact was mainly related to the reduction of interpersonal contacts. The measures strengthened the work in the form of home-office, video calls and meetings, recruitment of new employees, training, sales and communication in general to a virtual environment. When comparing positive and negative impacts, the negative ones prevail. In addition, many of these measures had other consequences, such as psychological impact in the form of greater uncertainty, frequent changes, loneliness due less contacts. It is a question of how measures that could be used by only part of the employees (e.g. home-office was used only by a limited number of employees according to their activities) strengthened or caused conflict or dissatisfaction of employees who could not use similar changes due to their type of work. The companies faced shortfalls in the number of employees due to increased

morbidity and quarantine, while these changes limited them, but did not stop their production. The question is to what extent these changes were temporary and to what extent they brought a long-term change to personnel work. The possible incorporation of these changes into long-term practice could indicate the positive impact of these measures, signaling that some of the changes have worked well, bring more efficient operation, reduce costs and suit both to the companies, and to their employees. It can be expected that the positive effect was a significant shift in the use of digital technologies in communication, data sharing, e-learning etc. Further expansion of research in this area would provide answers to these and many other questions, it would be beneficial to expand research to other economic sectors and comparing the change in the longer term after the end of the pandemic.

5. Conclusions

The arrival of the coronavirus pandemic had significant impacts on the labour market and the way of personal work. Most of impacts were negative, but it was also possible to identify some positive ones. A positive impact can be seen in acceleration of digitalization, as companies had to adapt quickly to the imposed preventive measures reducing interpersonal contact. They also took advantage of the possibility of working from home for employees whose job description allowed it. The preventive measures included limited travelling abroad and reduction or interruption of business activities in some industries. The most adversely affected industries were tourism and gastronomy, where companies had to dismiss some staff, but e.g. the automotive industry also faced some negative impacts. The government issued a support programme called Antivirus, which aimed to mitigate the coronavirus pandemic impacts and to slow down the growth of unemployment. On the other hand, negative impacts were not so extensive in the area of the chemical industry. It was not necessary, with a few exceptions, to reduce production. However, the chemical industry also used the government support programmes. Chemical companies had to cope with higher demands placed on hygienic measures, increased sickness absence rates, it was necessary to adapt the work environment, change the working method in some groups of workers to a home office, and to introduce new forms of communication with job applicants within recruitment or within employee training.

Conflict of interest: none

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Implementation of Industry 4.0 in Czech Food Enterprises: Motivation and Barriers

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Abstract: The current trend of digitization across companies, namely the Industry 4.0 concept, brings a number of challenges but also promises of future benefits resulting from its implementation. The aim of the paper is to analyze and evaluate the motivation of enterprises for the implementation of Industry 4.0 and similarly, to evaluate the barriers to its implementation. The subjects of the survey represent enterprises in the food industry in the Czech Republic. The results showed the main motivations and barriers to the implementation of Industry 4.0 across food enterprises in the Czech Republic. Correlation analysis expanded the results by the possible influence of the size of the enterprise. An important finding also was that environmental and social factors do not play a significant role in the context of motivation and barriers to the implementation of Industry 4.0.

Keywords: industry 4.0; food enterprises; motivation; barriers

JEL Classification: M10; M15

1. Introduction

The significance of the Industry 4.0 concept is described by Philbeck and Davis (2018) who state that technological change is a driver of transformation relevant to all industries and parts of society. Thus, it can be said that the motivations for implementation go far beyond, for example, the goal of increasing efficiency. Other motivations and barriers can thus be influenced, for example, by environmental and social factors, which are represented by the Sustainable development concept as defined in 1987, which is based on a balance of three pillars – environmental, social and economic (World Commission on Environment and Development, 1987).

Reduction of raw material and energy intensity, optimization of logistics routes, increase in productivity in production or decentralized systems for energy distribution are the benefits of implementing Industry 4.0 regarding the efficient use of resources. Fully automated production processes offer the production of even small production batches, which can then reflect the changing demand for production. The efficiency of the production factor of labor will be intensive due to increased labor productivity, reflecting the continuous development of technology and implementing existing resources in complex solutions and promoting their stability (Mařík, 2016).

1.1. Motivation to Implement Industry 4.0

Industry 4.0 as a trend and concept represents very often the subject of empirical research. It is especially important to answer following two questions: what are the motivations for its implementation? What are the barriers to the process? As stated by Bravi and Murmura (2021), it depends mainly on the maturity level of the company whether the benefits of implementation outweigh the associated costs. Just as there is no single valid Industry 4.0 model that is universal for all businesses, there are different motivations for the implementation. Based on the research of these authors, which was conducted in the Italian environment of SMEs, it can be said that the main motivations for the implementation of Industry 4.0 include increasing competitiveness, simplifying internal procedures and the pressure exerted by consumers. Lower weight was given by companies to time saving in the production process and environmental protection.

Lin et al. (2019) present in the Chinese example other major motivations that may be behind the implementation of Industry 4.0 across companies. Improvements in the company's financial performance, innovation activities and return of stocks can be achieved. In addition, a positive impact on the level of information transparency of the company can be noted. Another research among SMEs within the UK is Masooda and Sonntag (2020) which lists as possible benefits, i.e. the motivation for the adoption of Industry 4.0 technologies, improving flexibility, cost efficiency, quality and competitive advantage.

The last and at the same time very important motivation for companies is to remain competitive in the context of other companies on the market in this digital era (e.g. Genest & Gamache, 2020). Turkyilmaz et al. (2021) further state that the industry is expected to improve flexibility, productivity and sustainability. Another impact in a broader sense is also the further development of the knowledge-based economy which is associated with a positive impact on society.

The readiness of enterprises for the implementation of Industry 4.0 can be assessed from many perspectives, for example, regarding the product offered (Gurjanov et al., 2018), the level of digitalization (Xu & Duan, 2019), the technology used (Dalenogare et al., 2018), the management system (Trstenjak & Cosic, 2017), the environment (Bolisani & Bratianu, 2018), the culture or the employees (Gunasekaran et al., 2019). The above-mentioned authors often state that the digitalization of business processes is a necessary condition and a key area regarding the implementation of Industry 4.0.

1.2. Industry 4.0 and its Relation to Sustainable Development

Although it is possible to say from empirical results that environmental motivations and benefits are often lagging behind, sustainable development (World Commission on Environment and Development, 1987) and the Industry 4.0 concept are interrelated and this link cannot be ignored. Furstenau et al. (2020) state that the number of studies related to Industry 4.0 and sustainability is growing significantly. The strong relationship between the concepts is confirmed and characterizes sustainability as one of the pillars of intelligent manufacturing. An important finding is that scientific efforts are primarily aimed at strengthening both the economic and environmental spheres, but there is a shortage in the

third pillar of sustainability – the social one. Based on their results, Bai et al. (2020) recommend the adoption of mobile technology, as it has an impact on sustainability in all industries. They also found that nanotechnology, mobile technology, simulation and drones have the highest impact on sustainability in the following areas: automotive, electronics, food and textiles. However, it is important to thoroughly analyze such an investment in the context of the industry before the implementation. Müller et al. (2018) focused on opportunities and challenges that precede the actual process of implementing Industry 4.0 on a sample of German companies. The results show that strategic, operational, environmental and social opportunities are positive drivers of implementation. On the other hand, challenges related to competitiveness, future viability and a satisfactory organizational and production level hinder the progress, which is a surprising finding that can also be considered as important. The authors further state that various specific characteristics of the examined companies are also important.

1.3. Barriers to Implementing Industry 4.0

Another area with which the Industry 4.0 implementation process is connected is the definition of barriers. Türkeş et al. (2019) state in their research among SMEs in Romania that the managers of these companies agree in particular that the main barriers and future challenges for the implementation process are: lack of knowledge about Industry 4.0 and understanding of the strategic importance of Industry 4.0, more focus on operation at the costs of developing the company, few human resources, the need for continuous education of employees and the lack of standards. Majumdar et al. (2021) present barriers in the Indian clothing industry: lack of trained staff, commitment to top management and government support. The authors also found the area of research and development to be insufficient. Kumar et al. (2020) divided the challenges into two categories: cause and effect. They identified the lack of motivation from original equipment manufacturers and customers as the main challenge or barrier in the "cause" category. In the second category "effect" was found to be the biggest challenge the fear of Industry 4.0 technologies in the context of sustainability.

It is also important to define the factors that can affect the whole implementation process. Jayashree et al. (2021) state that top management and IT infrastructure have the most significant impact on the implementation of Industry 4.0 and the overall trend towards sustainability. On the contrary, supply chain integration represents an insignificant factor among SMEs. It is also possible to conclude from other results that SMEs with high levels of process automation and high product variety have a much easier process of implementation of Industry 4.0, as stated in Yu and Schweisfurth (2020).

2. Methodology

The aim of the paper is to analyze and evaluate the motivation of enterprises for the implementation of Industry 4.0 and similarly to evaluate the barriers to implementation. The source of data represents a survey conducted among enterprises in the food industry in the Czech Republic. The research was carried out at the beginning of 2021 and the data was

collected from 102 enterprises using an online questionnaire survey. The chosen barriers and reasons for implementing Industry 4.0 were selected based on a research that addresses the issue (Kamble et al., 2018; Muller et al., 2018; Raj et al., 2020; Turkes et al., 2019). A questionnaire consisting of more than twenty questions was developed for the research using closed, dichotomous and scaled question types. Prior to the research, the questionnaire was consulted with several managers representing exclusively manufacturing companies. In view of the focus of the research, only enterprises belonging to category C, namely enterprises of division 10 of the CZ-NACE classification, were contacted. Division 10 consists of these subgroups: Manufacture of dairy products, Production of mill and starch products, Manufacture of other food products, Manufacture of bakery and farinaceous products, Production of industrial feed, Production of vegetable and animal oils and fats, Processing and preserving of meat and production of meat products, Processing and preserving of fruit and vegetables, Processing and preserving of fish, crustaceans, and molluscs.

To evaluate the data, descriptive statistics as well as Pearson correlation are used, where H0: $r = 0$ and Ha $r \neq 0$. Hypotheses were established as the size of the company and the specific reason for implementation are independent variables. Similarly, the second hypothesis - the size of the company and the specific barriers to implementation are independent variables. One of the objectives of the data collection was to represent the enterprises in the sample as accurately as possible with respect to the real representation of enterprises in the Czech Republic. The research as well as this paper is not limited to SMEs, as according to Acosta et al. (2016); Traill & Meulenberg, (2002), large enterprises are often the ones that innovate first.

3. Results

The research, described in more detail in the methodology section of this paper, was focused on food enterprises in the Czech Republic. The food industry is a key and historically important sector of the Czech industry. The Czech Republic, similarly to the European Union countries, does not suffer from food shortages and thanks to support programs, production reaches a relatively high level. As already described earlier in the methodology section of the paper, one of the objectives of the data collection was to make the representation of enterprises as accurate as possible with regard to the actual representation of firms in the food industry. According to the CZ-NACE categorization, the food industry belongs to Division 10 with a total of nine subgroups. Figure 1 shows the percentage of enterprises in Division 10 according to the CZ-NACE methodology in the Czech Republic and the representation of enterprises in the survey. A total of 102 enterprises participated in the survey, with large enterprises represented by a total number of 21 enterprises, small and medium-sized enterprises (SMEs) by 78 and finally, micro enterprises by 3 representatives.
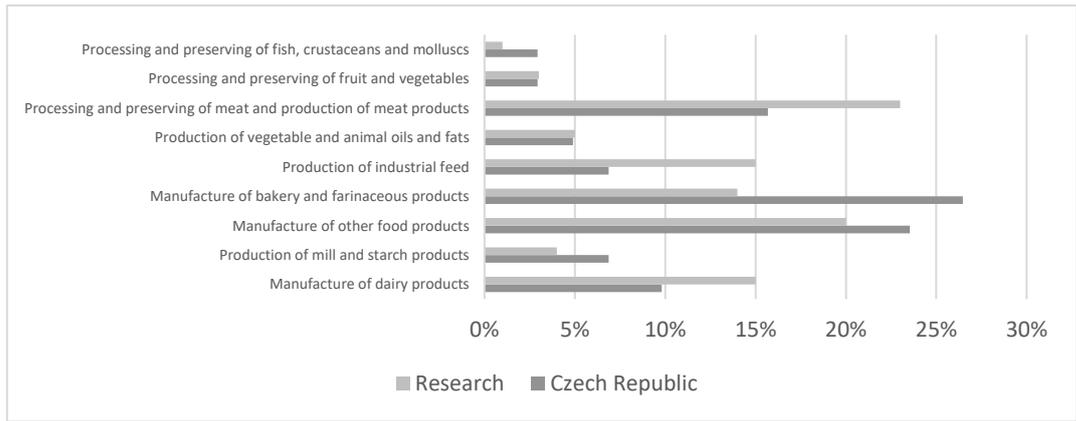
Figure 1. Representation of enterprises in section 10 CZ_NACE in the Czech Republic and own research

The chart shows that the largest difference between the actual market representation and the survey can be observed in the subcategory Manufacture of bakery, confectionery, and other flour products and also in the category Processing and preserving of meat and manufacture of meat products. One of the questions in the survey asked respondents whether they have set key performance indicators (KPIs) as part of their strategies. It turned out that more than 72% of companies do not have KPIs set for the implementation of Industry 4.0. At the same time, in the area of readiness, 26 enterprises reported that implementing Industry 4.0 is part of their corporate strategy. Enterprises were also asked whether they export their own production outside the country. A total of 83% of the enterprises involved in the research export their products abroad.

The literature review provided a brief introduction regarding the reasons – the motivation for the implementation of Industry 4.0. The research itself assesses the readiness of companies to implement the new industrial revolution and the reasons for implementation are also part of the research. The methodology of the paper describes how the different reasons for implementation were selected, which are as follows: competitiveness and market growth, environmental and social benefits, emergence of new business models, higher added value and cost savings. The distribution of data regarding the reasons for implementation is shown in Figure 2.
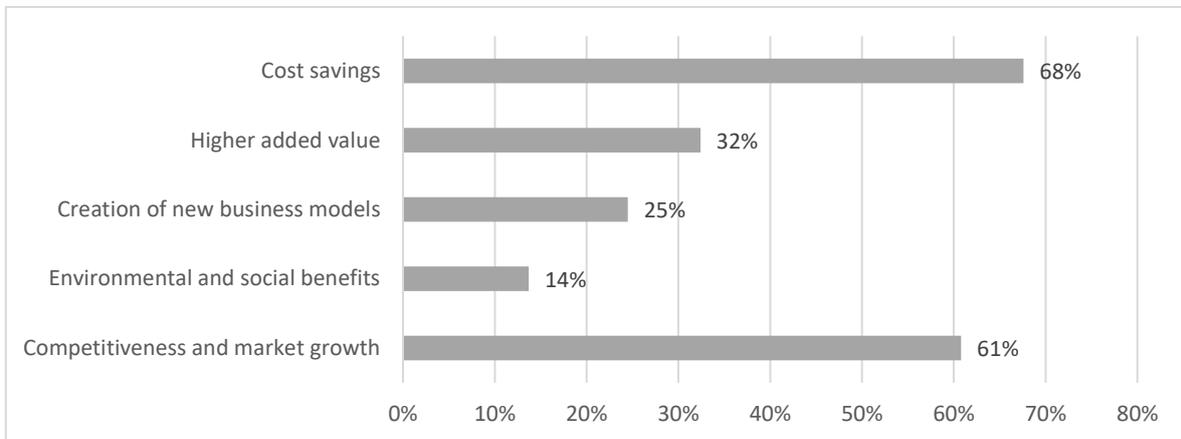
Figure 2. Reasons for implementation – data layout, multiple answers

The chart shows that the most important reasons for implementation are cost savings and competitiveness. This is followed by reasons for implementation such as higher added value, creation of new business models and environmental benefits. Interestingly, a relatively low proportion of businesses (25%) mentioned the creation of new business models as a reason for implementation, as digital transformation is changing the way businesses create value. Social media are changing the way businesses interact with customers and big data is not only being used for customer relationship management but also specifically for emerging data-driven models. The question arises whether the businesses involved in the research differ in some way regarding the different reasons for implementing Industry 4.0. The Pearson X2 test was used to evaluate the relationship between the size of the enterprise, expressed in terms of number of employees and the specific reasons for implementation, with the hypotheses for Pearson correlation set as H0 = 0 and Ha ≠ 0. Table 1 shows the results.

Table 1. The Pearson X2 test – company size – motivation

Employees	Competitiveness	Environmental and social benefits	Business models	Higher added value	Cost savings
Pearson	0.034	0.146	0.376	-0.006	-0.001
Sig.	0.737	0.143	0.000	0.954	0.995
N	102	102	102	102	102

At the significance level $\alpha = 0.05$, we were able to reject the null hypothesis only for the reason of implementation of the emergence of new business models, and thus we speak of a medium strong positive correlation according to Ratner (2009). The second area examined was barriers to the implementation of Industry 4.0, i.e., in general, any obstacles that stand in the way of companies to implement the Industry 4.0 concept. Figure 3 presents the distribution of data in the case of barriers to implementation.
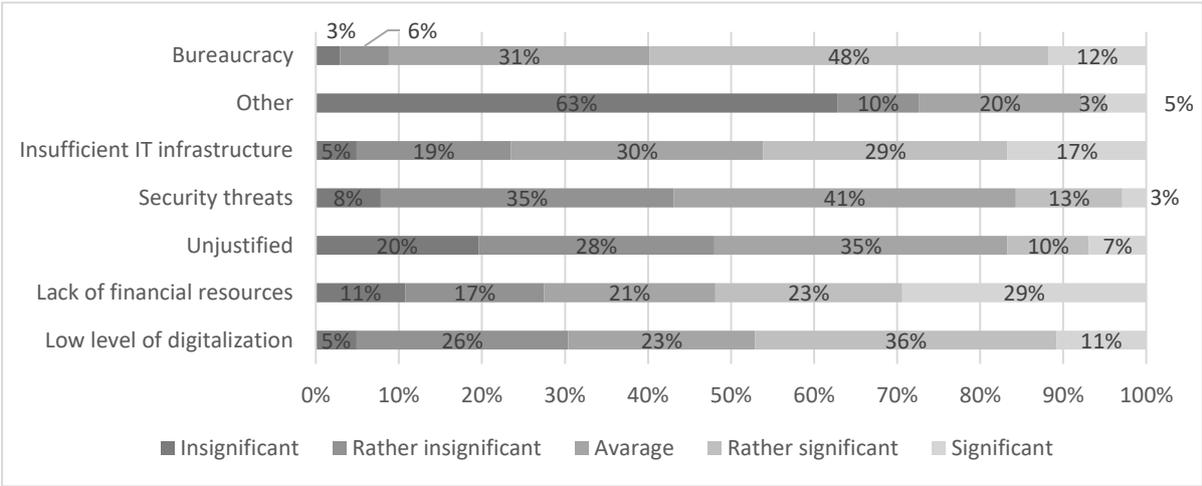
Figure 3. Barriers to implementation – data layout, scale question

The chart shows that more than 50% of businesses identified lack of financial resources as a significant or rather significant barrier. The variables of low level of digitalization, insufficient IT infrastructure and bureaucracy have high values in the range of rather

significant – significant. The barrier to implementation called "Other" was identified as not significant by more than 60 enterprises. Two possible interpretations are offered here. The first suggests that the other barriers considered by enterprises are insignificant and the second that enterprises have not encountered other barriers. Similarly to the individual reasons for implementing Industry 4.0, the barriers to implementation were statistically evaluated with respect to the size of enterprises expressed in terms of number of employees. Again, the Pearson X2 test was used, with the hypotheses in the case of Pearson correlation set as H0 = 0 and Ha ≠ 0. The results are shown in Table 2, with significant results marked with * for clarity.

Table 1. The Pearson X2 test – company size – barriers

Employees	Low level of digitalization	Lack of financial resources	Security threats	Insufficient IT infrastructure	Bureaucracy	Other	Unjustified
Pearson	-0.288*	-0.444*	0.059	-0.335*	-0.087	-0.070	-0.315*
Sig.	0.004	0.000	0.556	0.001	0.387	0.428	0.001
N.	102	102	102	102	102	102	102

Based on the available data and the chosen significance level of α = 0.05, the null hypothesis was rejected in favor of the alternative hypothesis, thus demonstrating a relationship between the number of employees for the variables: low level of digitalization, lack of financial resources, inadequate IT infrastructure and unjustified. In all these cases, there is a moderately strong negative correlation.

4. Conclusion

The aim of the paper was to analyze and evaluate the motivation of companies to implement Industry 4.0 principles and to evaluate the obstacles that stand in the way of successful implementation of the modern industrial revolution. The literature review provides the theoretical basis of the paper, characterizes the barriers to implementation, the most common reasons and highlights the importance of sustainability in relation to Industry 4.0. The research is described in detail in the methodology section of the paper.

The introduction of the research part consists of a characterization of the obtained data, especially regarding the individual components of Section 10 according to the CZ-NACE methodology. The research has shown that the most important reasons or aspiration of enterprises to implement Industry 4.0 is cost saving and competitiveness. Similar conclusions have been reached by several other researches that focus on the adoption of Industry 4.0 (Hofmann & Rüsch, 2017; Masood & Sonntag, 2020; Müller et al., 2018). The dependence between the number of employees and the given reasons or motivations for implementation has been shown only for the reason "creation of new business models". A possible reason for this is that Digital Transformation does not directly lead to improved business performance as it requires companies to change their business models in the first place (Bouwman et al., 2019). King and Grobbelaar (2020) state that Industry 4.0 creates the conditions for business model innovation, and it is inevitable that in times of rapid change, business models as well as business tools need to be rethought. Furthermore, they also mention that the use of new

business models leads to the acquisition of key resources in the development of new products, for example in the form of outsourced workers called crowd sourcing which is used instead of hiring professional employees. One of the main challenges of emerging business models is to create new value propositions that ultimately improve the customer experience. The second part of the research focused on selected barriers to the implementation of Industry 4.0. The barriers identified by respondents as significant are: low level of digitalization, insufficient IT infrastructure as well as bureaucracy. Similarly to the reasons for implementing Industry 4.0, the barriers were statistically tested with respect to the size of the company. For the barriers that were identified as significant after the evaluation, a negative correlation was confirmed in all cases at the selected significance level. It can therefore be concluded that the larger the enterprise is – the more employees it has, the less it encounters following barriers: low degree of digitalization, lack of financial resources, insufficient IT infrastructure and the unjustification of the whole concept.

It is also important to emphasize that although a number of authors (Furstenau et al., 2020; Bai et al., 2020; Müller et al., 2018) state that environmental considerations are an important factor that can influence the motivation of companies to implement the Industry 4.0 concept, this relationship cannot be confirmed based on the results of the correlation analysis.

The paper is not exhaustive in its scope. Given the period that elapsed between the acquisition of data and the presentation of partial results in this paper, it is rather a pilot output of a comprehensive research. The period in which the data were collected certainly represents a limitation. During the global pandemic, the food industry was also affected by production cutbacks, supplier outages and employee absenteeism. Innovation projects are clearly the first to be curtailed in times of crisis.

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Analysis of Marketing Communication Tools and Brand Building of Family Business in Terms of International Environment – Case Study

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Abstract: Building a corporate brand in an international environment is currently an opportunity for companies to reach out to new customers and increase brand awareness across the national markets. Therefore, in order for a company to become well-known and successful, it needs to constantly build its brand in order to make it stand out from competing products and to strengthen its position in the eyes of the customer. These are precisely the factors that very often influence and support enterprises with the help of individual marketing communication tools. The case study thus focuses on analysing the communication mixes of a selected Czech family brand operating on both the domestic and foreign markets. The result part focuses on the individual differences and characteristics of the cultural differences inherent in the various communication tools and the corporate strategy. The results part also include comparison of the individual communication mixes and their costs. The last part of the case study focuses on deriving conclusions that could help other companies if they were to internationalize.

1. Introduction

Globalization has enabled the rapid development of international business in the scope of just a few years, both in terms of manufacturing and in the service sector (Machková, 2021). It is factors such as the development of international trade, the free movement of capital and the development of modern communication and electronic technologies, which, coupled with other factors, have become the driving force behind the development of international business brands and have thus increased competition in the international markets (Machková, 2021; Birsan, 2018; Muis, 2020). As stated by Surugiu C. and Surugiu R. (2015), globalization not only affects the development of companies themselves, but also gives firms space to make the most of market opportunities with regard to the size and potential of the companies themselves.

A family business brand is a kind of bridge between a company, a manufacturer, a retailer and a consumer or customer (Podnikatel.cz, 2021). According to the American Marketing Association (2021), a brand is a name, a concept, a design, a symbol, or a combination of all these, which allows consumers or customers to differentiate between that company's product and those of its competitors. As indicated above, in the international

environment the brand is then affected by several different factors. According to Samiee et. al. (2021), one of the most important factors is the intense and fierce competition in the international market and the heterogeneity of the behaviour of customers with cultural differences. Fann and Zhou (2020) point out that, given this situation, it is appropriate to adapt language and culture, which may subsequently be beneficial in building the branding and, in the long run, may reduce overall expenditure on traditional communication media. The marketing communication also influence other factors such as brand preferences, brand image etc. (Ebrahim et al., 2016; Schultz et al., 2013). That is why the international marketer must deal with brand communication differences in foreign environments from the characteristics of domestic environments.

This idea, coupled with the limited number of scientific or practical articles comparing communication activities within two different markets, prompted the creation of this case study, which may therefore expand the available resources relating to this topic and at the same time could offer an imaginary point of reference for new areas of research or analysis.

2. Methodology

This case study was created in collaboration with the company's owner, between September 2018 and April 2019. Various data collection methods were used when writing the study. These methods include in-depth interviews with the company's owner and individual employees focusing on this topic within the company. In addition, the company's internal (unpublishable) resources, annual reports and internal databases were used when preparing the case study. Last but not least, methods of observation were also used to collect data, thanks to collaboration between the author and the company itself. Observation was used not only for practical participation at certain business meetings and other activities involving representatives of German partners, but also in the analysis of online marketing tools. Overall, this case study aims to find answers for the following research questions:

1) Which communication tools used the company on the domestic market between September 2018 and April 2019?
2) Which communication tools used the company on the German market between September 2018 and April 2019?
3) What are the main differences between both communication mixes?

2.1. Presentation of the Company

This case study presents an analysis of the communication tools used by HOKAMI CZ on the Czech and German markets. HOKAMI CZ, s. r. o. has been operating on the market since 1991, although this family company has officially existed since it was first established by its entry into the Commercial Register on September 3, 1997. The company, currently headed by Ing. Josef Suska, employs approximately 300 people in the Czech Republic and Poland. The brand's main scope of business is the provision of the full range of services related to the production of printed circuit boards. These individual activities may therefore include the provision of screen printing templates for surface-mount technology (SMT), the production and mounting of printed circuit boards, soldering, cleaning, testing, painting

and assembly. Given its extensive investments and flexibility, after receiving the customer documentation HOKAMI CZ, s. r. o. is able to supply all the required products which are used today in satellites, aircraft, cars, medical devices, industrial machinery, military technology, etc. Thanks to its production capacity of 100 million SMD components and 6 million THT components per month, the company is able to meet demand both in this country and in the markets abroad, where it exports more than 85% of all its products. This fact, as well as its possession of various certificates and ratings (Quality Management System according to ČSN EN ISO 9001: 2016, D&B rating: 1A1 etc.), allows the company to achieve a relatively good turnover. At the turn of 2018-2019 this turnover amounted to almost 1 billion Czech crowns.

3. Results

3.1. Marketing Communication Used within the CR

The communication tools used by the company during the period in question include personal sales, public relations, sales support and online marketing. For such a specific company and its customer base elements such as advertising and direct marketing did not provide as much information in 2018 as the tools listed below, and therefore the company did not use them during that time.

3.1.1. Personal Sales

Of all the elements in HOKAMI CZ's communication mix, personal sales can be described as the most important tool for most of its business and non-business relations. Owing to the nature of the product and the specific nature of the business environment, it is almost essential to visit customers on a regular basis and strengthen mutual relations between individual brands. Above all, the company sees foreign relations as being especially important, as these make up the majority of all the products and services it sells. According to the CEO of HOKAMI CZ, building and reciprocating mutual trust are essential in order to create and maintain any relationship.

The company still has a great many customers, which allows it to increase its turnover, and compared to its Czech and foreign competitors it has a 5-year lead in production, technology and possesses several patented trademarks. Therefore, within the domestic market the company does not focus so much on reaching out to new customers and is rather contacted by them. In response to an inquiry from a customer, the company is motivated to create a range of products and services. It should also be mentioned that the offer of these products and services differs from customer to customer and the actual course of personal sales also varies.

Personal sales can be used effectively if there is the need to explain the features and nature of the products or services on offer. At the same time, during face-to-face negotiations, the company's representatives are able to respond to the suggestions and reactions of customer representatives. The company usually prefers to hold personal meetings in its own premises, where, before or after the meeting itself, management

representatives can give the customer a tour of production and the company's other departments. These tours can give the customer a better understanding of how the product is manufactured and provide a greater insight into the company's corporate culture. If the company's representatives are invited to a place other than the company's premises, samples, examples of products and supporting documentation containing, for example, product parameters, etc., can be of assistance.

3.1.2. Sales Support

In the domestic market the business uses a few sales support tools, which focus on boosting immediate sales, but also on raising awareness of the brand. Various promotional gifts are used to strengthen the company's brand, such as pens and bags, which bear the company's logo and name. What is more, the company has thicker paper binders for papers, contracts and other documents, which are always given to the customer along with these gift items during negotiations. However, these gift items (bags, T-shirts etc.) are not always used for commerce; they are also used as sponsorship gifts at various events in Liberec region.

During negotiations with the customer, internal documents are also used, which are always produced or modified at the customer's request. These include, for instance, documents describing the technical specifications of individual parts, their prices, draft designs, etc. This documentation is generally one of the most important means of sales support and is often decisive in closing the deal. It is therefore essential that this documentation be processed in a professionally comprehensible form and with interesting graphic design.

3.1.3. Public Relations, Sponsoring and Event Marketing

These marketing communication tools are the second most commonly used set of tools after personal sales. The individual activities within the company will always be explained according to the impact that PR activities have on target groups.

One of the most important tools within the company is internal communication, especially email. This type of communication is a fast and generally reliable means of passing on various levels of information within the company's entire organisational structure. The company's management has also opted to create a corporate magazine. This magazine should provide employees with information about the company's achievements during previous years, its plans for the future, competitions and crossword puzzles for prizes, surveys, and, most of all, should present internal communications that cannot or should not be disclosed publicly. As the company's management holds its staff in high esteem, employees receive bonuses throughout the year. One example of this is the annual presentation of flowers to all the company's female employees on International Women's Day. During the year, various training sessions, surprises and events are prepared for all the staff. As part of their work, employees also have other means of obtaining benefits, such as in the café or the dental surgery that the company has helped to fund.

In the eyes of other stakeholders, HOKAMI CZ strives to present itself as a socially responsible company. Therefore, over the years, it has invested a great deal of money in

setting up a local organic farm, which is situated just a few metres away from the company. As mentioned above, the company also invested its funds in a nearby café and dental surgery, run by one of the children of the company's family management. Both these establishments are open to employees as well as to the general public. The company is thriving not only in terms of its local investments, but also wins various awards in business rankings and competitions. The awards the company has received include, for example, the 2018 Liberec Region Czech Leader award and the Vodafone Company of the Year award in 2016. Thanks to these awards and references from other entrepreneurs the company has attracted the interest of several journals, newspapers, prestigious magazines etc. These include, for instance, the weekly Ekonom and Hospodářské noviny. Over the years, the company has also become a long-standing major sponsor of the Czech Tennis Championship and a supporter of youth hockey.

3.1.4. Online Marketing

Online marketing is a relatively new and unexplored tool for the company, although it sees an opportunity for its use in the future. The company sees the main benefit of online marketing to be the fact that it makes it easy to communicate its message online, quickly and at low or zero cost, enabling it to reach selected customer segments or other stakeholders.

The company now has its own website, which acts as a kind of cornerstone for the enterprise and its customers. For the company, this is one of the first and also longer-standing tools that it has started to use for its online communication. Initially, the site provided only the most basic information, with no graphics or content. Of course, as the company developed, along with the technologies themselves, the site began to take the shape that can be found today at www.hokami.cz. The overall concept of the website today is based on simplicity and clarity. The company's main goal for this website is currently to add more content and link the site with other online communication tools. Therefore, the site is now constantly updated, with new elements being gradually inserted and added (pictures, videos, corporate news etc.), which could not previously be found on the site.

In the past, the company has faced the problem of staff shortages, so it has begun to seek new ways to attract and reach out to potential job applicants. This is where social media have come into play, in this case offering a relatively cheap and fast alternative means of getting new people to join the company's ranks. These social networks have mainly been Facebook and Youtube.

In 2018 the Facebook account "Work at Hokami CZ" was followed by 134 people and had 128 "likes". As mentioned earlier, the initial aim was to spread awareness and information about the existence of the brand amongst potential applicants. The content of the Facebook account therefore focused on what it is like to work at HOKAMI, on various work-related bonuses and benefits, and actual job vacancies. The content has now been modified slightly, so as to appeal to a much larger audience. The wall now features topics such as the company's achievements, while information affecting the company's CSR is shared and the brand itself is strengthened in the eyes of staff as well as the general public.

In order to promote the company and make it more appealing, several short videos have been shot, which can be found in the videos section on Facebook, as well as on the YouTube channel "Hokami CZ". The YouTube channel is the latest element in the company's online communication mix. In 2018 the YouTube channel had just 2 subscribers and 2 videos. The average number of views for the videos was 223 in in 2018.

3.2. Marketing Communication Used in the Selected Foreign Market

3.2.1. Personal Sales on the German Market

In both the local and foreign markets, personal sales are one of the means enabling the company to gain new customers. The position the company holds in the Czech market can also be transferred to the international environment, primarily due to the specific nature of the products and services it offers and the relative scarcity of competitive companies with the corresponding technology.

The biggest difference here can be seen in the company's management style and the individual personal meetings, which are always held in a different market. As these meetings are mostly held abroad, more funds need to be spent on sending sales representatives on business trips to present the company on the German market. The increasing volume of funds entails more complex and far more important requirements for the preparation of business negotiations, which are affected primarily by the customs and culture that prevail in the German market. The cultural differences identified through corporate practice include, for example, the need for perfect grammar during negotiations, as well as punctuality and accuracy. When contacting a German customer for the first time, the company prefers to communicate in writing, where great emphasis is placed on the German language, grammar and editing the message to ensure that it is free of errors. The company's sales representatives are sent to meetings one or two days in advance, precisely in order to avoid delays or the eventual cancellation of the scheduled meeting. According to the company, one of the most critical factors is punctuality, when failure to meet the set times or deadlines for a meeting may result in the German customer classifying the firm as an inferior company or breaking contact with it altogether. In most cases, the content of a personal meeting is specified before the company staff arrive. This enables the structures and agendas of meetings to be dealt with, drafted and approved in advance, including the stated starting and ending times. If everything goes well and both parties arrive at the meeting, there are first a few words of welcome, during which the parties always shake hands, after which they get down to the agenda of the meeting fairly quickly. This could be described as directness, which is also one of the characteristic traits of German customers. During the meeting itself it is important to be prepared, otherwise in most cases the German party brings the negotiations to an end and ceases to do further business with the company. During the course of the meeting, it is essential to provide truthful information and to support all important information with graphs, tables, etc., and it is obviously necessary to distinguish important information from what is unimportant, and to address the participants by their full name, including any titles, unless stated otherwise. Last but not

least, it is essential to mention that German customers are very particular about compliance with obligations in a business relationship and also dislike uncertainty.

However, the business process does not end upon the conclusion of the personal meeting; on the contrary, this sees the start of another important phase for the company, and that is meeting the customer's wishes and needs. During and after the entire business process, the company provides its German clients with complete customer support, with the ability to communicate any of the customer's requirements and wishes 24 hours a day, 7 days a week.

3.2.2. Sales Support on the German Market

Almost all the support tools used on the German market are based on the basic concept applicable to these elements within the domestic market. As a rule, the design and image of these tools are also the same, but some tools are modified so to be more informative for the German customer. Obviously, items such as pens and bags, etc., do not require any modification. This category of non-localized tools can include promotional gifts bearing the company logo, samples and demonstration models, or small presentation forms. One special tool that can be included in this group is business cards, which from the beginning have been designed for both the domestic and the foreign market. Business cards play a crucial irreplaceable role at international business meetings, where the exchange of business cards is a way of presenting the company, and above all business cards provide the manufacturer and the customer with one another's contact information and help build the company's brand.

The second group in the company comprises what are known as localized sales support tools (print catalogues, price lists and leaflets etc.), which in most cases are characterized by the fact that they bear far more important, more specialised and possibly specific information, enabling sales representatives to exert a positive influence on the German customer's decision-making process. The company also creates presentations and various internal documents, which are always prepared for each customer on an individual basis. This is always due to the fact that each customer has different product requirements, together with the specificity of the services used. Some of these localized tools are used in foreign negotiations, as well as in company presentations abroad. As these tools are localized, the company needs to invest more funds in production itself; it is more time consuming to create and modify the actual tools that would suit the customary practices on the German market. However, the most important factor for the success of these tools is the linguistic quality of the text, and the accuracy and comprehensibility of the message communicated to the German customer.

3.2.3. PR on the German Market

The company's PR activities on the German market are amongst the most high-profile tools in its international marketing mix. What is important within the German market is to work to build the company's reputation and, above all, to maintain its position as a credible foreign entity, one with which German companies will not be afraid to do business. As this is

an international environment, the company is forced to invest a large amount of funds in PR activities and the company's managerial staff also strive to use tools that the company does not use so often to address customers in the domestic market.

One very important element of these tools is the company's participation at German trade fairs. Since 2014 it has become a tradition for the company to attend the international Electronica trade fair, which was held every year until 2018 in Munich. It should be noted at this point that this was before the Covid-19 pandemic. Trade fairs are a great opportunity for the company to present its activities abroad and enable it to forge better relationships with foreign customers and potential cooperating partners. At the same time, by attending trade fairs, the company can gain a better picture of where it stands in relation to the international competition and get a look at or discover new production technologies and processes that are on show at trade fairs. Trade fairs often include professional talks, which, as they are given by experts, are often a source of know-how for the company, helping it work with future trends and future developments in this branch of industry. According to the company's management, these exhibitions and fairs can be thought of as a ticket to a foreign market, which can often also be the most important source of information for the customers themselves. HOKAMI CZ has therefore put together a team responsible for presenting the company and its business activities to German customers and in charge of preparing, presenting and building brand awareness at these trade fairs.

Its other PR activities within the German market include, as in the domestic market, support for the people affected by the flooding in the Zittau region. Being a socially responsible company, the company strives to develop and assist with the activities of smaller business entities within the Tripoint region. This region comprises the border territory between Germany, Poland and the Czech Republic. Last year the company invested funds to support local bio-farms and small businesses in this area. Within the German market, the company has already succeeded in gaining a reputation as a trustworthy brand for German companies, mainly due to the WOM between customers and other media.

3.2.4. Online Marketing on the German Market

Online marketing communication on the German market is subject to the same conditions as on the Czech market. However, at the international level, in terms of visitor numbers, the company's home page is at the forefront of its marketing, visited by 5 times more foreign customers than domestic ones on average. As a result, emphasis is placed on the localization of these pages into English and German. The biggest difference between the Czech and foreign language versions lies in the fact that the company is far more active in adding Czech content than it is with the foreign language versions.

In addition, German customers have the opportunity to visit other media on which the company presents itself from foreign markets, especially social media, which in international terms includes the company's Facebook, LinkedIn, and YouTube accounts. In the international context, Facebook and YouTube face the same problem as the aforementioned foreign language versions of the website. The vast majority of all the messages it communicates are in Czech, although this does not give German customers a

deeper insight into what happens in the company. The customer is thus entirely dependent on the visual aspects of the company's presentation on social media, namely images and videos, which are sometimes accompanied by short foreign language captions.

The LinkedIn profile HOKAMI CZ, s.r.o. is big news on this social network. The company's profile currently has 182 followers and its presentation on this social network is in English. The "ABOUT US" section on this profile gives a brief biography of the company. Another important section in this profile is the "JOB OPPORTUNITIES" section, where the company always posts vacancies in the company as needed. The "HOME" section contains space to share information and create content that the company has not yet used.

As the company is still just testing the strength and potential of social media in the B2B market, it is already aware of several shortcomings that have arisen so far. The most important of these is the lack of foreign language content and insufficient time to create it. If the company were able to invest more time in creating foreign language content, it could increase the number of its followers not only from the German market, but from all over the world. The company could also attract more followers and raise awareness of the company by unifying the individual names of its accounts under a single name. As online media are becoming an affordable and inexpensive means for the company to reach out to potential customers and present itself and its services and products on an international scale, a meeting will be scheduled to outline future steps to be taken in the firm's online communication.

3.2.5. Comparison

Decisions about the applicability of current and future tools in the company are influenced by the company's financial situation and the management's willingness to invest in those marketing tools, its business goals, number of customers and the ability to spread those marketing activities across different departments due to the lack of a marketing department.

As regards how usable these communication tools are given the scope of the market, it is evident that the tools that the company uses in this country serve as a kind of springboard for the marketing communication tools used in the foreign market. There are certain similarities as well as differences in the individual tools play a part in communication with current and potential customers in the given markets. These differences can be seen, for instance, in the use of online marketing and in the company's participation at trade fairs. In terms of its usability and reach, online marketing is aimed mainly at Czech customers, although foreign customers do also have access to these tools, at the cost of missing out on certain messages if a different language version is chosen. As regards its participation in trade fairs, foreign exhibitions and trade fairs are more important for the company than the Czech ones, as the majority of its production is exported to the German market. Moreover, the German market is more sophisticated than the Czech market in terms of electrical production technologies, and more innovations are emerging in this sector than in the Czech Republic. In personal sales and its use of all the other tools, the company also has to work with factors such as cultural differences, different consumer behaviour, language differences and the available competitiveness of other companies, which also affect the form and style of the message it communicates across the individual countries.

In terms of costs for the year in question, 2018, marketing expenses accounted for 0.23% of the company's turnover in the Czech Republic and Germany. Of this, 0.09% was expended on marketing activities in the Czech Republic and the remaining 0.14% on the German market. A breakdown of the costs within the framework of the marketing tools used is shown in Figure 1 and Figure 2.
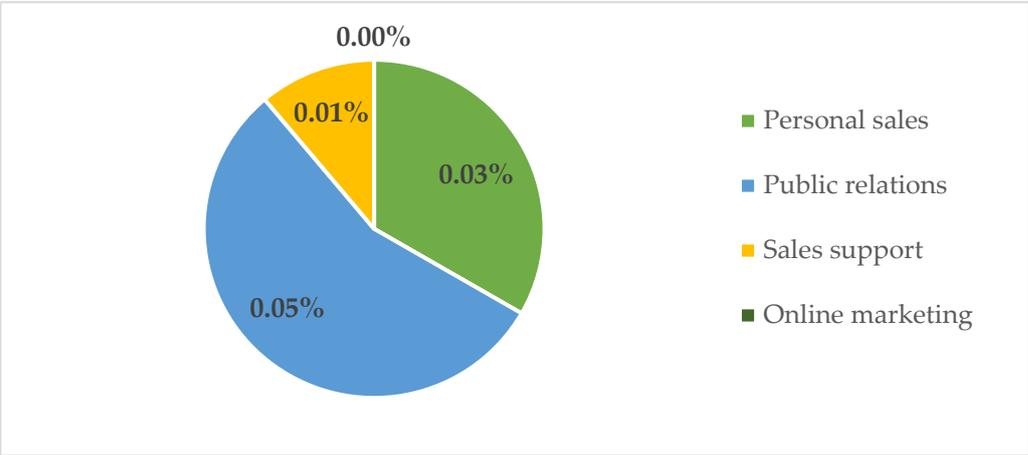
Figure 1. Percentage of expenditure on marketing activities in the Czech Republic
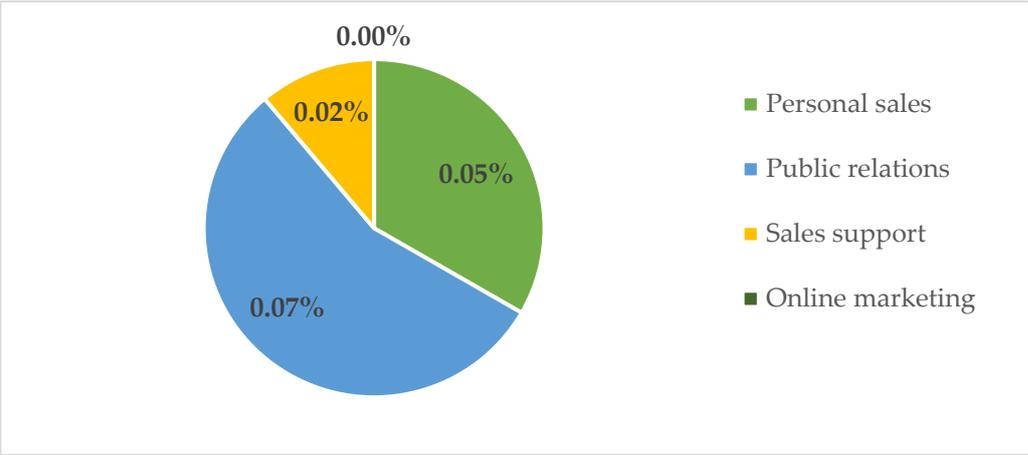
Figure 2. Percentage of expenditure on marketing activities on the German market

4. Discussion

Based on finding answers on research questions and provide analysis of communication mixes, the above case study enables some conclusions to be drawn, which could aid other companies that are considering entering a foreign market.

One of the most important steps is to be aware whether the company has sufficient funding and know-how to enable it to engage in business and marketing activities in the selected international market (Lopes, 2019). In terms of comparing the company's marketing expenses, it may be inferred that the process of adapting and customising communication in the foreign market is far more demanding as regards the funds that need to be invested (Brei et al., 2011). Another factor that can aid companies in successful communication and building their brand in the foreign market is adaptation and the use of existing (local)

communication tools, which can act as a kind of springboard for the linguistic and cultural adaptation of the international communication mix (Akgün et al., 2014). According to Keller (2007), the optimal combination of the communication mix and its tools, such as the aforementioned personal sales, sales support, PR and online communication tools, has a positive impact on international brand building and aspects such as the image, awareness and knowledge of the brand, etc. This case study also presents that management of communication activities has really important role in corporate strategic management (Milichovský, 2013; Steyn, 2004; Kumar, 2008) and marketing communication itself can be marked as the most visible and audible component of the marketing mix (Purcarea et al., 2015; Duralia, 2018). The idea that family brands applying digital marketing gain a competitive advantage over brands that use only traditional marketing tools (Nadanyiova et al., 2021) cannot be fully supported. For supporting this idea, the next research and analysis of company's online communication tools would be needed.

5. Conclusion

The case study focuses on analysing and comparing the communication mixes used by the family company HOKAMI CZ on the German and Czech markets. Based on this analysis, conclusions are presented that can aid companies in planning their international communication activities. However, it is important to bear in mind that all the above conclusions should be appropriately verified in a subsequent study by means of a questionnaire survey and statistical methods.

Company communication strategy has slightly improved after 2018. In these days there is for example new applied visual identity on HOKAMI CZ websites. A very small increase can be seen on social media websites; however, the company must make some important decisions. For example, YouTube channel get during 3 years only 5 new followers. The main reason is probably due to the lack of the right content that would give followers reason to follow company profile. Almost all marketing communication costs has also risen about 0,02 %. That is probably due to financing more in new marketing factors as brand visual identity and its application in to the each of marketing communication tool.

However, overall, the case study gives a relatively detailed and realistic view of the communication of a family brand in a selected international market.

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Employees at Risk of Poverty on the Czech Labor Market in the Period from the Global Economic Crisis to the Global Coronavirus Crisis

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Abstract: Czechia is one of the richest economies in the former Eastern bloc. However, wages are lagging significantly behind Western Europe and the situation does not seem to change in the future. This paper deals with the issue of the lowest wages in the Czech Republic in the period from the global economic crisis, the consequences of which were fully felt in the Czechia in 2009, to the global coronavirus crisis, which fully hit the world at the end of winter 2020. This is the period 2009–2020 and the paper focuses on comparing the issue of low wages between men and women. The development of wage distributions for men and women in the period 2009–2020 is captured, while three-parameter lognormal curves are used in the construction of wage distribution models. The minimum of lognormal curves is estimated by the minimum wage in a year, the remaining two parameters of lognormal curves are estimated by the maximum likelihood method. The fifth percentile, the first decile and the first quartile are used to determine the low wages. Overall, it is found that the phenomenon of low wages affects women to a greater extent than men in the Czechia.

1. Introduction

Working for low wages has been a very topical and politically important topic in most European countries. The current coronavirus and thus economic crises are leading many companies to the need to lay off employees or at least reduce their wages, which further emphasizes the importance of this area. For employees who were already earning low wages before the crisis, any further reduction in earnings can mean not only a dramatic threat to living standards, but also existential problems. The unfavorable development on the income side for poorer households is further exacerbated on the expenditure side of the budget through rising prices. The COVID-19 pandemic raises food prices around the world, including the Czech Republic, where food in March 2020 made a major contribution to higher year-on-year price growth. At the same time, food expenditure forms a significantly larger part of the budget of poorer households compared to richer households.

Working for low wages has been a hot topic of the Czech economy, too. For these reasons, the issue of low wages is a frequently researched topic in the Czech Republic and abroad.

An overview of the most important publications on this topic is presented in the following paragraph of this text. The aim of this paper is to capture the differences in the development of the entire wage distribution between men and women in the period from the global economic crisis, the consequences of which fully manifested in the Czech Republic in 2009, to the global and coronavirus and hence economic crises that hit the world at the end of winter 2020. A comparison of the development of the lowest wages of men and women in the period 2009–2020 is another no less important goal of this paper.

Three-parameter lognormal curves are used in modeling wage distributions. The beginning of these curves is estimated through the minimum wage, the remaining two parameters of the lognormal curves were estimated by the maximum likelihood method. The fifth percentile, the first decile and the first quartile are used to define the limit for the lowest wages. Development of these characteristics of wage level in the period 2009–2020 is captured in the paper.

The basic scientific hypothesis is based on the assumption that the phenomenon of the lowest wages poses a greater threat for women than for men.

Table 1 shows the development of the monthly amounts of the minimum wage in the period 2009–2020.

Table 1. Development of the minimum wage amounts in the years 2009–2020 in the Czech Republic

	Year					
	2009	**2010**	**2011**	**2012**	**2013**	**2014**
Minimum wage	8,000	8,000	8,000	8,000	8,208	8,500
	2015	**2016**	**2017**	**2018**	**2019**	**2020**
Minimum wage	9,200	9,900	11,000	12,200	13,350	14,600

Note: In 2013, the minimum wage was CZK 8,000 until July 31 and CZK 8,500 from August 1. The amount shown in the table represents the weighted average of the minimum wage of CZK 8,000, which was valid for seven months, and the minimum wage of CZK 8,500, which was valid for the remaining five months.

1.1. Literature Overview

The issue of low-income households and the poverty of their families is a constant research topic of many domestic and foreign authors. We only give examples of some of them.

The research (Kreidl, 2000) analyses the perceived "*legitimacy of poverty and wealth in the United States, West Germany, the Netherlands, Hungary, the Czech Republic, and Russia,*" discussing several theories about the perception of poverty and wealth, the most influential being the dominant ideology. Data from the International Social Justice Project demonstrate that when it comes to poverty, "*individuals distinguish between merited, unmerited, and fatalistic types of poverty.*"

The pair of authors (Eriksson & Pytlíková, 2004) report that "*after the initial decline in the level of real minimum wage rates, there were series of unusually large increases in their levels*" in the Czech and Slovak Republics between 1999 and 2002, by 70% and 50%. Based on information from the same employee-employer data sets, the authors examine the impact of increasing the minimum wage on wages and employment. The authors found that "*there are some, but not significant, job losses*" in response to minimum wage increases and that the impact on

corporate wages is relatively large, suggesting "*that further increases of a similar magnitude may very well have negative consequences for employment.*"

Paper (Večerník, 2004) provides "*a summary of evidence on the development of poverty in the Czech Republic since 1989.*" The author states that "b*efore 1989, poverty was caused mainly by demographic factors. In contrast, unemployment became the strongest factor of poverty under the market economy,*" which to a large extent "manifested itself after 1997, when unemployment in the Czech Republic rose rapidly and "*the numbers of long-term unemployed grew even faster.*"

The study (Sirovátka & Mareš, 2006) analyses "*the pattern of poverty and social exclusion in the Czech Republic and the impact of social policy on this pattern.*" The authors find that "*the poverty rate in the Czech Republic is among of the lowest in Europe, on the other hand. The authors consider labor market policy measures to be insufficient in scope and inadequate in material deprivation, as well as concentration of poverty within specific population groups, is high, with the unemployed facing the highest risk of poverty … targeting groups which are facing the highest risk of labour market exclusion and povert*y.*"

Study (Jones, 2007) states that "*income inequality and relative poverty among the working-age population in Japan have risen to levels above the OECD average*" and that "*this trend is partially explained by labour market dualism, with an increasing proportion of non-regular workers who are paid significantly less than regular workers, as well as by other factors, including the aging of the workforce.*" The author emphasizes that "*social spending as a share of GDP has been expanding in the context of population aging, although it remains below the OECD average and the proportion received by low-income households is small.*"

The pair of authors (Kohl & Platzer, 2007) considers "*Governments in Central and Eastern Europe are dominant players in the field of industrial relations, acting in a 'liberalisation dilemma' between the needs of further state regulation to compensate the shortcomings of autonomous self-regulation by social actors and the demands of liberalised markets in the enlarged EU.*" This article highlights the current "trends of differentiation and convergence of remuneration principles as well as "*urgent tasks of the state to regulate the unsolved problems of poverty, labour markets and labour standards.*"

The issue of the relationship between the minimum wage and employment is also addressed in a case study of a pair of authors (Neumark & Wascher, 2000). Locally, the authors focus on the New Jersey and Pennsylvania circuit with relevant comments.

The paper (Aidukaite, 2011) summarizes "*recent sociological changes in the ten new member states of the European Union of Central and Eastern Europe and the earlier and recent debates on the emergence of a post-communist welfare state regime. The findings of this document suggest that, despite some slight differences within, the new countries of the European Union show lower indicators compared to the EU-15 in terms of minimum wages and social protection expenditure. The degree of material deprivation and the shadow economy is on average also higher if compared to the EU-15 or the EU-27.*"

The paper (Dobija, 2011) considers "*the phenomenon of human natural dispersion is a starting point for the theory of minimum wage, which ought to be sufficient to counterbalance the natural thinning out of the initial human capital of an employee.*" The author considers the statutory minimum wage to be often too low and considers labor productivity to be one of the basic

factors that allow the proper level of the minimum wage to be determined. The author highlights the 8% rule, which states that *"each human capital is vanquished by spontaneous and random diffusion, which averages 8% of the initial capital."*

The team (Marx et al., 2012) notes that at the European level and in the most Member States of the European Union, higher employment rates are considered the key to better poverty outcomes and that so far shift ratio analysis was used to *"estimate the impact of rising employment on relative income poverty."* The authors *"propose a more sophisticated simulation model that builds on regression-based estimates of employment probabilities and wages. … This article shows that employment growth does not necessarily result in lower relative poverty shares, a result that is largely consistent with observed outcomes over the past decade."*

The purpose of paper (Wang & Gunderson, 2012) is *"to estimate the impact of minimum wages on employment and wages in China. … The study finds that overall, minimum wages in China do have an adverse employment effect, but the effect is statistically insignificant and quantitatively inconsequential."* The authors found that *"the adverse employment effects are generally larger in the more market-driven sectors, in the low-wage sector of retail and wholesale trade and restaurants, and for women, however even these effects are extremely small."*

The study (Bartošová & Želinský, 2013) emphasizes that *"poverty is still a serious problem in developing and developed countries."* The authors point out that *"before 1989, Czechoslovakia was a communist state with a centrally planned economy, in November 1989 the Velvet Revolution restored democracy in the country, and on January 1, 1993, Czechoslovakia split into two countries, the Czechia and Slovakia."* The authors point out that *"before 1989, the acceptance of the existence of poverty was contrary to the communist ideological principle of equality, and socio-economic research on it was even prohibited."* The term poverty has been replaced by limited ability to consume.

The paper (Crettaz, 2013) emphasizes that although awareness of the re-emergence of working poverty is growing, *"this topic remains relatively under-researched."* This article provides a comprehensive *"review of the literature dealing with the situation in Europe, North America and the Antipodes, with a focus on the theoretical models found in this literature, the definitions used and the risk groups identified."* The article concludes by focusing on what remains to be done, as there are *"good reasons to think that working poverty might become a more pressing problem in the near future."*

The three authors (Pavelka et al., 2014) analyze the motivational function of the minimum wage and compare *"the net minimum wage with the subsistence minimum."* The authors found that *"the motivational function of the minimum wage has been reducing in recent years,"* especially for people with dependent children. The last part of the article contains *"an analysis of the relationship between the increase in the minimum wage and the unemployment rate in the Czech Republic."* The authors found that *"there is no clear relationship between the minimum wage and the unemployment rates in the Czech Republic."*

The author (Sturn, 2018) investigates *"effects of minimum wage rates on low-skilled, female low-skilled, and youth employment,"* where *"the sample consists of 19 … OECD countries from 1997 to 2013 for low-skilled workers and from 1983 to 2013 for young workers"* and *"six different static or dynamic estimation approaches are applied on different versions of the specifications, controlling for up to quadratic time trends. … The findings provide little evidence of substantial disemployment*

effects for low-skilled, female low-skilled, or young workers" and "*the estimated employment elasticities are small and statistically indistinguishable from zero.*"

A team of authors (Caliendo et al., 2019) offers a discussion on "*the short-term effects of the introduction of a new minimum wage in Germany in 2015.*" The authors emphasize that this minimum wage was not only generally binding, but was also set at a relatively high level, and concluded that while hourly wages increased for low-wage earners, some small negative effects on employment could be identified. The authors point out that the effects on aspired goals, such as reducing poverty and inequality, have not materialized in the short term. Instead, there was a tendency to shorten working hours, which mitigates the desired positive impact on monthly income.

1.2. Database

The data come from the official website of the Czech Statistical Office (Czech Statistical Office, 2021). The wage data presented on the website of the Czech Statistical Office are in the form of interval frequency distributions with extreme open intervals. The employee's gross monthly wage in the individual years considered (annual data) is the main variable examined.

The data for this research includes employees in both business and non-business spheres. The wage is paid to the employee for the work done in the private (business) sphere, salary in the budget (state, public, non-business) sector. From the point of view of the data from the Czech Statistical Office, both wages in the business sphere and salaries in the non-business sector are included under the wage term.

The data was processed using the SPSS and Statgraphics statistical packets and the Microsoft Excel spreadsheet.

2. Methodology

2.1. Three-Parameter Lognormal Curves

The characteristic features of the process described by the lognormal model are the gradual action of interdependent factors, the tendency to develop in geometric sequence and the growth of random variability into systematic variability, i.e. differentiation. In the field of economics, wages and incomes of the population are among the many phenomena that the lognormal model can interpret.

The random variable X has a three-parameter lognormal distribution with parameters μ, σ^2 a θ, where $-\infty < \mu < \infty$, $\sigma^2 > 0$, $-\infty < \theta < \infty$, if its probability density has a shape

$$f(x; \mu, \sigma^2, \theta) = \frac{1}{\sigma \cdot (x - \theta) \cdot \sqrt{2\pi}} \cdot \exp\left[-\frac{[\ln(x - \theta) - \mu]^2}{2\sigma^2} \right],$$

$$= 0, \qquad \text{else.}$$

(1)

The probability density of the three-parameter lognormal distribution is asymmetric, positively skewed. A graph of the probability density of the three-parameter lognormal distribution as a function of the values of the parameters μ, σ^2 and θ is shown in Figures 1–2.
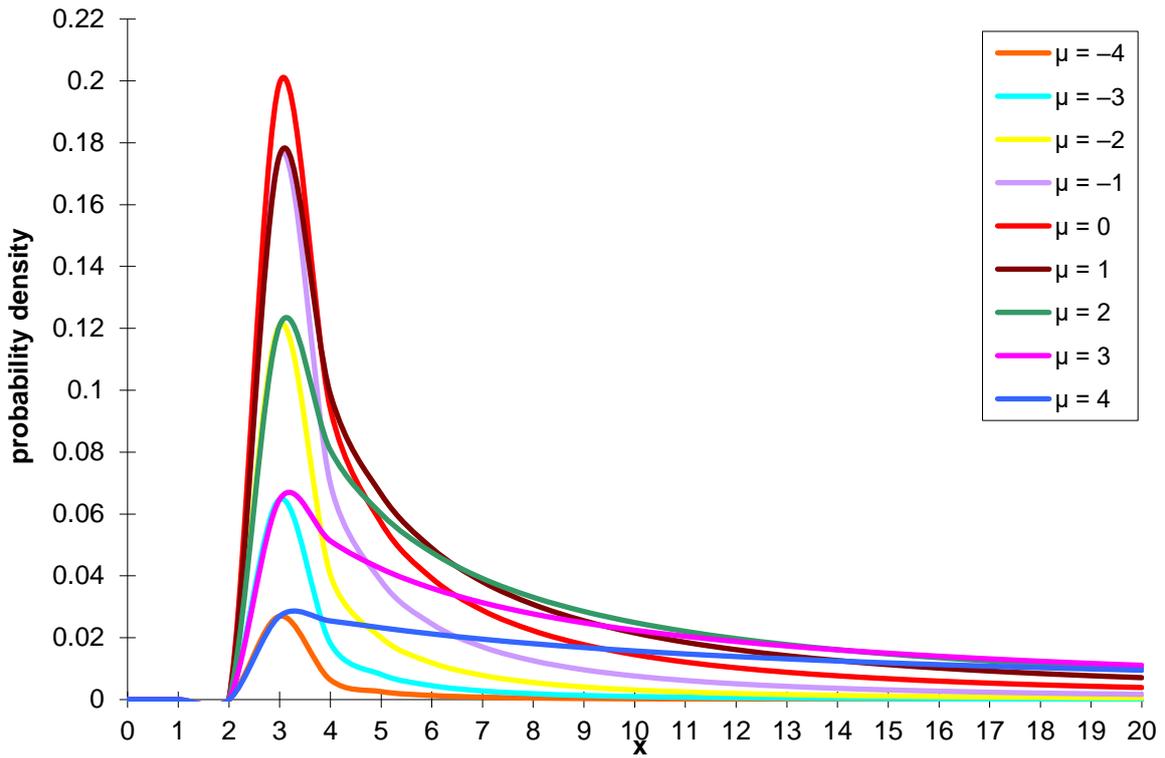
Figure 1. Probability densities of three-parameter lognormal distribution for parameter values $\sigma = 2$ $(\sigma^2 = 4)$; $\theta = 2$
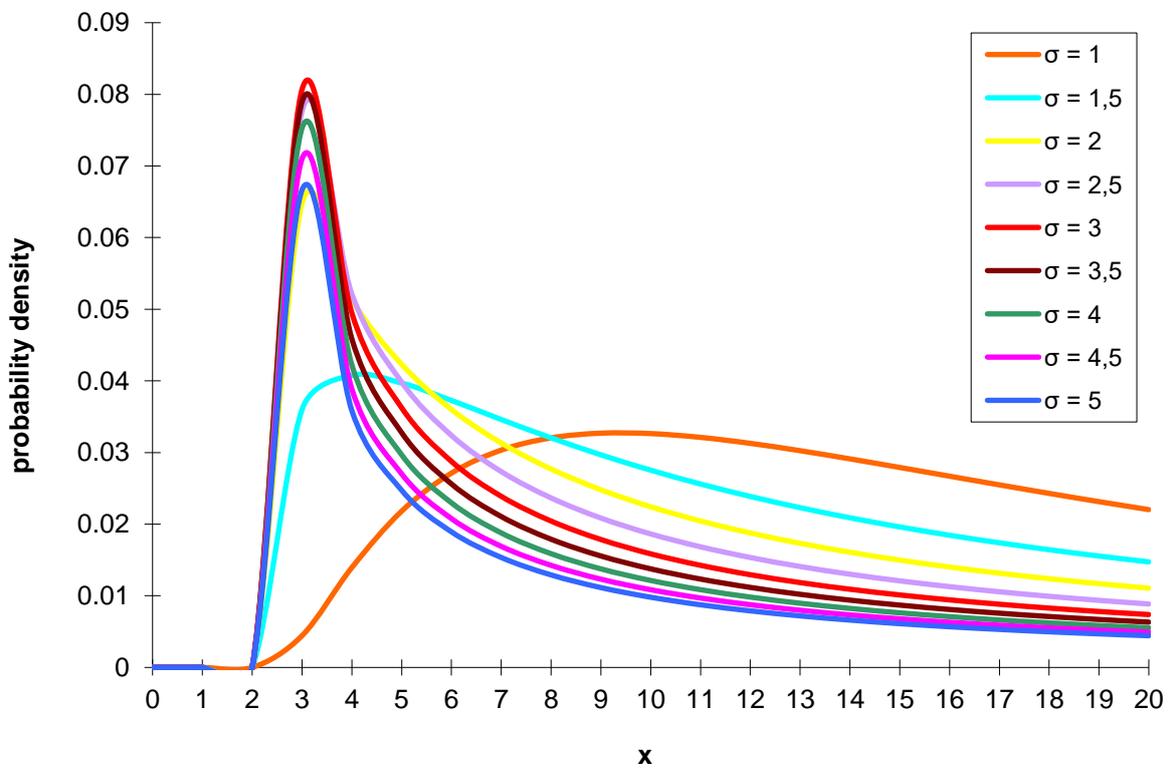
Figure 2. Probability densities of three-parameter lognormal distribution for parameter values $\mu = 3$; $\theta = 2$

The parameter θ represents the minimum (theoretical minimum) of the three-parameter lognormal curve, the expression exp (μ) is the distance of the median wage from this theoretical minimum. The parameters μ and σ^2 represent the expected value and variance of the logarithms of the distances between wage and the theoretical minimum.

The values of the parameters of the three-parameter lognormal curves were estimated using the maximum likelihood method, while the minimum wage in the given year was considered as an estimate of the parameter θ

$$\hat{\theta} = \min. \text{ mzda}. \tag{2}$$

The maximum likelihood estimates of the remaining two parameters μ and σ^2 calculated from the interval frequency distribution have the form

$$\mu(\hat{\theta}) = \sum_{i=1}^{k} [\ln(x_i - \hat{\theta})] \times p_i, \tag{3}$$

$$\hat{\sigma}^2(\hat{\theta}) = \sum_{i=1}^{k} [\ln(x_i - \mu) - \mu]^2 \times p_i, \tag{4}$$

where p_i are the relative frequencies of the individual intervals and x_i are the midpoints of the intervals, $i = 1, 2, \ldots, k$, k is the number of wage intervals.

2.2. Descriptive Characteristics

The *P%* quantile from the interval frequency distribution is estimated as follows. First, it is necessary to determine in which interval, the searched *P%* quantile is located, which is the interval where the *P%* value first exceeds the cumulative relative frequency of the interval (multiplied by one hundred in percent). We then estimate the *P%* quantile value by linear interpolation using the relation

$$\frac{x_P - x_l}{x_u - x_l} = \frac{P - i_l}{i_u - i_l} \quad \circledR \quad x_P = x_l + \frac{x_u - x_l}{i_u - i_l} \times (P - i_l), \tag{5}$$

where: x_P is the *P%* quantile,

        x_u is the upper limit of the interval in which the *P%* quantile is located,

        x_l is the lower limit of the interval in which the *P%* quantile is located,

        i_u is the cumulative relative frequency after multiplying hundreds in percent of the interval in which the *P%* quantile is,

        i_l is the cumulative relative frequency multiplied by one hundred in percent of the previous interval.

The fifth percentile represents the 5% quantile, which is the wage value that separates 5% of the lowest wages from the remaining 95% of wages. The first decile represents the 10% quantile, which is the wage value that separates the 10% of the lowest wages from the remaining 90% of the wages. The first quartile, also called the lower quartile, is the 25% quantile, which represents the wage value that separates 25% of the lowest wages from the remaining 75% of wages.

The growth rate of the time series has a shape

$$100 \times k_t - 100 = 100 \times \frac{x_t}{x_{t-1}} - 100, \quad t = 2, 3, ..., n,$$ (6)

where x_t is the value of the variable x in year t and k_t is the growth coefficient in year t.

3. Results

Figures 3–4 represent the development of model wage distributions for men and women in the period 2009–2020. These figures show that all wage distributions are positively skewed, which means that below-average wages outweigh above-average wages. This situation is typical for wage distributions. In the initial period of 2009–2020, the wage distributions of men and women have more kurtosis and they are more positively skewed; over time, we observe a tendency for the kurtosis and skewness of these distributions to decrease, which means that wages increase over time. If we compare the model wage distributions of men and women, it is clear that the wage distributions of women have more kurtosis and they are more positively skewed than the wage distributions of men, which indicates a higher level of wages in favor of men compared to women.

Figures 5 shows the development of the 5th percentile, 1st decile and 1st quartile, which separate 5%, 10% and 25% of the lowest wages of men and women in the period 2009–2020. This figure shows higher values of these quantiles in the case of men compared to women in the whole period. Figures 6–8 show the growth rates of the 5th percentile, 1st decile and 1st quartile of the wage distribution of men and women in the period 2009–2020. These figures show a decrease in the above-mentioned characteristics of wage level in 2011, when the effects of the global economic crisis hit mainly wages in the Czech Republic. This decrease is more pronounced in men than in women. Significant wage growth is recorded in the period 2017–2019 just before the coronavirus crisis, especially in women.

4. Discussion and Conclusions

Based on the analysis, it was proved that the issue of low wages affects women to a greater extent than men in the Czech Republic. The basic scientific hypothesis can therefore be considered proven. As in (Blau & Kahn, 2017), analogous reasons can be seen. For example, *"women's work force interruptions and shorter hours remain significant in high-skilled occupations." Psychological attributes or noncognitive skills comprise one of the newer explanations for gender differences in outcomes."*

For the comparison, the study (Magnusson, 2013) reveals *"a non-linear relationship between sex composition and wages, where the highest wages for both men and women are earned in sex-integrated occupations."*

Gender differences in occupations and industries, as well as differences in gender roles and the gender division of labor remain important, and research suggests that discrimination cannot be discounted. Interesting paper (Schwenkenberg, 2014) analyzes *"intergenerational mobility experiences of daughters and sons with respect to their fathers' occupational status and documents changes in gender differences over time. While women have been in occupations with lower*
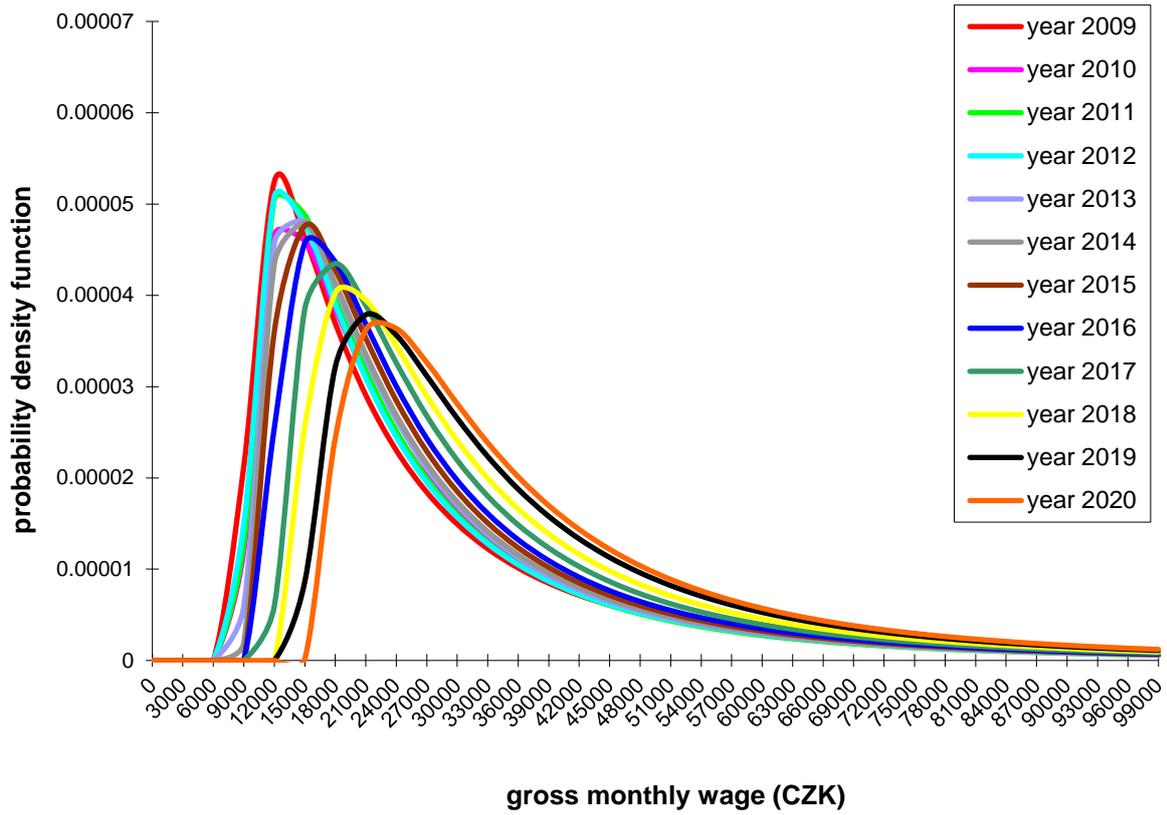
Figure 3. Development of model wage distribution for men in the period 2009–2020
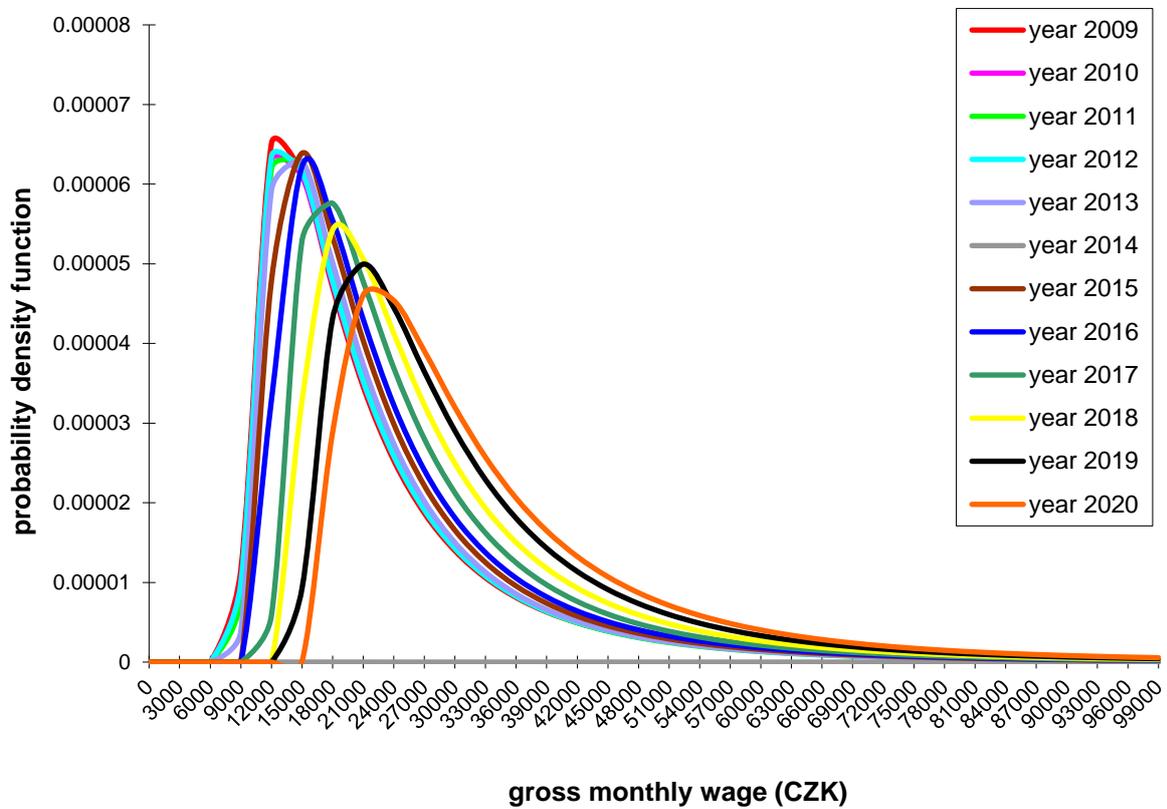
Figure 4. Development of model wage distribution for women in the period 2009–2020
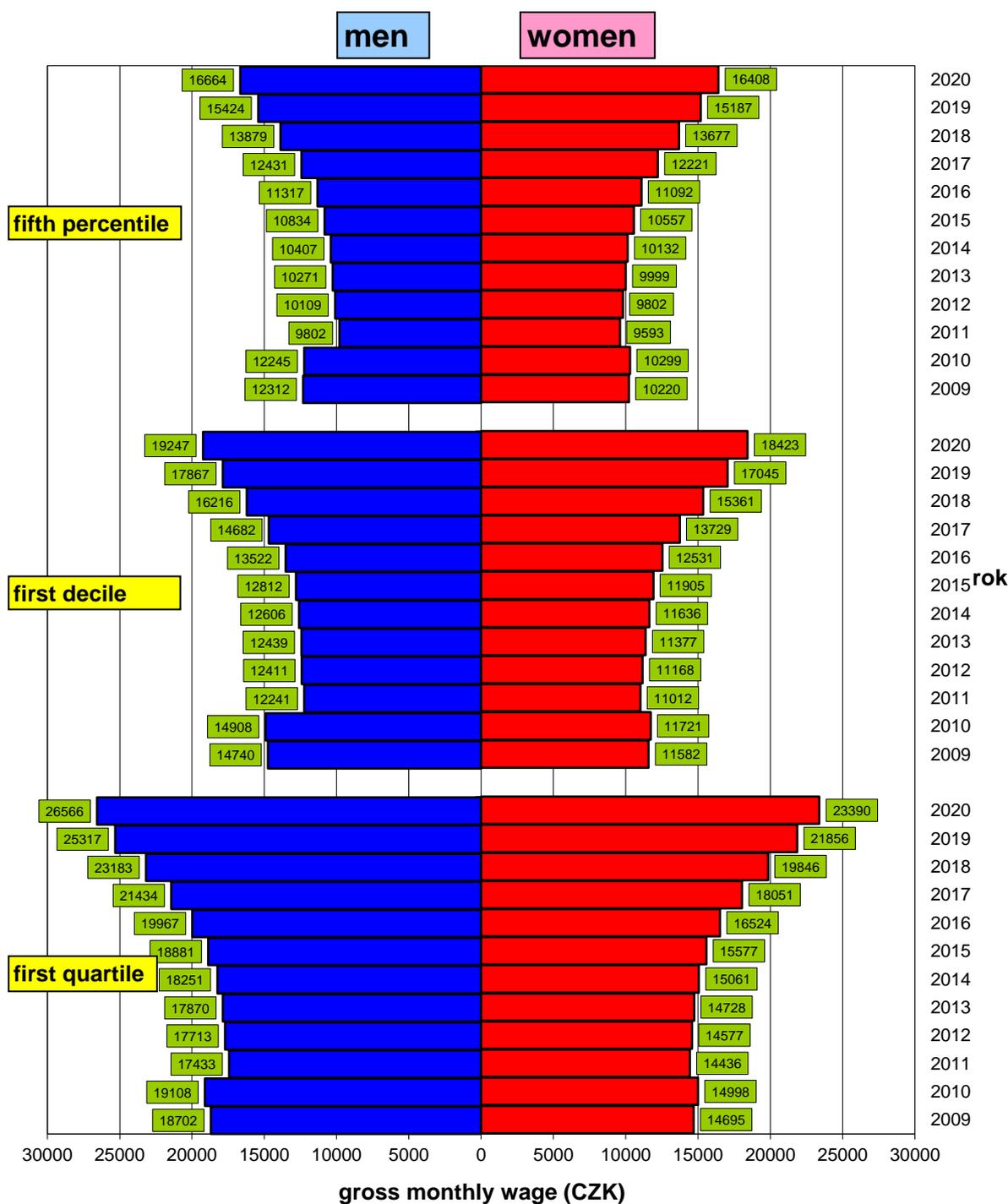
Figure 5. Development of the fifth percentile, the first decile and the first quartile of the gross monthly wage of men and women in the Czech Republic in the period 2009–2020

overall earnings potential, men are more likely to be in occupations characterized by long hours and low returns. The mobility gap in earnings has been closing and a mobility advantage with respect to education has been emerging."

The consequences of the coronavirus crisis on the functioning of countries and the lives of their populations are the subject of research by many scientists around the world. Study (Laborde et al., 2020) emphasizes that as the coronavirus "*pandemic progresses, trade-offs have emerged between the need to contain the virus and to avoid disastrous economic and food security crises that hurt the world's poor and hungry most.*" The authors of this study point out that
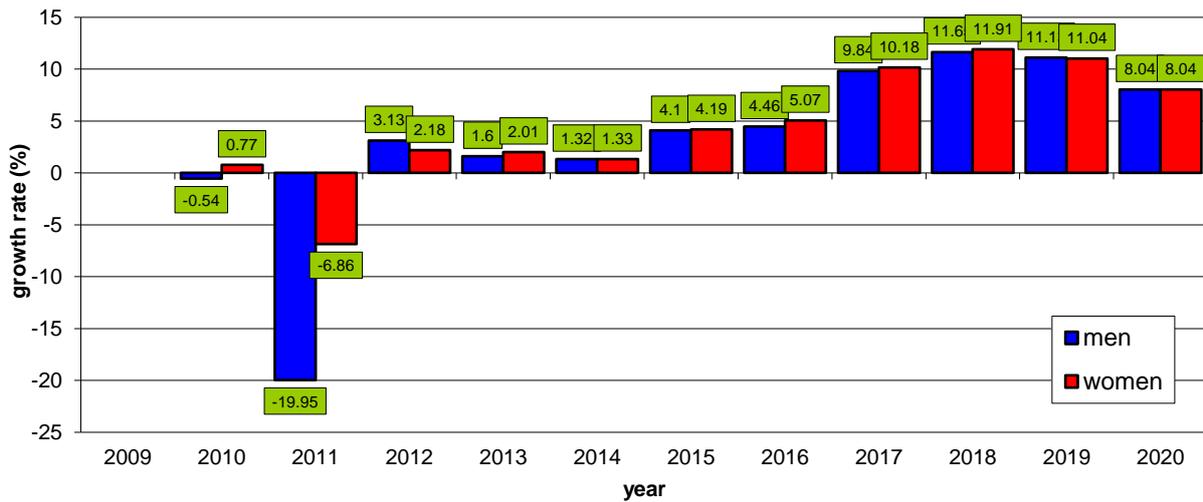
Figure 6. Development of the growth rate of the fifth percentile of gross monthly wage in the Czech Republic in the period 2009–2020
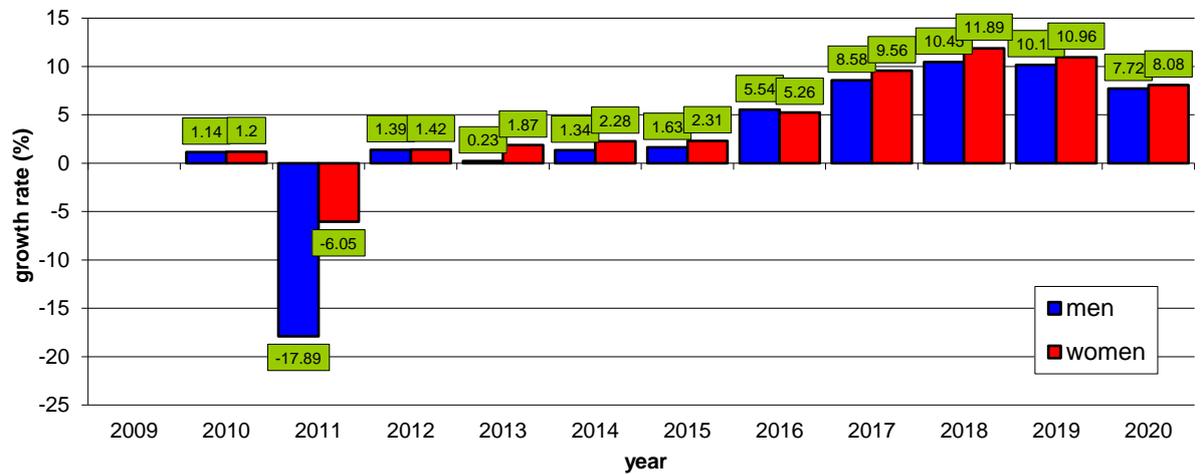
Figure 7. Development of the growth rate of the first decile of gross monthly wage in the Czech Republic in the period 2009–2020
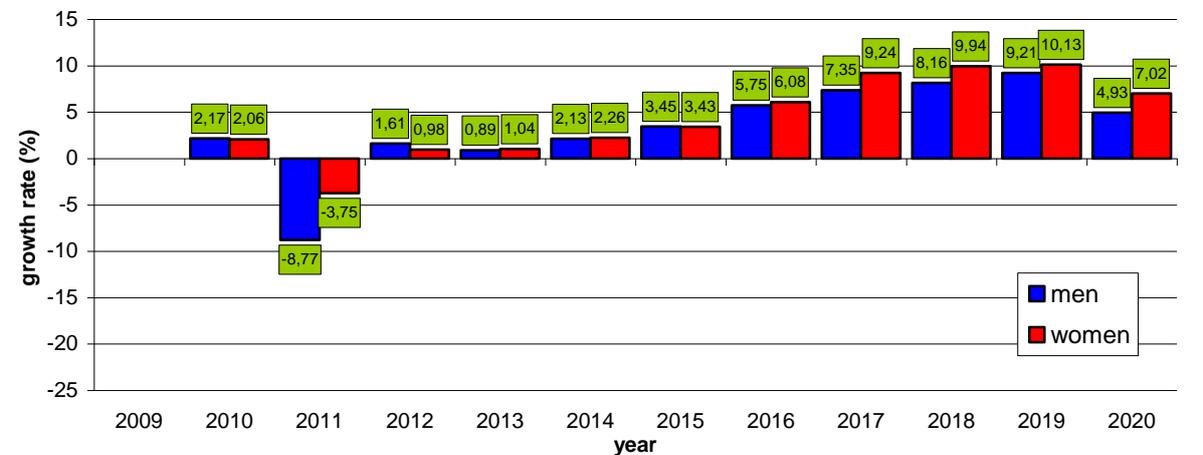
Figure 8. Development of the growth rate of the first quartile of gross monthly wage in the Czech Republic in the period 2009–2020

"*COVID-19 threatens access to food mainly through losses of income and assets that prejudice ability to buy food*" and that "*the poorest households spend around 70% of their incomes on food and have limited access to financial markets, making their food security particularly vulnerable to income shocks.*" The research (Manderson & Levine, 2020) deals with the beginnings of the coronavirus crisis in the world. The authors point out that people around the world "*spent much of the last week tracking the exponential spread*" and numbers infected with coronavirus, and „*the consequent retraction of social engagement.*" The authors „*are beginning to take stock of the social, economic, and political fallout that will follow as the virus surely spreads, with colder weather, to the global and geographic south.*" The authors emphasize that „*we are witness to mediatization of the pandemic; closing of schools and universities, libraries and museums; cancellation of conferences and smaller meetings; and loss of income for people who run stalls and street-side services and work in the informal economy.*" The paper (Júnior et al., 2020) presents "*several risk factors common to coronavirus and psychiatric illnesses as overcrowding, disruption of sewage disposal, poor standards of hygiene, poor nutrition, negligible sanitation, lack of access to shelter, health care, public services, and safety.*" The authors state that "*these associated with fear and uncertainty create a closed ground for psychological sickness*" and coronavirus infection. The onset of the coronavirus crisis is also addressed in the article (Cook & Grimshaw, 2021). The authors underline that the coronavirus „*outbreak and resultant economic crisis has led to governments in Europe taking extraordinary action to support citizens*", where „*the International Labor Organization recommended such measures should include targeted support for the most affected population groups and women form one of these groups, with disproportionate impacts on their employment and economic resources already documented.*" The study (Zavras, 2021) accentuates that "*the coronavirus disease … pandemic induced economic shock in Greece, which translated into a decrease in household income. The objective of this study is to measure social inequality with regard to income loss due to the COVID-19 pandemic in Greece, … the Erreygers' Concentration Index is calculated, using social class as the ranking variable. … According to the results of the logistic regression model,*" the author finds that "*the odds of experiencing income loss are higher for residents of the Aegean Islands and Crete but also for self-employed, part-time employed, and unemployed individuals.*"

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New Challenges in Accounting Practice in the Slovak Republic Related to Digitalization

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Abstract: Information technologies, automated processes and digitalization as a part of Industry 4.0 have influenced all spheres of social and economic life, including accounting. The accounting and tax practice have to respond to the growing number of electronic accounting records that is why the automated processing of accounting documentation, digitalization and electronic communication are nowadays a natural part of accounting practice. At present, there are several laws in the legislative process in the Slovak Republic responding to the current situation as well as to changes coming from the European Union environment. One of them is the communication between accounting entities and the Financial Administration Authority of the Slovak Republic, which is, as of the 1 January 2022, required to be provided entirely electronically. The paper focuses on questions related to the future position of accounting profession, as well as on the processes of digitization and digitalization in the accounting and tax practice, with the accent on the legislation required to reflect the changes and challenges related to the growing number of electronic accounting records. The source data consist mainly of academic and professional papers, as well as of the legislation related to the subject of our research.

Keywords: digitalization; accounting; practice; accounting documentation; accounting records; Industry 4.0

JEL Classification: M41; M48; O14

1. Introduction

The scientific and technical development is unstoppable. The First Industrial Revolution (also called as Industry 1.0) that started in 1760 in England and that has brought the switch from agricultural economy to factory production, has significantly affected all the areas of the social, political and economic life. New mechanical production facilities with the help of water and steam power have been introduced during it. The world went through two more industrial revolutions (Industry 2.0 and Industry 3.0), and nowadays we are experiencing the Fourth Industrial Revolution (Industry 4.0). All industrial revolutions were related to the scientific and technological progress. Industry 2.0 was characterized by the division of labor and mass production with the help of electrical energy. Industry 3.0 used the progress achieved in electronic and IT systems that further automated production without human intervention (Microstep-hdo, 2020). According to Ceoforum (2021), Industry 3.0 has been affected mainly by birth of internet.

Currently, the whole world and society are in the middle of the Fourth Industrial Revolution (Industry 4.0), which is also known as the Digital Revolution. Digital technologies affect all aspects of modern life from individuals to societies, from economies to cultures, and changes the world (Tekbas, 2018). Industry 4.0 (this title was used for the first time at the exhibition in Hanover in 2011) is characterized by creation of industrial networks, the global introduction of smart technologies, the building of smart factories, the building of the so-called intelligent industry, and this development is really very fast (Industry4.sk, n.d.). The basic condition for Industry 4.0 is widely accessible internet that allows a very easy connection of a large number of people around the world. The Industry 4.0 is focusing on the transformation of the economy and society, depending on developments in artificial intelligence, robotics, autonomous devices, 3D printers, nanotechnologies, and other fields of science.

This fast development of information technology has affected all aspects of business operations, especially those related to international and national trade, including the area of accounting, financial reporting, auditing and taxes. According to Mancini et al. (2017) digital technologies significantly influence the accounting information and management control systems. Many digital systems that did not exist ten years ago are now actively used in the accountancy profession (Tekbas, 2018). Development of modern computer systems leads to decreasing the workload of accountants. Repetitive actions, complicated and difficult accounting transactions are, thanks to information technologies, made easily and quickly, with higher effectiveness.

COVID-19 pandemic has an impact on processes of automation and digitization in accounting, too. Social distance, movement restrictions, working from homes (so called home-office) have forced accounting entities, accountants, auditors to find new ways of communication or submitting of documents. The work environment of accountants and auditors has moved to the home office, which has brought new challenges with regard to the processing of the accounting documentation received or requested, client management and communications, as well as technical equipment (Mokošová & Blahušiaková, 2021).

The legislation should respond to new challenges related to automation, digitization and digitalization. Issuing acts related to electronic signature, e-invoicing, GDPR, security of transferring information, growing number of electronic records, and so on, play a very significant role in this case. The purpose of the paper is to analyze current state and trends in digitalization and automation in accounting, financial reporting, taxes and audit in the Slovak Republic. The paper focuses also on new amendments of Slovak accounting legislation related to automation and digitalization in accounting and taxes practice and their impact on performance of the accountants' and auditors' work.

2. Methodology

We have studied and analyzed relevant printed and electronic sources of literature, as well as the legislation related to the subject of our research in order to achieve our research purposes. We have studied mainly academic sources obtained from databases Web of Science, SCOPUS, as well as professional papers from websites of biggest accounting and

auditing companies, professional bodies, accounting and tax authorities written in English and Slovak. The searching criterion were the above-mentioned keywords, with focus on digitalization, digitization, automation in accounting, taxes, and audit. We have received more than 300 various scientific papers, which have been examined and through selection processes we have chosen those stated in references that have contributed to our research the most. We tried to investigate the depth of digitization and automation in accounting practice in various countries, as well as the challenges resulting from this process. We have also analyzed and compared accounting legislation in the Slovak Republic valid until 31 December 2021 with legislation that entered into force on 1 January 2022. We have used mainly methods of analysis, comparison, deduction and induction, as well as the method of generalization.

3. Digitalization in Accounting and Auditing Practice

Digitalization can be defined (Definition of Digitalization - Gartner Information Technology Glossary, n.d.) as "the use of digital technologies to change a business model and proved new revenue and value-producing opportunities, it is the process of moving to a digital business". Digitalization is the conversion of analog information into texts, photographs, and voices, among others. On the other hand, automation, which is often used in relation with digitalization, is understood as the automatic execution of tasks without periodic interference (What Is the Difference between Digitalization and Automation?, n.d.). Another term used with digitalization is digitization, but these two terms need to be distinguished. Digitization is defined as the process of converting anything (for example paper records) into a digital format (Bevans, 2021). It is usually the first step toward the automation.

Digitalization of accounting and tax processes is not only for big companies. However, companies with a large number of documents usually benefit from digitalization. But even small companies can profit from digitalization. Small companies need to compare the benefits resulting from digitalization with cost of implementing it, building and securing the necessary infrastructure.

There are many authors and researchers dealing with digitalization in accounting, investigating the impact of digitalization and automation on employment, accounting profession, and development in accountancy and taxes in particular countries, such as Justenhoven et al. (2018), Güney (2014), Pajarinen et al. (2015), Gulin et al. (2019), Dečman et al. (2019), Agostino et al. (2021), and so on.

3.1. The Impact of Digitalization and Automation on Accounting Practice

Development of technology and digitalization allow updates and changes of accounting profession, which belongs to the professions the most affected by the technological developments and globalization (Gulin et al., 2019). Due to massive digitalization it is expected that many jobs, professions will disappear altogether (Jylhä & Syynimaa, 2019). According to Grace et al. (2018) there is 50 per cent chance that artificial intelligence will beat the performance of human beings in 45 years and replacing the human workforce totally in

120 years. This is supported by the results of the research conducted by Frey and Osborne (2017), who state that the accounting profession is on the top of the list of job profession at risk of automation, with high probability of being automated and digitalized in the near future. The introduction of cloud computing has also significantly affected the growing trend of digitalization in the area of accounting (Dečman et al., 2019). Digitalization of accounting implies a change in selecting, processing, and storage of documents. As a result of their research, Agostino et al. (2021) suggest that digitalization has important implications for accounting and accountability in three main areas: the production of data and information, the consumption of these data, and their effects.

The result of digitization is that documentation no longer exists in a traditional paper-based system because it is fully digitized in electronic form. Traditional accounting methods (such as paper, receipts, registration, declaration notification, and so on) are replaced by internet-based accounting systems (such as cloud system and blockchain technology). This is supported by research of Gulin et al. (2019), who state that accounting profession is faced with numerous challenges in the area of digitalization, to which belong for example the use of big data in accounting and financial reporting, cloud computing and continuous accounting, artificial intelligence and blockchain technology, which have an impact on the future of accountancy. Almost all accounting companies use the cloud in their financial reporting processes. All these changes require the establishment of integrated document management systems (DMS), possibility of electronic storage of accounting ledger, automatic recording, and e-storage of invoices, as well as e-invoicing. Due to this, accounting professionals will have more strategic and managerial oriented role (Smith, 2018), because many transactions, which are made by accountants nowadays, will be automated and made by artificial intelligence in the future.

The solution suggested by Tekbas (2018) is "Accounting Engineering", which will enable the accounting profession to evolve with engineering abilities. Accounting Engineering can be understood as the transformation of the accountancy profession resulting from the technological developments, such as digitalization, artificial intelligence, and the Industry 4.0. Both professions, accounting as well as engineering, are dealing with data collection and analysis, their development and solutions, and providing them to decision makers. Both are based on processing the input data into the output reports. As Tekbas (2018) states, "an accounting engineer is a person, who can adapt to technological developments and actively use technological products in professional practices, specialized in his own field, combine practical and theoretical knowledge with philosophy, mathematics, and technology."

Digitalization of accounting is closely related to digitalization of the tax system that means (Dečman et al., 2019) "the possibility of filling electronic tax returns, but it is also expected that tax administrators will provide a better, streamline service and become more efficient in carrying out their work". Digitalization cannot be understood as a conversion of tax return from paper form to .pdf format and uploading it to the Tax Administration website. According to ICAEW (2019) it should be "revolutionary, considering not only how taxpayers complete their fillings, but what is taxed and how the authority can leverage

powerful data pipelines to complete audit taxes without." Baisalbayeva et al. (2017) state six key components of a successful digital transformation related to tax administration:

- Compliance strategy,
- Legislative framework,
- Operational framework,
- Tax technology and infrastructure,
- Change management, training and education, and
- Performance measurement.

Hadzhieva (2018) states five steps that should be taken in order to ensure tax compliance and enforcement related to digitalization of tax administrations' operations:

- E-filling: standardized electronic forms for filling tax returns,
- E-accounting: e-invoices and similar data in an electronic format,
- E-matching: cross-referencing with accounting, bank and source data,
- E-auditing: electronic audit assessments, and
- E-assessment: assessments without tax forms by use of Blockchain technologies, and so on.

The processes of digitization and automation of accounting and taxes have both advantages and disadvantages. According to Dečman et al. (2019), Budnik et al. (2017) benefits resulting from digitalization of accounting and taxes and using technologies in the financial reporting processes are mainly cost savings; quicker and more effective business processes; better process control; automated collection and payment processes; improvement of transparency of processes; increasing of productivity and competitiveness; increasing data reliability, predictability and accuracy; increased visibility of end-to-end processes; increased ability to identify outliers and anomalies; easier access to relevant information; faster refunding procedures; decreased operating costs and reducing operation times for tax administrators; easier making financial forecasts and managing staff, and so on. Using information technologies in financial reporting can give companies a competitive advantage, because their financial reporting is more cost effective. The primary benefits of auditors using advanced technologies are increasing ability to identify areas of risk and reducing risk, to control weaknesses, provide deeper insights, identify data outliers and anomalies, and decreasing of costs.

According to Budnik et al. (2017), to limitations and disadvantages, when implementing new technologies and modern digital tax administration belong unauthorized access to company´s data; Internet and electricity outages leaving the company´s data out of reach; reliance on third parties to run the company´s financial reporting system; and all these issues dwarf worries about costs. Implementation costs, regulatory compliance, change management and lack of relevant skills belong to other factors slowing down the implementation of new technologies in some companies.

3.2. Development of Legislative Changes Related to Digitalization in Accounting in the Slovak Republic

When thinking about digitalization, it is necessary to take into granted the legislation process. The beginning of digitalization in the Slovak Republic dates back to 2002, when the

Act No. 215/2002 Coll. On Electronic Signature as amended was issued. This act was replaced by the *Act No. 272/2016 Coll. on trusted services for electronic transactions in the internal market and amending certain laws (Trust Services Act) as amended* in 2016. Both acts have defined terms like electronic document, electronic signature, electronic seal, private key, public key, accredited certified authority, certified authority, the office, and so on. They have defined the rights and obligations of entities using the electronic signatures and seals, as well as the authenticity and protection of electronic documents signed with an electronic signature or provided with an electronic seal. The D. Trust Certified Authority a. s. (DTCA) is the exclusive service provider of an accredited certification authority in the Slovak Republic.

First steps to automation in accounting appeared when computers and accounting software started to be used in accounting practice. Accounting books in the paper form were replaced by automated processing of accounting documents. In 2002, the new *Act No. 431/2002 Coll. on Accounting as amended* (hereafter referred to as "Act on Accounting") was issued. In accordance with the Act on Accounting, the accounting documentation of accounting entity shall include all accounting records. Till the end of the 2021, the accounting record could have either the written form or the technical form, both forms were equivalent. On 2 December 2021 the *Act No. 456/2021 amending Act on Accounting* was issued. The amendment entered into force on 1 January 2022. It has responded mainly to the growing number of electronic accounting records in accounting practice. It supplements and specifies conditions the accounting entity is required to follow when processing accounting records (Pastierik, 2021), specifies information the accounting documents must contain (Meluchová, & Mateášová, 2021). The written form of the accounting record has been replaced by the term the paper accounting record, and the technical form of the accounting record has been replaced by the term the electronic accounting record. The electronic accounting record has been specified as the accounting record made:

a) In the electronic format, and received or made available in the electronic format, whereby the electronic format is determined by the issuer of the accounting record or is determined on the basis of agreements with the recipient of the accounting record;

b) In accordance with Act on Accounting and sent electronically, for example as an attachment of an e-mail;

c) In electronic format for internal purposes of the accounting entity.

The accounting entity is required to ensure the credibility of the origin, the integrity of the content, and the legibility of the accounting record from the moment the accounting record is made (received, made available) until the end of the archiving period of 10 years. These are three new very important requirements for the accounting record. The credibility of the origin and the integrity of the content of the accounting record can be ensured by the signature of the responsible person, by electronic data exchange, or by the internal control system of the accounting records. The signature of the person responsible for the accounting transaction can be replaced by the electronic data interchange or by the internal control system. The electronic data interchange is the computer-to-computer exchange of business documents in a standard electronic format between business partners, which goes through a

process of verification, coordination, approval, and accounting for without the possibility of human intervention in the content of the accounting record. The signature can be either a handwritten signature, a qualified electronic signature or a similar verifiable signature replacing a handwritten signature in electronic form, which enables unambiguously verifiable identification of the person who made the signature. The signature will be accepted if the person uses a personal access code (name, password, key) to enter the information system. The accounting entities are required to determine the persons responsible for controlling the accounting process, as the internal control system of accounting records.

The new amendment of the *Act on Accounting* adjusts the method of transformation of the accounting records from the paper form into the electronic form, or vice versa. The transformation of the accounting record can be performed by a guaranteed conversion or by scanning into a file format in raster graphic form (for example saved in .pdf, .png, .jpg format). In the context of the archiving of accounting documentation, the amendment to the Act on Accounting defines the methods of storage of electronic accounting records on a data storage device, which can be optical drive, flash drive, memory stick, hard drive, cloud storage, and so on (Černegová, 2021).

Another important part of digitalization of accounting in the Slovak Republic is the Register of the Financial Statements (hereafter referred to as "register") that has been introduced by the *Act No. 547/2011 amending Act on Accounting* effective from 1 January 2013.

The register represents the information system of public administration administered by the Ministry of Finance of the Slovak Republic, which is as the register administrator responsible for creation, maintaining, and operating the register; for collecting and processing information from financial statements; for performing formal control of information contained in financial statements; for providing and making accessible documents filed in register to public administration bodies and other entities. The register is operated by the DataCentrum. The register in the Slovak Republic is divided into a public part and a nonpublic part. The public part of the register consists of documents of an accounting entity that prepares financial statements in accordance with IFRS; a company; a cooperative; a state-owned enterprise; a public administration entity; and other accounting entities if financial statements of these entities shall be publicly accessible.

The accounting entities in the Slovak Republic are required to file into the register mainly the financial statements; statements of selected data from financial statements; auditor's reports; Announcement on the approval of the financial statements, and so on. Accounting entities were allowed to file these documents in the electronic form or in the paper form till the end of 2021, except for value added taxpayers. Value added taxpayers have been obliged to communicate with tax authorities only electronically since 2014, which means that financial statements as well as all tax returns, and all other accounting and tax documentation were required to be delivered only in the electronic form. From 1 January 2018, the mandatory electronic communication was extended to all legal entities registered in the Commercial Register, and from 1 July 2018 to all sole traders carrying out business activities or other activities generating income, if they support their expenses incurred to achieve, maintain and sustain income for the purpose of determining the income tax base according

to *Act No. 595/2003 Coll. on Income Taxes as amended*. The new amendment of the *Act on Accounting* effective from the 1 January 2022 requires all accounting entities to deliver all the accounting documentation (including financial statements, annual reports, and the Announcement on the approval of the financial statements) only in the electronic form to register. The process of filing the documentation is simplified and the errors resulting from non-automated processing of financial statements are eliminated. Some accounting entities, such as the Slovak Information Service and the accounting entities not established for carrying out business activities (for example civic associations, which do not prepare tax returns, or are not required to have their financial statements audited by an auditor) can still file the financial statements in the paper form on to the register.

Electronic documents are delivered via the electronic mailroom operated according to *Act No. 563/2009 Coll. Tax Administration Law as amended*. The Financial Directorate of the Slovak Republic passes documents delivered in the electronic form on to the register administrator. The register administrator afterwards makes documents of accounting entities accessible in the public part of the register to all persons through the website in the electronic form. As of the 1 January 2022, the public part of the register will include financial statements of all legal entities that are obliged to file their documents on to the register, including community land trust, non-governmental non-profit organizations (civic associations, associations of owners of apartments and non-residential premises), and so on. In the non-public part of register only accounting documents of individuals that are not considered to be an accounting entity and organizational units of foreign entities will be filed.

The public part of the register allows accounting entities to have an access to financial statements of other accounting entities. Thus, they can work with datasets consisting of particular data and compare their economic results, financial position, and performance with other entities, or in time.

As of the 1 January 2022, the communication between the Financial Administration Authority of the Slovak Republic (hereafter referred to as "FAA") and taxpayers changed, too. The FAA will deliver documents to taxpayers exclusively electronically through the Central Government Portal (Slovensko.sk) in accordance with *Act No. 305/2013 Coll. on e-Government*. Till the end of 2021, the communication between taxpayers and the FAA has been providing through Financial Administration Portal (www.financnasprava.sk) in one direction – from the taxpayers to the FAA. As of the 1 January 2022, the communication will be carried out in both directions electronically (Financial Administration Authority, 2021). The main benefit of a comprehensive both-direction communication is to make more effective and speed up mutual communication between the FAA and its clients, making it one of the modern institutions within the European Union. It is expected that the implementing of both-direction communication will reduce operating financial costs, as well as decrease the number of printed paper documents that will have the positive impact on the environment.

Electronic communication relates not only to communication between accounting entities and accounting or tax authorities, but also to communication between business partners. It is obvious, especially in this time of COVID-19, when due to restrictions personal meetings and exchanging documents are limited, that accounting entities use other forms of

delivering documents to their business partners, accountants, and auditors. The very popular form of processing the accounting documents is scanning them and sending them in .pdf format to the responsible persons, or just simply use the electronic format with electronic signature.

3.3. *The Readiness of Companies for Digitalization and Automation*

Every activity in the company, such as the business process, the process of acquiring new customers, caring for existing customers, developing new products or services, and so on, can be automated and optimized with usage of digital technologies. The automatic transfer of orders from e-shop into accounting, mobile warehouse, online invoicing, intelligent warehouse management or remote document approval belong to other processes that can be digitalized and automated in the company. The delivery of goods or services can be invoiced from a mobile phone, payment of invoice can be made just by one click. Payments by smart phones or smart watches are commonly used nowadays. The entrepreneur can create bank account just by using smart phone and Internet.

Despite using of various accounting systems in accounting practice, and efforts to automate all processes in the company in the paper-less way, there are still documents (such as labor law documents) that need to be in the paper form. The most important issue is the possibility to archive documents in the digital form using the DMS. Incoming invoice in the paper form is transforming into the electronic form by scanning it in the registry office and extracting metadata from it. As a result, instead of the paper form of the document, only electronic one runs in the accounting entity. The electronic form of document then passes the approval process in the DMS, and after approval, the invoice is accounted for. These are examples of only few activities in the accounting entities that can be automated and digitalized.

The accounting practice in the Slovak Republic has proved that automation, digitalization, and the implementation of legislative changes related to digitalization of accounting is in progress. Although it is too early to evaluate the advantages and disadvantages of new changes, we interviewed six accounting entities during December 2021 and January 2022 about their readiness for digitalization in their practice. Three of interviewed entities were international consulting companies, and three were Slovak accounting entities providing accounting and tax services. In the paper, we state only first opinions, because we do not consider this sample relevant. According to respondents, the long-term benefit of digitalization as the result of scientific and technical development is obvious and unquestionable. The artificial intelligence influences all areas of decision-making, and management processes. The respondents have mentioned insufficient technical equipment, financial sources for implementing changes, professional training of employees, and analysis of relevant risks as the main problems related to digitalization.

Processes related to digitalization and automation, such as downloading of documents, their import into accounting software, and their automated accounting for, are, according to respondents, already being implemented. The respondents from consulting companies providing accounting and tax services see the fundamental change in the fact, that

professional consultancy will no longer be provided as a service only, but rather as a ready-made comprehensive solution that clients will take full advantage of for fee. Due to rapid changes, in which business operates today, clients will no longer have time or professional capacity to spend their financial resources to analyze their problems and search for optimal solutions. Instead, the clients will prefer an approach, where the consulting company has a ready-made solution for their current problems, which can be implemented in a short time. The increased rate of services outsourcing, higher specialization and global solutions through shared services centers have been also mentioned by respondents. Innovations, the flexibility and the ability to adapt to technical progress in digitalization will also play a significant role in accounting and tax consultancy companies. Each of interviewed companies works on projects related to applications that enable to external clients, as well as to internal employees to upload accounting documents into the system, record and approve attendance of employees, to scan documents for accounting for, assign documents according to the nature of the activity, and so on.

Another issue that is necessary to take into granted is, if Slovensko.sk as the central public administration portal, or FAA are prepared technically for full electronization and digitalization of companies. Will the existing system be able to handle the onrush of clients? The practice from January 2022 has proved big problems resulting from outages of the portal. Due to these outages, many companies were not able to file value added tax returns, as well as other documents filed electronically, on time. The accounting entities have not been penalized, yet. But what if the problem will repeat every month?

4. Conclusions

The accounting profession belongs to the professions the most affected by the technological development and digitalization. Nowadays, the accounting profession is faced with numerous challenges, such as the use of big data in accounting and financial reporting, cloud computing, blockchain technology, artificial intelligence. Digital systems are now actively used in the accountancy profession, and complicated accounting transactions are made easily and quickly, with cost savings and higher effectiveness. The profession of accountant is changing to somebody like Accounting Engineering – a person with accounting and engineering abilities. It is expected that the person of the accountant will be replaced by artificial intelligence in the near future and the work of accountant will be fully automated. Automation of processes related to accounting, accounting reporting, taxes, and audit has many advantages, but we can also see some limitations. The main benefits are cost savings; effective business processes; automated collection and payment processes; increasing transparency, productivity and competitiveness of processes; increasing data reliability, predictability; decreasing of operating costs, and so on. Limitations of digitalization and automation are especially the risk of unauthorized access to company's data; Internet and electricity outages; implementation costs, or regulatory compliance.

Our paper proves that the Slovak Republic has made a giant step towards digitalization and automation in accounting and tax practice. Due to the new amendment of *Act on Accounting* that entered into force on 1 January 2022, and that reflects mainly new challenges

related to electronic communication, the digitalization of accounting processes will be easier for accounting entities. Another positive matter is that as of the 1 January 2022, the whole communication between accounting entities (taxpayers) and the FAA will be provided entirely in the online environment using information technologies in both directions. We consider it a positive step within the corporate social responsibility, because this change will affect not only the performance of the accounting profession, but also have the positive impact on the environment.

The digitalization, automation, and electronical communication concern not only big multinational companies, but also small and medium sized companies, self-employed persons, and individuals. But are all these entities ready for this? Do they have sufficient technical and digital knowledge, and technical and software support? The age, education, experience and technical skills of persons acting on behalf of the accounting entity belong to other factors that have to be considered, when thinking about digitalization. Will the employees be able to keep up with technical progress and the government´s requirements for electronic communication? And what about the failure of the system? Will there be any sanctions if the accounting entity files the financial statements, tax returns or other notifications after the deadline due to technical problems?

Our brief research has revealed that many processes in accounting entities are more or less automated and digitalized. The insufficient technological equipment and the lack of financial sources are complications the accounting entities are facing regarding digitalization. Another point resulting from our brief research is that due to rapid changes in digitalization, the clients expect from accountants and consulting companies the ready-made comprehensive solution for their current problems that can be implemented in a short time.

Cyber security is another issue to be considered in the context of electronic communication. It is technically and financially demanding. Increasing protection of systems, networks and data from cyber-attacks from external, as well as from internal environment of the accounting entity should be the highest priority, when thinking about electronic communication.

There are many other challenges and issues related to digitalization that need to be considered, and solved in order to avoid problems and misunderstandings in the future. Only implementation can reveal its weaknesses and strengths. Responding to these questions and challenges could be the subject of the further research.

Conflict of interest: none

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Differences in the Level of Global Competence: A Case of Visegrad and Baltic Countries

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Abstract: The concept of global competence gained significant attention in the recent years, since especially young people are expected to effectively cooperate with individuals coming from diverse cultural and value systems. The aim of the paper is to provide an analysis of differences in the level of the global competence between Visegrad and Baltic countries as well as within these countries, in terms of gender and socio-economic status of the students. Based on comparison of the results of the OECD global competence survey released in October 2020 it can be concluded that students from Baltic countries show on average relatively higher level of global competence than students from Visegrad countries. Moreover, girls in the most cases and students with a more favorable background in all cases, report significantly greater level of global competence in each observed country.

1. Introduction

In the recent years, the concept of global competence is in the focus of attention of not only individual scholars but also international institutions, since many challenges and issues spill over from country to country and quickly become global. Hence, besides other aspects of personality development necessary for successful professional life such as emotional intelligence (e.g. Mura et al., 2021) specific competences needed for living in increasingly interconnected and changing world are important too. Especially young people are expected to cooperate with individuals coming from diverse cultural and value systems, while solving complex problems and creating economic and social values.

The concept of global competence itself is broadly described in the literature as a set of knowledge and skills that should make it easier for people to understand the environment around them, integrate across disciplinary areas in order to capture global issues and events and create opportunities for solutions (Reimers, 2010). More precisely, globally competent people have capacity to explore the world outside their immediate surroundings, recognize one's own and others' perspectives, communicate ideas effectively with different audiences and take steps to improve conditions (Mansilla & Wilson, 2020). The multidimensional facet of the global competence is reflected also in the approaches designed to its assessment.

One of the most known approaches based on dimension scope originally created by Hunter et al. (2006) is the Global Competence Aptitude Assessment, which was created on a basis of surveys of internationally renowned experts. Although it was originally aimed at assessing the global competence of employees in multinational companies without taking into

account other groups of the population, over time it has also found application in educational institutions (e.g. Schenker, 2019). However, one of the shortcomings that limits the wider international applicability of this instrument is its focus on the U.S. environment without considering broader international context. There are also some other individually developed approaches for assessment of global competence that are rather narrower in their scope or designed for specific situations or conditions (e.g. Li, 2013).

One of the most recently developed approach in this regard is the global competence framework, introduced by the OECD´s Program for International Student Assessment (PISA) in 2018. Since the OECD considers the concept of global competence to be a key issue for education systems around the world, it highlights own dominant status in evaluating such key interest (Andrews, 2021). The OECD global competence framework itself as well as the outcomes of evaluation published in October 2020 (OECD, 2020) evoked extensive academic discussion in this regard (e.g. Engel et al., 2019; Robertson, 2021).

Since outcomes of global competence assessment under PISA provide internationally comparable indicators of students´ performance in various dimensions, these results form a basis for analysis conducted within this paper. The methodology section of the paper introduces briefly the global competence framework itself, as well as the selection of the data used for own analytical purposes. The subsequent section brings the results and their discussion followed by concluding remarks.

2. Methodology

The aim of the present paper is to provide analysis of differences in the level of the global competence between the group of Visegrad and Baltic countries as well as within these countries, in terms of gender and socio-economic status of the students. Based on this, following research questions are formulated:

1. Are students from Visegrad countries more globally competent compared to their counterparts from Baltic countries?
2. Do boys show a different level of global competence compared to girls?
3. Do students living in diverse socio-economic environments show significant differences in the level of their global competence?

Only those countries that take part in the PISA global competence survey are included in the analysis, namely Slovakia, Poland and Hungary for the group of Visegrad countries and Estonia, Latvia and Lithuania for the group of Baltic countries.

For the purpose of the analysis, results of existing extensive survey completed in 2018 and published in 2020 (OECD, 2020) under the auspices of PISA were used. The survey was aimed to assess the level of global competence of students at the age of 15 years in 66 countries including three Visegrad and three Baltic countries. First, at least 150 schools were selected in each participating country, within which subsequently 42 students were picked out with the same likelihood to complete the survey, however their number could deviate from 42, but could not fall below 20.

Overall, the PISA assessment examines comprehensively whether students can reproduce what they have acquired at the end of compulsory education, as well as how well

students can extrapolate from what they have acquired and use their knowledge in an unknown environment inside and outside the school. Hence, PISA global competence framework has multidimensional nature, which consists of combination of four dimensions assessed through specific questions, as it is shown in Figure 1.

I. Examine local, global and intercultural issues - awareness of global issues - self-efficacy regarding global issues	*II. Understand and appreciate the perspectives and world views of others* - ability to understand the perspectives of others - interest in learning about other cultures - respect for people from other cultures - cognitive adaptability - attitudes towards immigrants
Global Competence	
III. Engage in open, appropriate and effective interactions across cultures - awareness of intercultural communication	*IV. Take action for collective well-being and sustainable development* - agency regarding global issues

Figure 1. Global competence framework (Adopted from OECD, 2020)

The first dimension of global competence framework is designed to assess students' ability to combine the knowledge they have gained about the world through formal education with their critical understanding and ability to form own opinions on local or global issues. The second dimension of global competence is routed around students' capacity to cope with unusual situations, including their interest in getting to know other cultures, as well as their attitudes towards individuals from other cultural backgrounds, including immigrants. The third dimension explores students' ability to engage in intercultural communication and their intensity of contacts with individuals from other cultures. Within fourth dimension, the practical nature of the above mentioned skills is assessed, namely students' sense of independence in relation to global issues and their ability to act for the collective good and sustainable development.

PISA´s assessment of global competence is based on the use of the two instruments, namely a questionnaire, which brings self-reported information from students on a set of questions and a cognitive test that is aimed at the cognitive aspects required to solve problems related to global and intercultural issues. With regard to the questionnaire, it assessed students' attitudes, knowledge and skills concerning all four dimensions of global competence. Likert-type scales were used to answer the questionnaire items and individual indexes related to particular countries and questions were further calculated. Positive values in the individual indexes indicate a higher level of global competence in the particular dimension in comparison to the average student across OECD countries and vice versa.

The OECD average refers to the arithmetic average of the results of the countries concerned. Since the main interest within this paper is to conduct comparative analysis of the global performance with regard to the gender and socio-economic differences, the results of testing of differences for statistical significance at the level of 5% are reported too. With regard to gender, positive differences show greater values for girls, while negative differences show greater values for boys. Similarly, regarding differences between other groups of students, i.e. socio-economically advantaged and disadvantaged students, positive differences show greater values for students with advantaged backgrounds (i.e. those in the upper quarter of the PISA index of economic, social and cultural status – ESCS) and vice versa.

3. Results and Discussion

Before analysis of the gaps in the level of global competence of the particular groups of students, the graphical display (Figure 2) shows overall level of students´ global competence in the target countries. The OECD average mean partial indexes have the value of zero.
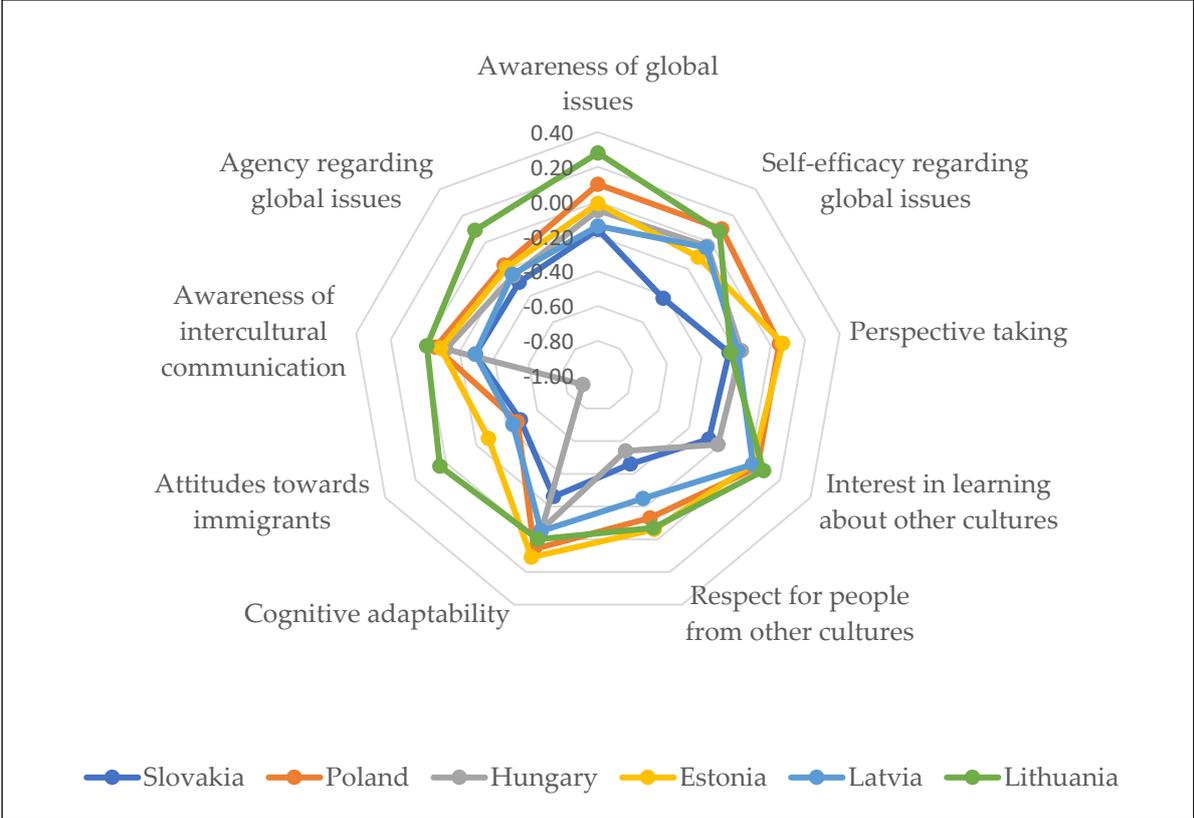
Figure 2. Overall level of students´ global competence in Visegrad and Baltic countries (based on the data adopted from OECD, 2020.)

Figure 2 shows that the highest level of global competence, slightly exceeding the OECD average in the most cases, is reported by Lithuania, driven especially be awareness of global issues, such as migration, sources and reasons of hunger, malnourishment and penury at various places of the world. Similar positions oscillating around the OECD average are shown by Poland and Estonia, with the common highest values of the index in cognitive adaptability and the lowest values of the index in attitudes towards immigrants. The relatively lowest level of global competence among Baltic countries is reported by students

in Latvia, with negative values of all the partial indexes except for desire to get to know people from other cultural backgrounds. Students from Hungary and Slovakia showed the lowest level of global competence with below average values of partial indexes in all cases. Extremely low values of the index reported both countries in the case of attitudes towards immigrants, which may generally be caused by perception of immigrants as competitors in filling vacant working positions as well as by their negative impact on public sources (Facchini & Mayda, 2009).

Within further step of the analysis a comparison of differences in the level of global competence among particular groups of students was conducted. Table 1 and Table 2 show the differences in the values of the mean index of each question designed to evaluate the level of global competence from the gender and socio-economic status point of view, for each Visegrad and Baltic country separately.

Table 1. Differences in the mean index values – Visegrad countries (based on the data adopted from OECD, 2020.)

	Slovakia		Poland		Hungary	
Dimension	Girls - boys mean index	Top - bottom quarter mean index	Girls - boys mean index	Top - bottom quarter mean index	Girls - boys mean index	Top - bottom quarter mean index
Awareness of global issues	0.1372*	0.6583*	0.0450	0.5409*	0.0430	0.5921*
Self-efficacy regarding global issues	-0.0857*	0.5604*	-0.0239	0.6209*	-0.1612*	0.6362*
Perspective taking	0.1922*	0.1060*	0.2964*	0.1865*	0.1202*	0.3113*
Interest in learning about other cultures	0.3109*	0.3662*	0.4239*	0.4316*	0.2948*	0.5237*
Respect for people from other cultures	0.4581*	0.4712*	0.6981*	0.3921*	0.2915*	0.6696*
Cognitive adaptability	-0.0321	0.1524*	0.018	0.2730*	-0.075*	0.3974*
Attitudes towards immigrants	0.2154*	0.2306*	0.3956*	0.0659*	0.1160*	0.2541*
Awareness of intercultural communication	0.2006*	0.3918*	0.2690*	0.3822*	0.1223*	0.3720*
Agency regarding global issues	0.1268*	0.3485*	0.2122*	0.2646*	0.0595*	0.3616*

* asterisk indicates statistically significant differences at the 95% confidence level

Students' awareness of global issues shows their consciousness about questions like change of climate and warming of the globe, migration, hunger or malnourishment at various places of the world, penury, global health, international frictions and gender gaps. In the case of girls, greater awareness of global issues was shown, however for Poland and Hungary the difference is not statistically significant. Similarly, students with advantageous backgrounds showed in all cases significantly higher awareness of issues with global scope that can be possibly attributed to the differences in access to information about these issues. This might be difficult in the case of vulnerable groups of students who are e.g. subject to grade repetition. Various after school programs could play a key role in this regard, providing these students with additional learning opportunities (Klumpner & Woolley, 2021).

Table 2. Differences in the mean index values – Baltic countries (based on the data adopted from OECD, 2020.)

	Estonia		Latvia		Lithuania	
Dimension	Girls - boys mean index	Top - bottom quarter mean index	Girls - boys mean index	Top - bottom quarter mean index	Girls - boys mean index	Top - bottom quarter mean index
Awareness of global issues	0.0756*	0.5002*	0.1560*	0.4441*	0.2823*	0.6405*
Self-efficacy regarding global issues	-0.0689*	0.5382*	-0.0560	0.6027*	-0.0125	0.6085*
Perspective taking	0.2889*	0.2988*	0.2260*	0.3095*	0.3279*	0.3613*
Interest in learning about other cultures	0.5009*	0.3936*	0.4332*	0.3233*	0.4774*	0.5078*
Respect for people from other cultures	0.5795*	0.4318*	0.4820*	0.5955*	0.5767*	0.5109*
Cognitive adaptability	0.0358	0.4198*	-0.070*	0.4118*	0.0658*	0.4695*
Attitudes towards immigrants	0.2600*	0.1934*	0.2180*	0.1311*	0.4034*	0.2693*
Awareness of intercultural communication	0.2675*	0.3281*	0.2750*	0.2721*	0.3618*	0.3961*
Agency regarding global issues	0.2219*	0.3627*	0.1417*	0.2806*	0.3234*	0.3762*

* asterisk indicates statistically significant differences at the 95% confidence level

Self-efficacy regarding global issues reflects the extent to which students could independently perform certain tasks related to global competencies. Boys showed slightly higher values of the index in this dimension; however, the gender differences are statistically significant only for Slovakia, Hungary and Estonia. With regard to socio-economic status, the findings indicate students in the upper quarter of the PISA index of economic, social and cultural status to have significantly greater self-efficacy concerning problems of the globe compared to students in the lower quarter of that index in all countries. One potential reason for this finding is that students with better access to media including social networks may be more acquainted with topics that are widely discussed in the media, such as global warming or the refugee crisis. According to McNelly and Harvey (2021), teachers should play an important and active role in developing conscious use of media and raising young people's media literacy.

The perspective taking question shows the extent to which students are able to appreciate and understand the worldviews of others who might be distinct in their cultural backgrounds, attitudes, beliefs or practices. Significantly greater sensitivity toward understanding the perspectives of others showed in all cases girls and students with advantageous backgrounds that might be related to the different approaches associated with educational activities within different socio-economic groups as well as to the differences in ability to operationalize cultural knowledge and assess culture-specific situations (LaRusso et al., 2016).

Interest in other people's cultures is generally based on acquiring knowledge about other cultures and willingness to be exposed to various cultural influences. Similarly, as in the case of the previous question, girls and students from the upper quarter of the ESCS

index showed significantly higher willingness to learn about other cultures what can be connected with curiosity, opportunities and sensitivity towards people from different backgrounds (Clark & Seider, 2017).

Respect for people from other cultures is based on the premise that all people have the same inner dignity and the inalienable right to select their own affiliation, opinions, beliefs and practices. The interconnectedness of the questions covering the dimension of the understanding and appreciation the worldviews and perspectives of others is reflected also in gender and socio-economic differences, since girls and students with advantageous background have significantly greater respect for people from other cultures in all reported cases.

Cognitive adaptability is associated with the capability to adapt one's thought and behavior to the prevailing cultural context or to new situations from which new requirements or challenges may arise. In the case of cognitive adaptability, the prevalence of girls is not so significant, what is particularly true for Estonia and Poland. On the other hand, in the case of Hungary and Latvia boys showed statistically significantly higher level of cognitive adaptability. Hence, the nature of gender gap is ambiguous in this question. Similarly as in previous cases, students with more favorable socio-economic status have possibly more opportunities to acquire cognitive adaptability skills which should in turn help them cope with feelings associated with cultural shock, such as stress, frustration, and alienation in novel environments (Levin, 2015).

The overall attitude towards immigrants reflects attitudes to such questions as equality of access to education, the possibility to vote and other rights that immigrants should have. More positive attitudes towards immigrants are shown by girls and students with advantageous backgrounds. These results are basically in line with findings reported by Alivernini et al. (2019) who showed that girls have a more affable attitude towards immigrants than boys.

Awareness of intercultural communication is focused on students' ability to communicate understandably and clearly in a wide range of situations, including interactions with foreign-speaking people. Girls and socio-economically advantaged students in all countries reported more significant ability to communicate across cultures than boys and their disadvantaged counterparts.

Agency regarding global issues is built on the other dimensions of global competence and emphasizes the practical and action targeted nature of the acquired skills. Again, a significantly greater sense of responsibility for the global challenges connected with caring for future generations and actions for collective well-being have girls and students with advantageous background.

4. Conclusions

The present study was focused on comparison of the level of global competence of the students between Visegrad and Baltic countries, as well as within these countries, in terms of gender and socio-economic status of the students. As the main tool, the results of PISA global competence survey were used. The results indicate that students from Baltic countries show

on average relatively higher level of global competence compared to Visegrad countries that is driven especially by Lithuania. On the other hand, students from Visegrad countries are less globally competent even when compared to the OECD average what is influenced especially by their markedly negative attitude toward immigrants. Possible reasons for this attitude can be found in the overall political climate, which is externally presented to the society. However, these aspects deserve further investigation within future research.

In terms of gender, responses on the majority of questions indicate greater level of global competence in the case of girls that can be possibly attributed to their greater cultural sensitivity. Only for "self-efficacy regarding global issues" and "cognitive adaptability" are the results ambiguous, with greater differences among investigated countries. On the other hand, in terms of socio-economic status, students with a more favorable background, (i.e. those in the upper quarter of the PISA index of economic, social and cultural status) report in all countries and with regard to all questions, significantly greater level of global competence compared to their disadvantageous peers. These findings most likely reflect differences in access to advanced education, including language learning, as well as opportunities to travel and practically interact with people from other cultural backgrounds. Deeper investigation of these aspects forms agenda of future research.

Conflict of interest: none

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Blockchain in Tourism – Systematic Review

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Abstract: Contemporary world is experiencing technological changes that are driven by data and its effective use. Cloud computing solutions and blockchain technology are ground-breaking technology. The tourism sector is facing significant challenges, it is necessary to change traditional approaches to tourism management. The aim of the paper is to understand the current knowledge of the role of blockchain in tourism. The paper is based on PRISMA 2020 guidelines for systematic reviews. The review is made up of 15 articles that were selected from the original 76 records that were found in the initial search on the Web of Science. The process is illustrated by a flow chart for systematic reviews. Key identified categories in this review are: customer aspect, technical aspect, legal concern, socio-economic aspect and environmental aspect, however, these aspects are not distributed evenly. Monitoring the interconnectedness of these aspects is a suitable topic for further research. A drawback of the review is that majority of the papers were theory-based and did not provide a real-life scenario. Authors claimed that this technology has the potential to bring many benefits, however, its implementation requires radical changes in companies, legislation and government, as well as the users themselves.

Keywords: blockchain; tourism; systematic review

JEL Classification: C80; Z32

1. Introduction

Given the changes and decline in interest in tourism caused by the COVID-19 pandemic, the time is right to look for new technologies and approaches that could have a positive impact on tourism development today. One such breakthrough technology could be the blockchain, which is known primarily in connection with cryptocurrencies. The aim of this systematic review is to find the possibilities of using blockchain in the tourism sector, the advantages, or risks of implementing this technology and to summarize identified approaches in this area. A blockchain is a socio-economic tool. Blockchain is trendy technology that is gaining more and more potential use in tourism. The tourism sector is facing significant challenges, the enormous amount of travel-related data brings great difficulties to tourism management. Processing the increasing amount of data is demanding both in terms of staffing and finance. It is necessary to develop a strategy how to change traditional approaches in tourism management via the employment of blockchain technology.

2. Methodology

The aim of the paper is to understand the actual current knowledge of the role of blockchain in tourism. As an entry into the research, a review is conducted because it enables

to figure out what the articles deal with, and what categories and aspects are most often researched.

The Paper is based on PRISMA 2020 guidelines for systematic reviews (Page et al., 2021). The search was conducted on 6th April 2022. The articles were selected from the Web of Science (WOS), where the primary criterion was to search for articles where the Topic was stated 'blockchain AND tourism'. Then, records that were not an article or proceedings paper, not in English, not available as Open Access and did not fall into the correct field were discarded. The following fields were selected as correct fields: Social Sciences Other Topics, Business Economics, Computer Science, Science Technology Other Topics, Telecommunications, Government Law, Public Administration, Information Science Library Science, Public Environmental Occupational Health. Due to the number of records and the recent year of release, there was no need to exclude articles due to the year of publication. One of the articles could not be obtained. Despite the applied filter, there was no Open Access and it was not possible to obtain a full paper. In this phase of the process, 18 papers were selected, which were then subjected to a full paper review. In one case the issue only concerned health tourism and not tourism as a whole and in the other two cases, the paper dealt with supply chain management and tourism was mentioned in the article only as one of the areas of potential blockchain technology use.

The search process was worked out by the authors, it was partially automated using Zotero citation software, which enabled the import of results from WOS, identification and automatic download of full papers and then work with citations. Due to the smaller number of articles, it was possible to conduct a full paper review of all the papers and subsequent manual identification of keywords and topics in the articles based on which it was possible to develop the main categories of this issue.

3. Results

According to the search strategy, which is described in the methodology, the review is made up of 15 articles that were selected from the original 76 records that were found after the initial search on the Web of Science. The process is illustrated by a flow chart (Figure 1) for systematic reviews based on PRISMA 2020.

Of the first 76 records, 12 records were discarded due to the wrong document type, 5 records due to the wrong field, 1 record due to an unwanted language, and 39 records that were not Open Access paper. Failed to get 1 record due to the fact that there was no open access paper through the filter. 18 contributions were submitted to the full review procedure, of which 3 were discarded because they did not fall into the given issue. This systematic search thus consists of 15 studies.

Table 1 summarizes basic information on selected studies: author and year of publication, title, number of citations and type of paper. The number of citations (Times Cited) is based on citations on the Web of Science.

Table 2 summarizes the scope and topics discussed in reviewed papers. We distinguished the basic aspects in the articles, that the authors examined. There were papers focused on customer-aspect (papers 1- 4, 9, 11, 13), then technical aspect (papers 2, 4, 6, 9-15),
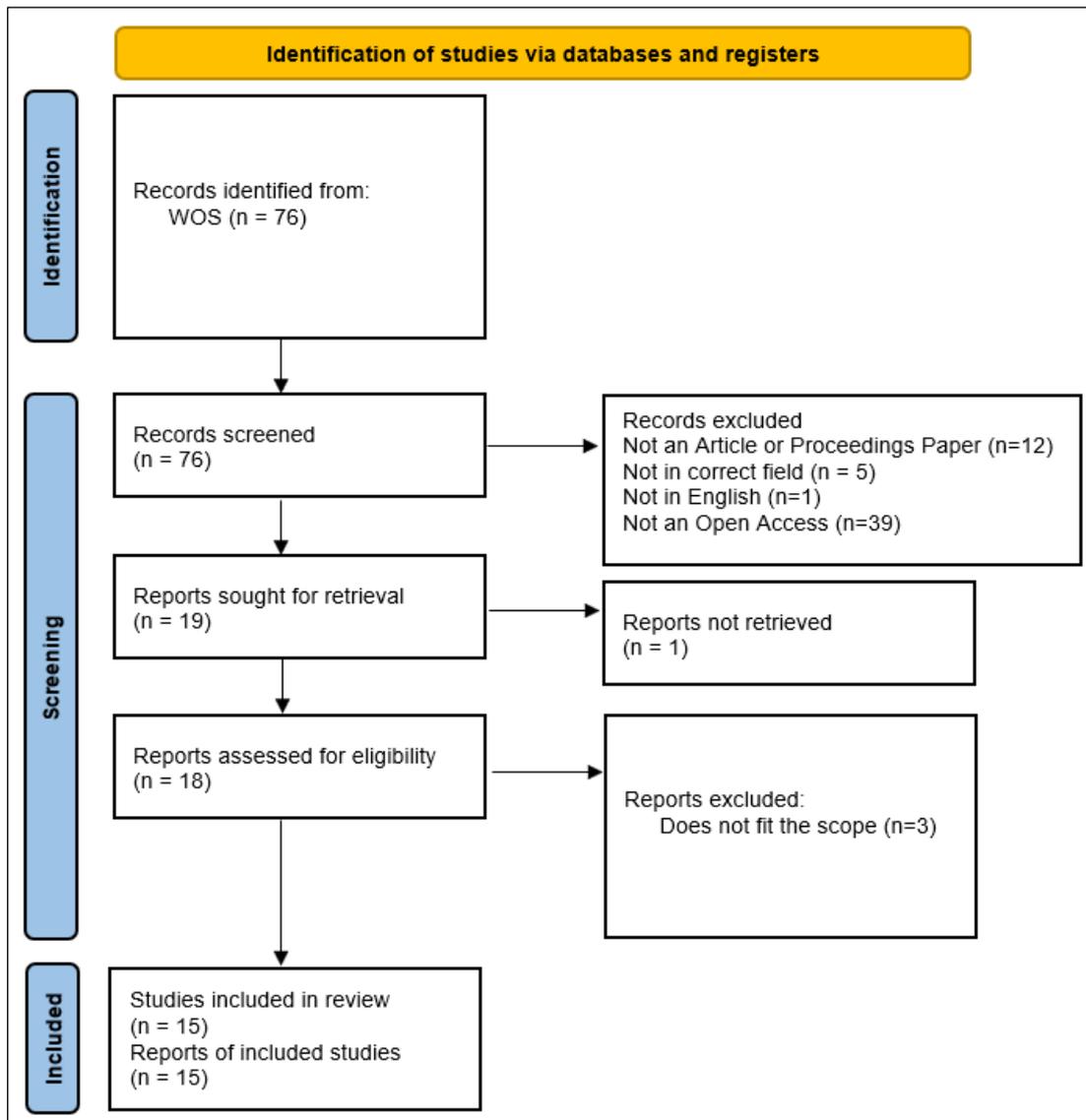
Figure 1. Flow diagram

utilization of concepts or existing applications (papers 1, 3-8, 11, 13-15), legal concerns (papers 1-7, 9, 11, 14) or socio-economic aspect (papers 1-3, 6, 7, 10, 13-15). Then some authors dealt with environmental issues (papers 14, 15) and as for COVID related papers, there were just two out of 15 examined articles (papers 3, 15). In addition, Shrestha et al. (2019) also addressed the need for blockchain applications and environments to be easy to use and to focus on quality. Zhang et al. (2021) were the only ones to deal with app interoperability and the use of the REST API. Veloso et al. (2019) discussed crowd-sourcing platforms and Wei et al. (2020) were the only ones to consider using big data.

There was an interesting article on medical tourism that unfortunately had to be discarded because it didn't fit the scope. (Tyan et al., 2021) The authors provided a comprehensive view of the advantages and disadvantages of their blockchain concept for medical tourism. However, since it is tourism focused primarily on health care, the paper had to be excluded, as this area has a large number of characteristics that are only applied to medical tourism and not tourism as a whole. The other two articles were excluded for a

Table 1. Selected papers

	Author and Year*	Title	Times Cited	Type of paper
1	Tyan et al. (2020)	Blockchain Technology for Smart Tourism Destinations	4	Article
2	Fragniere et al. (2022)	BLOCKCHAIN TECHNOLOGY IN THE TOURISM INDUSTRY: NEW PERSPECTIVES IN SWITZERLAND	1	Article
3	Raluca-Florentina (2022)	The Utility of Blockchain Technology in the Electronic Commerce of Tourism Services: An Exploratory Study on Romanian Consumers	0	Article
4	Zhang et al. (2021)	Interoperable Multi-Blockchain Platform Based on Integrated REST APIs for Reliable Tourism Management	0	Article
5	Melkic & Cavlek (2020)	The impact of blockchain technology on tourism intermediation	1	Article; Proceedings Paper
6	Barreto et al. (2019)	Cryptocurrencies and blockchain in tourism as a strategy to reduce poverty	2	Article
7	Viano et al. (n.d.)	Blockchain tools for socio-economic interactions in local communities	0	Article
8	Veloso et al. (2019)	Distributed Trust & Reputation Models using Blockchain Technologies for Tourism Crowdsourcing Platforms	7	Proceedings Paper
9	Wei et al. (2020)	Research on Construction of a Cloud Platform for Tourism Information Intelligent Service Based on Blockchain Technology	4	Article
10	Filimonau & Naumova (2020)	The blockchain technology and the scope of its application in hospitality operations	21	Article
11	Ahmad & Shah (2021)	MOVING BEYOND THE CRYPTO-CURRENCY SUCCESS OF BLOCKCHAIN: A SYSTEMATIC SURVEY	0	Article
12	Shrestha et al. (2019)	User Acceptance of Usable Blockchain-Based Research Data Sharing System: An Extended TAM-Based Study	7	Proceedings Paper
13	Nuryyev et al. (2020)	Blockchain Technology Adoption Behavior and Sustainability of the Business in Tourism and Hospitality SMEs: An Empirical Study	28	Article
14	Karger et al. (2021)	Blockchain for Smart Mobility-Literature Review and Future Research Agenda	0	Article
15	Benedict (n.d.)	Shared Mobility Intelligence Using Permissioned Blockchains for Smart Cities	0	Article

* n.d. designate early access

similar reason, as they focused exclusively on supply chain and blockchain use without the perspective of tourism. (Sharma et al., n.d.; Varriale et al., 2020)

(Wei et al., 2020) present a design of a comprehensive platform that would meet the requirements of smart tourism and would connect a wide range of stakeholders. It promotes the coordination of tourism management and service and the economic development of destinations that enable the development of a friendly relationship between tourists and community residents. Research is run at consumer and technological levels. Research is based on user behaviour analysis conducted on a series of priority selection rules. The Internet of

Table 2. Scope of selected papers

	Tyan, I. et al.	Fragniere, E. et al.	Raluca-Florentina, T	Zhang, L. et al.	Melkic, S., Cavlek, N	Barreto, I. B. et al.	Viano, C. et al.	Veloso, B. et al.	Wei, C. et al.	Filimonau, V., Naumova, E.	Ahmad, M. S., Shah, S. M.	Shrestha, A. K., Vassileva, J.	Nuryyev, G. et al.	Karger, E. et al.	Benedict, S.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Costumer	x	x	x	x					x		x		x		
experience	x	x		x					x						
satisfaction			x	x											
trustworthy reviews							x				x				
Technical		x		x		x			x	x	x	x	x	x	x
technology acceptance model												x	x		
cloud platform									x						x
smart contract		x		x		x				x	x	x		x	
Uses	x		x	x	x	x	x	x			x		x	x	x
cryptocurrencies	x		x	x	x	x	x	x			x		x	x	
smart cities	x			x							x			x	x
smart tourism	x			x						x	x	x			
mobility / shareable vehicles														x	x
supply chain				x		x				x					
Legal	x	x	x	x	x	x	x		x		x			x	
privacy concerns	x		x	x	x						x				
interventions / government	x	x				x	x		x					x	
regulation / legislation		x				x								x	
Socio-economic	x	x	x			x	x				x		x	x	x
local communities	x	x	x				x								
poverty						x	x								
sustainability	x					x					x		x	x	x
Environment														x	x
COVID			x												x

Things technology, massive database, cloud computing technology, and scientific analysis, the intelligent tourism application model are applied in the research. (Wei et al., 2020)

Karger et al. (2021) conducted a recent systematic literature review to analyze blockchain's role in mobility and transportation in smart cities. Authors distinguish in the issue the following categories: Technology, Cities and Government, Citizens and tourists, Law, Economy. The category of tourism is partially addressed, however being a part of the global environmental issue and the technical solution, we have not discarded this paper. Authors visualize interdependencies of the use-cases with each other as well as with the environment.

Barreto et al. (2019) research is in the phase of the design and proposal on how to use cryptocurrencies and blockchain technology in economic activities in tourism. To boost tourism business in small merchants depends on government support and the development of suitable infrastructure. Paper doesn´t bring an applied real-world scenario.

Nuryyev et al. (2020) present a study that is based on empirical inquiries about cryptocurrency payment adoption among medium-sized enterprises. Cryptocurrency payment is a new technology disrupting the traditional way of operating tourism and hospitality. The technology acceptance model was adopted. The research was conducted employing a sample of 15,831 people in 101 medium-sized enterprises in Taiwan.

Tyan et al. (2020) discuss the implications of blockchain technology within the smart tourism domain. Again, it is only a scenario of a project waiting to be conducted. The issue is explored from social, economic, political, and environmental aspects.

Fragniere et al. (2022) based their paper on interviews with 18 professionals working in the tourism sector. They state that it is necessary to take into account that blockchain technology is still at a very technical level and therefore it is not accessible to professionals in the tourism sector. According to their research, it is necessary to keep in mind the state interventions and the need for blockchain technology to adapt to the tourism sector and not the other way around. According to their research, state interventions have to be taken into account. Blockchain technology must adapt to the tourism sector and not vice versa.

One of the few studies based on already real technology use is the paper by Viano et al. (n.d.) who talk about their project CommonsHood, which is a wallet app. According to them, it would be possible to solve financing through the wallet app, smaller merchants could use it for a loyalty program and it could also play its role in marketing. They claim that the blockchain can support the sustainability of the local economy. They also discuss digitization in the public sector and introduce the concept of "Government as a Platform". Their application is tested in local urban communing projects.

The paper (Filimonau & Naumova, 2020) discusses the introduction of blockchain technology as ground-breaking because; it disrupts the traditional way of tourism management and hospitality operations. This paper similarly approaches the issue to the Taiwanese study The Blockchain Technology Adoption Behavior and Sustainability of the Business in Tourism and Hospitality SMEs: An Empirical Study (Nuryyev et al., 2020). Implementation of Blockchain technology faces organizational, institutional, and technological challenges, in other words, they discuss organizational, institutional, and technological aspects.

Veloso et al. (2019) also describe online reviews and other tools for building trust and company image in their paper. Their main goal is to compare existing models with a focus on quality and authenticity. They also examine how false information can affect the tourism sector through the concept of crowdsourcing platforms.

Only one article considers the concept of multi-chain (Zhang et al., 2021). The authors are therefore considering more blockchains that would be interconnected so that it is possible to connect all aspects of tourism (accommodation, transport, etc.). They recognize two levels

of data that are used in tourism, namely those that may be public and those that can be considered sensitive to some extent and should therefore remain only in a private blockchain.

An interesting view is also provided by Ahmad and Shah (2021), who, like Veloso et al. (2019) talks about the importance of online reviews and the importance of their accuracy and correctness. They state that in a blockchain-based system, tourists would have a unique identity, so they could write reviews only from one profile that would not be editable.

Transportation is naturally an important part of tourism, even at the destination. Benedict (n.d.) presents a concept of a sharable vehicle. He introduces his concept in connection with the COVID pandemic; tourists are provided with information about the current COVID situation, as well as the current level of air pollution, where information targets people with respiratory problems.

A theory-based paper on an overall assumption by Melkic and Cavlek (2020) contributes to a better understanding of this blockchain phenomenon in tourism and raises the awareness for further research. Technologies reduce organizational and distribution costs, provide a direct real-time approach to end-users, they allow different areas like commerce and booking to be brought into one channel. But the implementation of new technologies depends on the decisions of those responsible. Therefore, it is necessary to be familiar with the issue and understand it.

The last article in this research deals with theoretical research. Shrestha et al. (2019) perceive their contribution mainly in the methodology of their paper, which according to them opens a new direction for the study of distributed ledger technologies and decentralized applications with a focus primarily on users. They emphasize above all the quality and enjoyment of the system, without which it is easily useless.

4. Discussion

Evidence has been summarized regarding current knowledge about the usage of blockchain in tourism and its potential. Blockchain technology has been one of the most discussed topics due to its all opportunities, but also threats. Melkic and Cavlek (2020). Limitations on the number of studies that are taken only from one database. Web of Science database guarantees the quality of published articles however, in other databases, there are numerous articles also of high quality, which were dropped from the search due to the set criteria.

Another drawback is that a majority of the papers were theory-based and not give a real-life scenario, e.g., Wei et al. (2020). As many authors have mentioned, this technology can bring many benefits, however, it encounters a problem with the implementation itself, which requires changes in companies, legislation and government, as well as the users themselves, e.g. Filimonau and Naumova (2020).

Shrier et al. (2016) argue that change which is the contemporary world experiencing is driven by data and its effective use. Cloud computing solutions and blockchain technology are groundbreaking and unique technology enabling storage and securing online authentication of data (Karaszewski et al., 2021). Alenezi et al. (2019) highlight the unlimited possibilities in the development of cloud platforms, operating globally and offering various

services, especially application-based services. Blockchain technology provides not only better data infrastructures and a network authentication mechanism, but it also provides a better quality of delivered services that can be delivered more comprehensively and at considerably lower costs Honar Pajooh et al. (2021). The possibility of universal use of blockchain technology is indisputable as it can have a wide range of applications in tourism. Key identified categories in this review are: customer aspect, technical aspect, legal concern, socio-economic aspect and environmental aspect, however, these aspects are not distributed evenly. Monitoring the interconnectedness of these aspects is a suitable topic for further research.

5. Conclusions

Whether we look at tourism from a global or local point of view, blockchain technology is seen as a promising potential, as evidenced by the research. Blockchain technology delivers solutions that address the huge growth of tourism-related data, the ability to respond and process instantly and systematically manage special arrangements to meet requirements caused by a global threat like a pandemic.

The findings of the studies included in this literature review are promising, despite the limitations described concerning study designs.

Conflict of interest: none

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Preferences of the Population Concerning Municipal Waste Disposal Systems

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Abstract: One of the important areas of city and municipal management is the decision-making process related to waste disposal systems. The applied system should definitely contribute to the sustainable development of cities, municipalities and society as a whole and should also be economically acceptable. However, the real success of these systems depends on the willingness of the population to participate in the system. Therefore, when designing these systems, cities and municipalities should know and respect the preferences of their inhabitants concerning the system of sorting and disposal of waste from the given city or municipality. This issue is addressed in the paper. It presents the results of the primary quantitative research among 500 inhabitants of the Czech Republic intended to identify preferences of the inhabitants in the field of waste disposal. Research shows that the systems that are currently used as standard are the most preferred, i.e. the system "maintaining the current flat rate and free use of common containers for sorted waste" and "maintaining the current flat rate with periodic collection of sorted waste". The biggest differences in respondents' opinions are those depending on the form of housing.

1. Introduction

Waste management is an important part of environmental protection. Countries proactively fulfilling the sustainability strategy monitor the volumes of waste produced (including municipal waste) and strive to reduce the volume of unsorted and unused waste in particular.

An international comparison of municipal waste generation per capita is relatively favorable for the Czech Republic. There are countries whose municipal waste generation per capita is almost double (e.g., Denmark, Luxembourg) and a number of countries that are comparable according to this criterion (e.g., The Netherlands, Slovenia, Portugal). However, it is true that there are countries with half to two-thirds of the volume of municipal waste per capita, such as Romania or Poland (Czech Statistical Office, 2021a).

In principle, the average generation of municipal waste per capita in the Czech Republic comprise an annual volume of municipal waste higher than 5 million tons and an annual

volume of municipal waste generated by municipalities currently approaching 4 million tons. These numbers are constantly increasing over time, as shown in Table 1 and Table 2.

Table 1. Municipal waste generation in tonnes (Czech Statistical Office, 2021a)

Year	2017	2018	2019
Municipal waste (t)	5,176,513	5,247,462	5,337,521

Table 2. Municipal waste generated by municipalities in tonnes (Czech Statistical Office, 2021a)

Year	2017	2018	2019
Municipal waste (t)	3,669,883	3,731,469	3,831,493

Waste management systems designed at the level of individual cities and municipalities have certain degree of variability. When designing and modifying these systems, the general goal is to minimize the volume of non-reusable waste, especially by introducing or improving sorting systems. The result of this effort is an increase in the utilization of municipal waste. Currently, approximately 52% of municipal waste is utilized annually (Czech Statistical Office, 2021a) and further increase in utilization depends not only on the sophistication of the waste management systems applied, but also on the motivation and willingness of the population to utilize it. Therefore, it is desirable to conduct research revealing this motivation and willingness, or to directly reveal the wishes, requirements and preferences of the population. However, these sociological researches are not carried out, either in the Czech Republic or in the world. That is why we are dealing with this area. The aim is to publish the results of research focused on understanding the preferences for the system of municipal waste disposal in cities (or municipalities) and thus contribute to the improvement of waste management systems not only in the Czech Republic.

2. Theoretical Background

Factors to be taken into account when deciding on the system for disposing of municipal waste include, in particular, the sizing of the whole system, deciding on the sorting system for sortable municipal waste constituents, the method of disposing of unsorted municipal waste and setting municipal waste disposal charges.

According to Pierini et al. (2021), all municipal waste comprises the following 5 main categories: (1) paper and cardboard (all types of paper and cardboard including Tetra Pak® packages); (2) plastic (all kinds of plastics); (3) other recyclable waste (metal, glass, textiles); (4) organic waste (food and garden waste) and (5) non-recyclable waste (e.g. disposable napkins, diapers, contaminated pet bedding, dirty non-washable containers).

According to Gu et al. (2015), the total volume of municipal waste generated by individual households is shaped by the level of education of the main organizer of the family, but also other factors such as local customs and culture, applied consumption patterns and housing. Pierini et al. (2021) add that the volume of municipal waste generated is increased by home food preparation, the presence of infants and domestic animals. In their opinion, however, it is not affected by sorting or composting habits. The total volume of municipal

waste in a given area is then influenced by factors such as the living standards of the population, population density, geographical conditions, etc. (EKO-KOM, 2021).

Regarding the possibility of sorting, according to Pierini et al. (2021) and Dangi et al. (2013), half of domestic waste generation corresponds to organic waste and almost a third corresponds to recyclable materials. According to research by Gu et al. (2015), compostable and recyclable waste accounts for up to 89.3% of municipal solid waste. The sorting system can therefore reduce the volume of non-reusable waste to 10-20% of total municipal waste. According to Gu et al. (2015), the largest share consists of packaging (non-refundable 51%, returnable 15.8%).

Recyclable materials were defined by Abarca-Guerrero et al. (2013) for the purposes of own study as follows: plastics, paper, metal, glass, organic waste, batteries, electrical and electronic waste. A more detailed classification (in the field of plastics) was then discussed in research by Putri et al. (2018). Having divided plastics in waste into three types, PET bottles and PP cups, hard plastics and soft plastics, they found that 100% of respondents collected PET bottles and PP cups, 90% of respondents collected rigid plastics, but only 10% of respondents collected soft plastics. In their view, the main reason for this is the need to spend additional time and space, with soft plastics having little or no value in the recycling market.

When designing a separate waste collection system, the fact that different types of sorted waste are generated differently during the week, as shown by Gu et al. (2015), should also be taken into account. They state, for example, that the largest amount of paper and plastics is generated on weekends (which in their opinion is due to the concentration of consumer purchases on the weekend).

Closely related to the success in sorting and the volume of unsorted waste are the costs of waste management arising at the level of cities and municipalities. These depend on the amount and structure of waste, on the scope and method of service provided in accordance with legislative requirements and, last but not least, on mandatory expenditures given by legislation (charges and taxes) (EKO-KOM, 2021). The municipality's waste management costs are then offset by waste charges paid by citizens. They are collected on the basis of the Local Fees and Charges Act, with the amendment thereto defining two "new" local charges, namely the municipal waste management system charge and the charge for disposing of municipal waste from real estate. Municipalities can choose only one of them (epravo, 2021).

The creation and operation of a waste management system is often perceived only as the responsibility of the local government, the population is at best considered co-responsible together with the city or municipality. However, this is a narrow view of the issue, waste management involves a large number of stakeholders who play their roles in shaping the system, but have different interests (Abarca-Guerrero et al., 2013).

One of the most important stakeholders is the population. The success of any waste management system depends on its active and sustainable participation (Kattoua et al., 2019) If there is none, it is one of the main reasons for complaints from the public administration (Filho et al., 2020).

The role of the population is both to reduce the total volume of waste and the volume of non-reusable waste. The total volume of waste is reduced as a result of individual decisions

on what to buy, while the volume of non-reusable waste is reduced as a result of decisions on the method of disposing of household waste. It is therefore essential to have a good understanding of the factors influencing the preferences and behavior of individuals in this area, or at least of these preferences (Pierini et al., 2021). However, this understanding is only marginal so far as the outputs of such research are rather partial. Still, it was found, for example, that 81% of households sort their waste consistently and also that in 68% of households that do so, 5–9 categories of waste are sorted, while in 5% of these households it is sorted only according to 1–2 categories (Pierini et al., 2021). It has also been revealed that the waste management equipment available significantly influences the choice of waste disposal method and also that the insufficient capacity of waste containers and the longer distance to reach them increase the likelihood of illegal dumping in public spaces (Tadesse et al., 2008). However, research aimed at finding out people's preferences in the field of municipal waste disposal has not yet been carried out. Therefore, we conducted primary quantitative research in this area and formulated its conclusions.

3. Research Methodology

The main goal of the primary research was to find out people's preferences for different household waste disposal systems.

The individual household waste disposal systems were defined as a combination of 2 factors that can fundamentally affect household preferences. These were the method of calculating the payment for waste disposal (increased payment without waste sorting, current payment with waste sorting and weight-based pay-as-you-throw scheme) and the separate waste collection method (free disposal of separate waste in local public containers, free periodic collection of separate waste, purchase of sorted waste at special civic amenity sites). The following household waste disposal systems were investigated:

- Higher flat-rate payment for municipal waste and abandonment of the household waste sorting system.
- Maintaining the current amount of the flat-rate payment for municipal waste and free disposal of separate waste in local public containers.
- Maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door collection.
- Maintaining the current amount of the flat-rate payment for municipal waste and the purchase of sorted waste at special civic amenity sites.
- Weight-based pay-as-you-throw scheme and free disposal of separate waste in local public containers.
- Weight-based pay-as-you-throw scheme and free periodic door-to-door collection.

As part of the questionnaire survey, respondents were asked to determine the order of individual methods of waste disposal according to declining preference using values 1-6 (i.e., 1 to indicate the most preferred system). The questionnaire also included the survey of demographic characteristics of respondents (gender and age) and data related to the surveyed household (size of municipality and type of household).

An electronic questionnaire was used for data collection. Comprehensibility and time the respondents needed were examined within the piloting of the questionnaire. It showed that the comprehensibility of the questions was sufficient and the time requirements bearable.

Data collection took place in the period from August to October 2021 among the population of the Czech Republic aged 15–64. 500 respondents were included in the research on the basis of quota sampling with quotas for gender and age according to CZSO data as at 31 December 2020 (Czech Statistical Office, 2021b). Their structure by age and gender is shown in Table 3.

Table 3. Structure of respondents by gender and age

Gender	Age					
	15–24	**25–34**	**35–44**	**45–54**	**55–64**	**Total**
Male (%)	7.2	10.2	12.4	11.8	9.4	51
Female (%)	7.0	9.6	11.6	11.2	9.6	49
Total (%)	14.2	19.8	24.0	23.0	19.0	100

Respondents came from municipalities with less than 2,000 inhabitants (25.0%), 2,001–10,000 inhabitants (21.0%), 10,001–100,000 inhabitants (32.9%) or cities with a population of more than 100,000 (21.2%). In terms of household type, 51.0% of respondents living in a housing unit and 49.0% of respondents living in family houses took part in the survey.

Descriptive and inferential statistics methods were used in the data analysis. A mean rank was used to evaluate the preferences for the disposal system. Friedman test at 0.05 significance level was used to verify the statistical significance of differences in the order of individual disposal systems. Bonferroni correction was used in post hoc pairwise comparisons. The Kruskal-Wallis test at 0.05 significance level was used to verify the statistical significance of differences in the attitudes of respondents from different groups (by gender, age, municipality size and household type).

4. Research Results

Primary quantitative research has provided a number of interesting findings in the area of people's preferences for various household waste disposal systems. Based on a comparison of the mean rank of individual systems, it can be stated that the most preferred variants are systems in which the current amount of flat-rate payment for municipal waste is maintained in combination with free removal of sorted waste to common containers or periodic collection of sorted waste (see Table 4).

The result of the Friedman test ($\chi2 = 469.4$; $p < 0.001$) shows that the differences in the preferences for household waste disposal systems are statistically significant. Post hoc pairwise comparisons revealed that the difference in the preference for maintaining the current amount of the flat-rate payment for municipal waste and free disposal of separate waste in local public containers (mean rank 2.55) and maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door collection (mean rank 2.71) is not statistically significant ($\chi2 = 5.814$; $p = 0.239$). Therefore, the systems that are

Table 4. Preferences for individual municipal waste disposal systems from the point of view of the population surveyed

Municipal Waste Disposal System	Mean Rank
Maintaining the current amount of the flat-rate payment for municipal waste and free disposal of separate waste in local public containers.	2.55
Maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door collection.	2.71
Weight-based pay-as-you-throw scheme and free disposal of separate waste in local public containers.	2.98
Weight-based pay-as-you-throw scheme and free periodic door-to-door collection.	3.18
Maintaining the current amount of the flat-rate payment for municipal waste and the purchase of sorted waste at special civic amenity sites.	3.36
Higher flat-rate payment for municipal waste and abandonment of the household waste sorting system	4.74

currently used by default have the greatest preference. This points to the limited possibilities of changing existing systems more radically. From the point of view of the population, the system based on paying a higher lump sum payment for municipal waste with leaving the household sorting system has the least chance of acceptance (mean rank 4.74).

The analysis of opinions depending on the respondent characteristics showed differences in opinions according to gender, age, size of the municipality and type of household.

Men do not differ in their preferences from women as regards the two most used systems today, so both genders prefer the same methods of household waste disposal as the entire surveyed population (see Table 5).

Table 5. Differences in the preferences for individual municipal waste disposal systems depending on gender

Municipal Waste Disposal System	Mean Rank		Kruskal-Wallis test	
	men	women	χ^2	p
Maintaining the current amount of the flat-rate payment for municipal waste and free disposal of separate waste in local public containers.	2.64	2.45	2.760	0.097
Maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door collection.	2.71	2.72	0.062	0.804
Weight-based pay-as-you-throw scheme and free disposal of separate waste in local public containers.	3.02	2.94	0.362	0.547
Weight-based pay-as-you-throw scheme and free periodic door-to-door collection.	3.35	3.01	4.625	0.032
Maintaining the current amount of the flat-rate payment for municipal waste and the purchase of sorted waste at special civic amenity sites.	3.36	3.37	0.029	0.865
Higher flat-rate payment for municipal waste and abandonment of the household waste sorting system	4.57	4.91	5.736	0.017

However, there are statistically significant differences between two systems that are not currently common. Women more strongly than men prefer the weight-based pay-as-you-throw scheme combined with free periodic door-to-door collection ($\chi^2 = 4.625$; p = 0.032). Conversely, men, more than women, prefer a higher flat-rate payment for municipal waste and abandonment of the household waste sorting system ($\chi^2 = 5.736$; p = 0.017).

The differences in respondents' opinions between various age groups are statistically significant for two systems. In principle, it can be stated that the preference for maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door collection increases with age ($\chi2 = 18.70$; $p = 0.001$). This trend can also be traced in the case of the weight-based pay-as-you-throw scheme combined with free periodic door-to-door collection ($\chi2 = 15.98$; $p = 0.003$) (see Table 6).

Table 6. Differences in the preferences for individual municipal waste disposal systems depending on age

Municipal Waste Disposal System	Mean Rank					Kruskal-Wallis test	
	15–24	25–34	35–44	45–54	55–64	χ^2	p
Maintaining the current amount of the flat-rate payment for municipal waste and free disposal of separate waste in local public containers.	2.85	2.51	2.70	2.33	2.44	7.909	0.095
Maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door collection.	3.17	3.01	2.58	2.44	2.57	18.70	0.001
Weight-based pay-as-you-throw scheme and free disposal of separate waste in local public containers.	3.13	2.97	3.00	2.97	2.87	1.161	0.884
Weight-based pay-as-you-throw scheme and free periodic door-to-door collection.	3.31	3.73	2.93	2.96	3.11	15.98	0.003
Maintaining the current amount of the flat-rate payment for municipal waste and the purchase of sorted waste at special civic amenity sites.	3.62	3.62	3.30	3.23	3.16	7.434	0.115
Higher flat-rate payment for municipal waste and abandonment of the household waste sorting system	4.93	4.83	4.63	4.85	4.51	4.886	0.299

Table 7. Differences in the preferences for individual municipal waste disposal systems depending on the size of the municipality

Municipal Waste Disposal System	Mean Rank				Kruskal-Wallis test	
	up to 2000	2001–10000	10001–100000	100001+	χ^2	p
Maintaining the current amount of the flat-rate payment for municipal waste and free disposal of separate waste in local public containers.	2.47	2.83	2.50	2.42	4.132	0.248
Maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door collection.	2.48	2.48	2.90	2.90	11.72	0.008
Weight-based pay-as-you-throw scheme and free disposal of separate waste in local public containers.	3.06	2.99	3.01	2.81	1.902	0.593
Weight-based pay-as-you-throw scheme and free periodic door-to-door collection.	3.30	2.77	3.31	3.26	7.611	0.055
Maintaining the current amount of the flat-rate payment for municipal waste and the purchase of sorted waste at special civic amenity sites.	3.34	3.22	3.37	3.55	3.436	0.329
Higher flat-rate payment for municipal waste and abandonment of the household waste sorting system	4.49	4.85	4.87	4.71	3.372	0.338

Regarding the differences in opinions according to the size of the municipality, a statistically significant difference was demonstrated only for the system "maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door

collection". With the size of the municipality, the preferences for this system decrease ($\chi 2 = 11.72$; p = 0.008). It is more preferred by cities and municipalities with up to 10,000 inhabitants (see Table 7).

The most significant differences in respondents' attitudes can be observed depending on the form of their housing. Respondents living in housing units prefer the system "maintaining the current amount of the flat-rate payment for municipal waste and free disposal of separate waste in local public containers" more than respondents living in family houses ($\chi 2 = 12.24$; p < 0.001). Conversely, they prefer maintaining the current amount of the flat-rate payment for municipal waste but combined with free periodic door-to-door collection ($\chi 2 = 7.954$; p = 0.005). Respondents living in family houses generally prefer a periodic collection. Even if the payment was weight-based, they prefer periodic collection of sorted waste more than respondents living in housing units ($\chi 2 = 9.714$; p = 0.002) (see Table 8).

Table 8. Differences in the preferences for individual municipal waste disposal systems depending on the type of household

Municipal Waste Disposal System	Mean Rank		Kruskal-Wallis test	
	unit	house	χ^2	p
Maintaining the current amount of the flat-rate payment for municipal waste and free disposal of separate waste in local public containers.	2.31	2.80	12.24	<0.001
Maintaining the current amount of the flat-rate payment for municipal waste and free periodic door-to-door collection.	2.89	2.53	7.954	0.005
Weight-based pay-as-you-throw scheme and free disposal of separate waste in local public containers.	2.95	3.02	0.264	0.607
Weight-based pay-as-you-throw scheme and free periodic door-to-door collection.	3.42	2.94	9.714	0.002
Maintaining the current amount of the flat-rate payment for municipal waste and the purchase of sorted waste at special civic amenity sites.	3.44	3.28	1.532	0.216
Higher flat-rate payment for municipal waste and abandonment of the household waste sorting system	4.62	4.86	2.522	0.112

5. Conclusion

The primary research examined the preferences of the population in relation to municipal waste disposal systems defined by a combination of two factors (the amount of payment and the method of waste collection). The main findings can be formulated as follows:

- systems that maintain the current level of charges are preferred, weight-based pay-as-you-throw systems are less preferred, and systems that would lead to increased charges are least preferred;
- periodic collection is generally preferred by households from family houses and the elderly;
- women are more willing to sort waste. Compared to men, they prefer weight-based systems. At the same time, less than men, they prefer systems without waste sorting.

These findings suggest that the population has at least a minimal environmental inclination, but is reluctant to bear the higher costs associated with waste disposal. However, what the real motives of the population evoking the preferences identified has not yet been

clarified. Therefore, follow-up research should focus on revealing these motives. Knowing them, and knowing the preferences as well, can then become the basis for improving municipal waste disposal systems at the level of cities and municipalities.

Conflict of interest: none

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Performance Assessment in the Bioenergy Field: Evidence from European Countries

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Abstract: The main goal of the article is to determine the performance in the bioenergy field for European countries, using a well-known approach – Data Envelopment Analysis (DEA). The variables chosen for the analysis try to substantiate: the innovation level in the bioenergy field, human resource, the degree of bioenergy use and the economic impact generated by the development of the bioenergy field, in order to achieve the relative level of performance. Nineteen European Countries (here decisional units) are in the spotlight of receiving the title of either performers or non-performers in this field, occupying a certain position in the country performance ranking. DEA also enables projections for each country that can be used in order to reach the efficiency threshold. Finally, a summary of peers is presented, for best practice models.

1. Introduction

There is no doubt that the issue of energy consumption (particularly renewable energy) is a very important one, especially since recently, amid the SarsCov-2 pandemic and not only, both in Europe and worldwide, the price of energy has risen. Over time, the topic of renewable energy has been analyzed by many authors, from multiple perspectives: the efficiency of using renewable energy (Aldea & Ciobanu, 2011; Dracea et al., 2020), its role in transforming society (Carstea et al., 2019) and in human development (Zahid et al., 2021), the implications of renewable energy consumption in economic growth and economic development (Bildirici & Ozaksoy, 2018; Șoavă et al., 2018; Kouton, 2021), the influence of renewable energy on different economic activities (Lu et al., 2019; Baran, 2015; Waheed et al., 2018; Liu et al., 2018) etc.

In order to improve national energy security and to reduce the potential for global warming, renewable energy should play an important role in achieving sustainability. This is the reason why European countries developed their strategies in order to use bioenergy, trying to replace the fossil fuels with "eco-friendly" technologies or solutions. In this context, the performance assessment in the bioenergy field plays a leading role in economic and social development, as well as in terms of environmental issues.

Currently, the bioenergy sector has gained momentum in the global energy economy, primarily due to the fact that it is considered a clean and renewable energy source that can

bring about a tremendous improvement in dealing with environmental issues (Marinescu & Cicea, 2018; Cicea et al., 2019; Marinescu et al., 2019). In this way, Winquist et al. (2019) showed that the promotion of the renewable energy sources is a direct consequence of the observations made on the climate change. Related to this statement, Cicea et al. (2019) highlighted the options which are used in response to increasing environmental concerns: biogas and biomass (solid biofuels or liquid biofuels). Also, as shown in various researches, bioenergy can have an important role in achieving economic growth, taking into account that it can be considered energy from renewable sources (Pirlogea & Cicea, 2011).

The novelty of this article is to provide a comprehensive method to measure the performance of the European countries in the bioenergy field, taking into account different dimensions. Meanwhile, this article can provide useful information to stakeholders in order to identify the opportunities to improve bioenergy production or the effectiveness of the actual bioenergy production process. In this article, recent methods used to assess the performance in the bioenergy field are highlighted. Depending on the objective of the research, there are approaches used at the microeconomic level and approaches used at the macroeconomic level, each with its own limitations, but useful in determining the potential.

2. Literature Review

One can talk about the performance assessment in the bioenergy field at the microeconomic level, Buonocore et. al (2012) highlights the performance and sustainability of bioenergy in Sweden (Enköping town), proposing a methodology that treats performance from several perspectives. An extended LCA approach was used in this study to investigate the Enköping integrated bioenergy production system. In the adopted framework, named "Sustainability Multimethod Multiscale Assessment" (SUMMA) (Ulgiati et al., 2012), several evaluation methods were jointly applied to provide a comprehensive set of extensive and intensive indicators at multiple scales and dimensions. In order to ensure the maximum consistency of input data, an inventory of all the input and output flows was carried out, to form the common basis for further processing: impact assessment, energy and material efficiency, performance indicators. Then, each of these input and output information was subsequently processed by applying the SUMMA framework.

In order to analyze the impact of bioenergy for each component, various methods have been outlined in the literature. Analyzing inputs such as abiotic raw materials, biotic raw materials, water and air, the Material Flow Accounting method (Hinterberger & Stiller, 1998; Bargigli et al., 2005) evaluates in which the environment is affected by the deviation of material flows from the normal cycle, producing products or services instead. Through this method all phases of the production are going to be investigated: production, use, recycling or disposal, showing us the extent to which we are able to protect the environment. The Emergy Accounting method (Odum, 1988; Brown & Ulgiati, 2004) is another method used in order to evaluate the environmental performance of the system taking into account both the environmental inputs (rain, wind, solar radiation, etc) and indirect environmental inputs such as human labor and services.

In the literature, life cycle thinking is an approach that is in the attention of specialists, being used in order to analyze the sustainability aspects of bioenergy product systems (Thabrew et al., 2009; Hosseinzadeh-Bandbafha et al., 2021), for which four specific methods have been outlined: social life cycle assessment (S-LCA); life cycle costing (LCC); life cycle assessment (LCA); life cycle sustainability assessment (LSCA) (Petit-Boix et al., 2017).

If we are interested in analyzing the performance in the bioenergy field at a macro level, there are several methods of significant interest such as, regression analysis, principal component analysis (Fucec & Marinescu, 2014), Data Envelopment Analysis (DEA) or Performance Index analysis in the bioenergy field. DEA method is known as the data wrap method and has been widely used in various fields for more than forty years since its conception by Charnes, Cooper and Rhodes (Olariu, 2017). It serves to analyze the performance of certain activities or areas of the economy, performance seen in the form of efficiency.

Table 1. DEA method in the literature

Nr.	Authors	Level	Field	Goal achieved
1	Aletras, Kontodimopoulos, Zagouldoudis, & Niakas, (2007)	Micro	Health	Effectiveness of health care reform on the Greek healthcare system.
2	Roman & Suciu (2012)	Macro	Research & Development	Efficiency of research and development activities for European countries, using as variables investments in the field, number of patents, R&D expenses, and staff employed.
3	Halkos & Tzeremes, (2012)	Micro	Renewable energy	Financial performance of companies operating in the field of renewable energy.
4	Paço & Pérez (2013)	Micro	Hotel services	Hotel performance due to the use of IT&C applications.
5	Dincă, Dincă, & Andronic (2016)	Micro	Public administration	Efficiency of public spending in the provision of goods and services (health, education, services).
6	Zhou, Poh, & Ang (2016)	Macro	Environment	Environmental performance of OECD countries.
7	Marinescu, Cicea, & Ciocoiu (2018)	Macro	Waste recycling of electrical and electronic equipment (WEEE)	WEEE management performance in European Union countries
8	Ulucan, Atici, & Ozkan, (2018)	Micro	Education	Assessment of academic quality for undergraduate programs in Turkish universities.

Roman and Suciu (2012) mention in their paper about the two types of efficiency, technical and allocative, which contribute to determining the total economic efficiency. Technical efficiency means obtaining a maximum output from the action of selected input elements. Allocative efficiency means the use of input elements in an optimal form to achieve a certain output. In the literature there are a multitude of scientific papers that use DEA to

study efficiency and respectively, performance. Table 1 summarizes some of them, identifying the field for which the method was applied, the level at which has been developed, but also the objective achieved by the researchers appealing to it.

Also, similar studies have been conducted in the field. A recent study (Cicea, Marinescu, & Pintilie, 2021) highlights the Performance Index in the bioenergy field, an analytical tool built on a methodology consisting of 7 phases: Structure, Data Collection, Data processing, Normalization, Weighting, Aggregation, and Robustness. Based on this analytical tool, some European countries were analyzed taking into account a series of specific indicators for 3 dimensions: innovation, efficiency and sustainability.

3. Methodology

3.1. Sources

This research will use and process statistical data to determine bioenergy performance for European Union countries based on DEA method. It will be able to provide the performers and non-performers in this field, by building the efficiency frontier of decision-making units.

The performance obtained by the DEA method is not an "absolute" one, because this method calculates the value of the performance score in relation to the performances of the decisional units in the analyzed group, not to a certain well-defined theoretical threshold.

The advantage of applying this method is that it does not require inputs and outputs, which have the same measurement units. Decision units are given by European Union countries for which the following indicators have been selected (listed in Table 2):

1. Bioenergy turnover, expressed in millions of euros (values at the level of 2015) which represents the output variable.
2. Number of registered patents (values at the level of 2013), the first input variable.
3. Number of jobs in the field of bioenergy (values at the level of 2015), the second input variable.
4. Installed capacity in MW (values at the level of 2015), the third input variable.

The main reason for selecting these indicators as input and output variables is related to their notoriety (they are internationally recognized indicators) and their ability to provide information on:
- The degree of innovation in the field supported by the number of patents in the field (patents protect valuable information for the implementation of new technologies that are to be launched on the market);
- Human resources through the number of available jobs (most of them created with the development of the bioenergy field);
- The degree of bioenergy use (in the form of heat, fuel or electricity) given by the installed capacity each year.
- The economic impact generated by the development of the bioenergy field (measured by the obtained turnover).

However, there is a drawback in using these indicators. It refers to the fact that at the moment of conducting this research only data for 2015 were available for almost all countries in one EurObserv'ER database. The last reported year in EurObserv'ER for instance, was 2017 but it covered less countries.

If discussing drawbacks, it is necessary to substantiate the fact that the DEA method is very broad and general. Along time many authors tried to highlight strengths and weaknesses of DEA method (Stolp, 1990), advantages and disadvantages (Fenyves & Tarnóczi, 2020; Jordá, Cascajo, & Monzón, 2012), demonstrating pitfalls after applying it (Sueyoshi & Goto, 2013; Wojcik, Dyckhoff, & Clermont, 2019).

Table 2. Input and output variables for DEA analysis (IRENA, 2019; EurObserv'ER, 2019)

No.	Country	Bioenergy turnover	Number of registered patents	Number of jobs	Installed capacity (in MW)
1	Austria	2,270	4	12,400	1,396
2	Belgium	780	0	3,200	945
3	Bulgaria	340	0	11,500	54
4	Croatia	460	4	16,900	53
5	Cyprus	30	0	300	10
6	Denmark	1,130	17	6,600	1,240
7	Estonia	490	0	8,700	281
8	Finland	4,230	47	25,800	1,987
9	France	6,780	80	63,400	1,304
10	Germany	11,580	111	99,900	8,429
11	Greece	260	0	6,900	51
12	Ireland	140	0	1,200	70
13	Italy	3,680	21	42,900	3,367
14	Latvia	780	3	22,400	126
15	Lithuania	470	0	11,800	71
16	Luxembourg	30	0	300	24
17	Malta	30	0	300	3
18	Great Britain	2,920	53	23,760	4,829
19	Poland	2,650	43	65,500	961
20	Portugal	780	3	9,500	577
21	Czech Republic	1,310	7	22,200	771
22	Romania	980	8	32,300	118
23	Slovakia	720	5	14,100	242
24	Slovenia	130	1	2,300	63
25	Spain	2,040	43	36,800	1,018
26	Sweden	4,690	21	27,300	4,716
27	Netherlands	670	11	5,000	863
28	Hungary	1,020	4	26,100	519

The number of direct jobs includes equipment production, plant construction, engineering and management, operation and maintenance, supply and exploitation of biomass. The number of indirect jobs refers to secondary activities, such as transport and other services (EurObserv'ER, 2019). Human resource, in the form of intellectual capital, is considered a fundamental source for innovation and knowledge (Salehi & Zimon, 2021), and along with working capital (which is considered one of the most important factor driving

energy commercialization) (Zimon, 2019; Zimon, 2021), contributes to obtaining competitive advantage within companies. The situations listed in the table above are among the most interesting. For example, by far Germany has a top turnover, but also a very large number of jobs in the field. France and Poland have created each more than 60,000 jobs, but the reported gain is about 2.5 times higher in France as compared to Poland. Finland and Sweden are very similar in terms of turnover but also in terms of jobs number. Denmark manages to gather a lot with little labor force, unlike Latvia, where there is four times as much labor force but a much lower turnover as compared to Denmark.

Given that the indicator on the number of registered patents is zero for certain countries at the level of the reported year, they (Belgium, Bulgaria, Cyprus, Greece, Ireland, Lithuania, Luxembourg, and Malta) will not be part of the analysis.

3.2. Applying DEA Method

In the application of the DEA method, the measurement of efficiency can be performed by reporting to inputs or to outputs (Marinescu, Cicea, & Ciocoiu). Thus, an efficiency measurement of inputs oriented analysis, involves minimizing inputs while maintaining the output level. On the other hand, an output-oriented measure of efficiency involves maximizing output and maintaining the current level of inputs.

As the name implies, the data envelopment method involves the existence of two enveloping surfaces, which refer to either constant return to scales (marked with CRS) or to variable (marked with VRS) return to scale. Both types will be used in the present analysis, as they are necessary to calculate the scale or allocative efficiency (as a ratio between the technical efficiencies reported by the two of them). Also, the DEA analysis will be performed with the help of DEAP 2.1. Figure 1 suggestively shows the input and output variables, but also the characteristics of the applied method. One of the features is the use of the one-stage method. Choosing "one stage DEA" from the five available in the program (1-stage, 2-stage, multi-stage, cost-dea, malmquist) (see appendix 1) will create a mathematical programming problem, which will find those values for outputs and inputs capable of maximizing efficiency for a country.
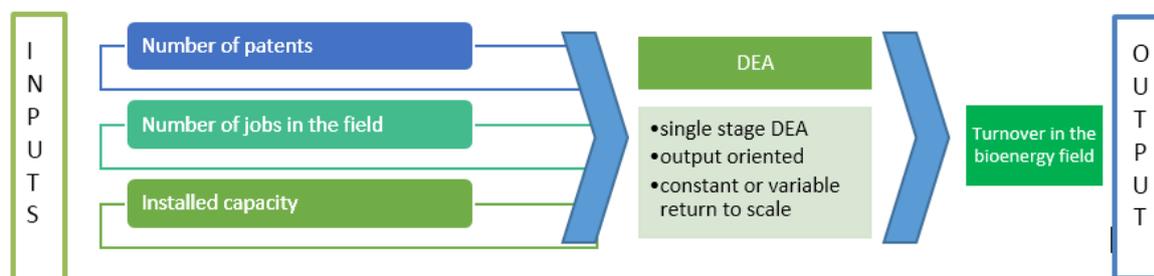
Figure 1. DEA with inputs, outputs and method

4. Results

Following the DEA analysis, values were obtained for the scale efficiency of each decision-making unit or the value of the performance pursued in the field of bioenergy.

Countries that have achieved a reported level of scale efficiency of 1 are efficient or performing countries in the field. Countries that have obtained values lower than 1, belong to the category of non-performers. Thus, they either do not use the inputs correctly to create the result or do not act as needed to influence the output.

For each inefficient decision-making unit, in addition to the value of scale efficiency, the type of scale returns, increasing or decreasing, is also reported (see Table 3). Increasing returns indicate that if a country experiences a slight change in its inputs, it will be felt in a major way in the value of output (here the turnover in the field). Decreasing returns indicate that if a country experiences a slight change in its inputs, the output will not change significantly.

Table 3. Efficiency of each analyzed unit

No.	Country	Technical efficiency through CRS DEA	Technical efficiency through VRS DEA	Scale efficiency	Scale returns
1	Austria	1	1	1	-
2	Croatia	1	1	1	-
3	Denmark	0.935	1	0.935	Increasing
4	Finland	1	1	1	-
5	France	1	1	1	-
6	Germany	0.706	1	0.706	Decreasing
7	Italy	0.586	0.893	0.656	Decreasing
8	Latvia	1	1	1	-
9	Great Britain	0.671	0.710	0.946	Decreasing
10	Poland	0.570	0.639	0.892	Decreasing
11	Portugal	0.713	0.728	0.979	Increasing
12	Czech Republic	0.726	0.749	0.970	Decreasing
13	Romania	1	1	1	-
14	Slovakia	0.849	0.871	0.975	Increasing
15	Slovenia	0.732	1	0.732	Increasing
16	Spain	0.496	0.497	0.997	Increasing
17	Sweden	0.938	1	0.938	Decreasing
18	Netherlands	0.732	0.884	0.828	Increasing
19	Hungary	0.733	0.795	0.922	Decreasing
20	Average	0.81	0.882	0.92	

Given that inefficient decision-making units have also been reported, the projections made in the DEA analysis can be further tracked in order for a unit to reach the efficiency threshold. As I explained in a previous paper (Marinescu, Cicea, & Ciocoiu, 2018) the purpose of DEA analysis is not only to determine the efficiency of revised units, but also to find target values for the inputs and outputs of an inefficient unit. Inefficient allocation is the failure to use the optimal combination of inputs. For example, in Table 4, Italy reports a value of 440.132 for radial dynamics of the output (turnover in the field) and a value of -17,010.190 for the second input's slack (number of jobs within the field).

Radial dynamic shows the improvements that can occur in the value of the output, while the slack values show the elements in excess, which should be diminished. Therefore, in order to converge towards performance, France may need to reduce the number of jobs (with the slack value of -17,010.19) and remain at the initially reported value of turnover or, given the current input conditions, it could achieve a turnover of 440.132 million euros.

The analysis does not indicate any slack on inputs 1 and 3, respectively the number of registered patents and the installed capacity. Therefore, the current level of these two input variables is able to support the reported level of turnover in the bioenergy field.

Table 4. Output projection for each unit to be efficient – Part 1

No.	Country	Variable	Initial Value	Radial dynamics	Slack	Projected Value
1	Austria	Output	2,270	0	0	2,270
		Input 1	4	0	0	4
		Input 2	12,400	0	0	12,400
		Input 3	1,396	0	0	1,396
2	Croatia	Output	460	0	0	460
		Input 1	4	0	0	4
		Input 2	16,900	0	0	16,900
		Input 3	53	0	0	53
3	Denmark	Output	1,130	0	0	1,130
		Input 1	17	0	0	17
		Input 2	6,600	0	0	6,600
		Input 3	1,240	0	0	1,240
4	Finland	Output	4,230	0	0	4,230
		Input 1	47	0	0	47
		Input 2	25,800	0	0	25,800
		Input 3	1,987	0	0	1,987
5	France	Output	6,780	0	0	6,780
		Input 1	80	0	0	80
		Input 2	63,400	0	0	63,400
		Input 3	1,304	0	0	1,304
6	Germany	Output	11,580	0	0	11,580
		Input 1	111	0	0	111
		Input 2	99,900	0	0	99,900
		Input 3	8,429	0	0	8,429
7	Italy	Output	3,680	440.132	0	4,120.132
		Input 1	21	0	0	21
		Input 2	42,900	0	-17,010.19	25,889.810
		Input 3	3,367	0	0	3,367
8	Latvia	Output	780	0	0	780
		Input 1	3	0	0	3
		Input 2	22,400	0	0	22,400
		Input 3	126	0	0	126
9	Great Britain	Output	2,920	1,195.047	0	4,115.047
		Input 1	53	0	-36.039	16.961
		Input 2	23,760	0	0	23,760
		Input 3	4,829	0	-901.779	3,927.221
10	Poland	Output	2,650	1,497.912	0	4,147.912
		Input 1	43	0	0	43
		Input 2	65,500	0	-23,673.6	41,826.314
		Input 3	961	0	0	961
11	Portugal	Output	780	291.511	0	1,071.511
		Input 1	3	0	0	3
		Input 2	9,500	0	0	9,500
		Input 3	577	0	0	577

Table 4. Output projection for each unit to be efficient – Part 2

No.	Country	Variable	Initial Value	Radial dynamics	Slack	Projected Value
12	Czech Republic	Output	1,310	438.720	0	1,748.720
		Input 1	7	0	0	7
		Input 2	22,200	0	-2,570.82	19,629.174
		Input 3	771	0	0	771
13	Romania	Output	980	0	0	980
		Input 1	8	0	0	8
		Input 2	32,300	0	0	32,300
		Input 3	118	0	0	118
14	Slovakia	Output	720	106.950	0	826.950
		Input 1	5	0	0	5
		Input 2	14,100	0	0	14,100
		Input 3	242	0	0	242
15	Slovenia	Output	130	0	0	130
		Input 1	1	0	0	1
		Input 2	2,300	0	0	2,300
		Input 3	63	0	0	63
16	Spain	Output	2,040	2,064.252	0	4,104.252
		Input 1	43	0	0	43
		Input 2	36,800	0	0	36,800
		Input 3	1,018	0	0	1,018
17	Sweden	Output	4,690	0	0	4,690
		Input 1	21	0	0	21
		Input 2	27,300	0	0	27,300
		Input 3	4,716	0	0	4,716
18	Netherlands	Output	670	87.626	0	757.626
		Input 1	11	0	0	11
		Input 2	5,000	0	0	5,000
		Input 3	863	0	-62.879	800.121
19	Hungary	Output	1,020	262.998	0	1,282.998
		Input 1	4	0	0	4
		Input 2	26,100	0	-6338.1	19,761.891
		Input 3	519	0	0	519

Following the DEA analysis, the next ranking (provided in Table 5) was obtained, depending on the performance score. There are six high-performing countries with a score of 1 and 13 less efficient countries in the field of bioenergy, with scores below 1. They have the opportunity to track performance in the field to improve their output (in this case turnover).

Also from Table 5, it can be seen that Germany, the country with the highest turnover in the field of bioenergy, is among the non-performers of the analysis, with a score of 0.706. It could do better than that, but not by using the example of other countries, but through its own mechanisms. This is shown in Table 6, where for Germany, in the "peer" column, no other country is suggested, but itself. The same for Slovenia, which, although a non-performer compared to the top countries, does not have a concrete example to follow as best practice models.

Table 5. Ranking based on performance score

No.	Country	Bioenergy Performance Score
1	Austria	1
	Croatia	
	Finland	
	France	
	Latvia	
	Romania	
2	Spain	0.997
3	Portugal	0.979
4	Slovakia	0.975
5	Czech Republic	0.97
6	Great Britain	0.946
7	Sweden	0.938
8	Denmark	0.935
9	Hungary	0.922
10	Poland	0.892
11	Netherlands	0.828
12	Slovenia	0.732
13	Germany	0.706
14	Italy	0.656

If we compare the values from Table 2 and Table 5, we can easily observe that countries with highest Installed capacity (in MW) have a small Bioenergy Performance Score. Germany, Sweden and Italy seems to be non-performers countries, even if they are in top 8 for all the analyzed indicators (Bioenergy turnover, Number of registered, Number of jobs, Installed capacity in MW). In this particular case, we emphasize the importance of appealing to the EROI concept (Energy Return of Investment), a tool used in order to predict which energy mix is the best. Weißbach et al. (2013) tried to highlight Energy Returned on Investment for various ways of producing energy, saying that the break-even number for fueling our modern society is about 7 for European Union. Other studies give similar results (Carbajales-Dale et al., 2014). Due to the fact that in these papers the score for biofuels is lower than 7, the authors highlighted that a lower EROI cannot sustain our society at our level of complexity as it is in the present.

Due to the fact that there are papers in the literature that reach the same conclusion as our work, that the level of performance in bioenergy varies from country to country and is influenced by many factors, we emphasize the importance of diversifying energy sources in European Union countries. A mix of renewable energy, fossil fuels and nuclear energy could be the most appropriate economic option in Europe, with renewable energy having the highest share. Each country must decide which mix is the healthiest, taking into account national and European legislation and objectives, which can generate high possibilities for economic expansion and diversification. In the case of Germany, Sweden or Italy, they are fully responsible of finding the best energy mix, Bioenergy Performance Score being an indicator that should be taken into account for the future direction.

Table 6. Summary of performers and followers

No.	Country	Peer / Peer weight	Peer / Peer weight	Peer / Peer weight
1	Austria	Austria / 1.0		
2	Croatia	Croatia / 1.0		
3	Denmark	Denmark / 1.0		
4	Finland	Finland / 1.0		
5	France	France / 1.0		
6	Germany	Germany / 1.0		
7	Italy	France / 0.09	Sweden / 0.596	Austria / 0.313
8	Latvia	Latvia / 1.0		
9	Great Britain	Sweden / 0.762	Austria / 0.238	
10	Poland	Austria / 0.178	France / 0.517	Latvia / 0.305
11	Portugal	Latvia / 0.149	Austria / 0.372	France / 0.007
12	Czech Republic	France / 0.046	Austria / 0.465	Latvia / 0.489
13	Romania	Romania / 1.0		
14	Slovakia	Austria / 0.080	France / 0.037	Latvia / 0.436
15	Slovenia	Slovenia / 1.0		
16	Spain	Austria / 0.229	France / 0.523	Latvia / 0.013
17	Sweden	Sweden / 1.0		
18	Netherlands	Austria / 0.001	Denmark / 0.625	Slovenia / 0.374
19	Hungary	France / 0.009	Austria / 0.301	Latvia / 0.690

Italy ranks last and has three good examples to follow, France, Austria and Latvia. Inefficient allocation is the failure to use the optimal combination of inputs. If we analyze the data in the above table, we can see that Austria is reported 9 times as a good example to follow by other decision-making units. It is followed by France, which appears as a "peer" 8 times, and Latvia, which appears 6 times. Although they are among the performers, Finland, Croatia and Romania are not mentioned as examples for other countries.

5. Conclusions

Based on the performed analysis, the DEA method offered the possibility to achieve a relative performance in the field of bioenergy in several countries of the European Union. In line with the obtained performance score, some countries have entered the category of non-performers in the field, but with the possibility to reach certain projected values of turnover, only if they consider various changes in the level of inputs. The human resource is the one that, through the number of jobs, has received most suggestions for change, in the sense of reducing them, in order to increase performance. By highlighting the best performance in the field of bioenergy, information and in-depth knowledge can be used to understand and disclose best practices that have contributed to the reported performance, but also to serve as examples for lower performing countries. We did not expect the countries with the highest Installed capacity in MW to have a low Bioenergy Performance Score. However, given that sustainability is the concept that ensures long-term development, it may be appropriate for these countries to direct their capital to other types of energy, including renewable energy, ensuring a mix that leads to a high Energy Return of Investment (EROI).

This research is not exempt from limitations emerging from data availability (which is directly connected to the possibility of using needed indicators for the necessary period of

time) and data timeliness (which triggers the risk of presenting outdated results). Another limitation refers to indicators selection. For instance, the present analysis does not take into account capital expenditures necessary to install capital for bioenergy generation (cheap technology with comparatively higher use of labor can then still be competitive) or local climate conditions, which restricts the use of certain modes of bioenergy production.

As future research directions, there are two such examples that may constitute the aim of further research design and that refer to the methodological approach. Regression analysis or principal component analysis are two other methods that may be used for obtaining a relative measure for performance in the bioenergy field.

Conflict of interest: none

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Cryptocurrencies – "Comparison" of Approach by IAS/IFRS and Czech Accounting Legislative

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Abstract: Even if the main focus is currently on the situation surrounding the "Covid-19 pandemic" it seems that cryptocurrencies as the issue are still discussed quite often. This article describes the problems solved taking into account the necessity to record information about business activities associated with cryptocurrencies transfers done by the accounting units with respect to legislative rules covering this issue in the Czech Republic, and in the EU (by IAS/IFRS). Objective of the contribution is to define the means of evaluation, keeping accounting records and classification of cryptocurrencies in the regulatory environment of the Czech Republic, IAS/IFRS and further, based on their comparison, to identify the most significant variations and influence of these variations on reporting the financial situation and performance of enterprises. The authors work with the historically given definitions associated with cryptocurrencies, information about the development of cryptocurrencies and approaches to their use. The contribution identified, using the analyses of data provided by international institutions (IFRS Foundation, Deloitte) and Czech national authorities (Ministry of Finance of the Czech Republic, Czech National Bank), that differences in the reporting of cryptocurrencies significantly affect the ratio of long-term and current assets and the amount of operating or investment cash flow.

1. Introduction

The intention to invent and work with "electronic money" is not new. It is the thought that has already appeared in 1989 when David Chaum succeed with the anonymous cryptographic electronic money, DigiCash (Pitta, 1999). Another milestone in cryptocurrencies development is the year 2008 when was this term used in relation to invention of the currency called "Bitcoin" (S.L., 2015). This kind of cryptocurrency is still used, as well as for example Ethereum, Tether, Binance coin, Cardano and others (Tretina & Schmidt, 2021; Stroukal & Skalický, 2021).

Cryptocurrencies represent one of the greatest technological innovations – at least in current years (Monteiro et al., 2019). They can be explained as decentralized payment sytems in which is the ownership demonstrated cryptographically (Lánský, 2018). System of cryptocurrencies can be understood as a system designed to issue tokens which are intended to be used as general or limited mean of exchange. They are often accounted using collectively kept digital ledgers using cryptography that should have the ability to replace

trust in the authorities (Pernice, 2021). Even if there the word „currency" represents part of the „cryptocurrency", it can´t be taken as the standard currency as explained in the following text. Cryptocurrencies are usually explained as tokens suitable for money transfers and satisfaction of some other needs.

Capital outflow, some other illegal trades, and the possibility of getting rich quickly attracted people to bitcoin operations, but sharp movements (fluctuations) in its price revealed the extent of the risks of such operations (Portnoy, 2018). The overview of ownership of payment units is stored in a data structure called „blockchain". New cryptocurrencies were often developed by modifying the parameters of another cryptocurrency and launching a new blockchain. Currently are new cryptocurrencies created as an application to other existing cryptocurrencies. These cryptocurrencies are labelled as „tokens". Creation of new cryptocurrency is said to be easy, but its value depends on willingness of users to pay for its units (Lánský, 2020). Cryptocurrencies were originally the technical problem. This problem was solved with the intention to "eliminate centralized control of money from government agencies and ensure speedy processing of transactions." (Reiff, 2021)

As the positive feature of cryptocurrencies is taken their blockchain system that can be used in different sectors of industry (Portnoy, 2018). Authors Li and Whinston (2020) state that *„cryptocurrencies are fundamentally different due to differences in the following factors: the identity management of their ledger writers, their consensus algorithms, and their coin supply"*.

Cryptocurrency is mostly a new and specific class of assets that is not associated with standard factors. According to previous studies, cryptocurrency shocks do not have statistically significant effects on standard financial market (except of the bond market – as stated in study by Liu, Rahman and Serletis (2020)).

Empirical research in the field of cryptocurrencies currently starts and represents therefore an extraordinary research opportunity for the academic sphere (Hardle et al., 2020). In studies by various authors are available polemics about their future existence. For example, Lánský (2020) examined, on a sample greater than 2,500 cryptocurrencies, the possibility that the cryptocurrency will not survive in the future and will be withdrawn from stock exchanges. For this purpose, for different categories of cryptocurrencies according to their previous trading time on stock exchanges, Lánský determined the conditional probability of delisting within 5 years. Conclusion of this author´s research is finding that the new cryptocurrencies are the riskiest ones. As the age of the cryptocurrency increases, the probability of its delisting decreases. Authors Ben and Wang (2019) conducted the comparison of the main cryptocurrencies' efficiency with the performance of stock market indices. Their results show that all cryptocurrencies show higher average returns and volatility than stock market indices, which addresses investors who take a risk.

Blockchain system and cryptocurrencies create a new civil financial society with a kind of self-regulation. Such processes are typical for the present. They do not represent development of new type of money, but they create their own way of interaction with currently used credit money. This new system may need (in future) kind of regulation by the state authorities (Portnoy, 2018). This regulation includes determination of valuation methods, reporting of cryptocurrencies in the financial statements (informing about the

financial position, performance and changes in financial position) of corporations and thus also methods of accounting for related accounting operations in the accounting books. This regulation takes place not only in the national legislative regulation, but also in international accounting standards.

Objective of this contribution is to define the means of evaluation, keeping accounting records and classification of cryptocurrencies in the regulatory environment of the Czech Republic, IAS/IFRS and further, based on their comparison, to identify the most significant variations and influence of these variations on reporting the financial situation and performance of enterprises.

For example, the Croatian authors Vasicek, Dmitrovic, and Cicak (2019) described the valuation, accounting and reporting of cryptocurrencies according to the IFRS accounting system. However, there is not any comparison with the Czech accounting regulations and finding focused on the effect of differences on reporting the financial position and performance of corporations.

2. Methodology

This contribution is based on desk research, during which was firstly conducted source research focusing on function, characteristics, future of cryptocurrencies and further about their accounting concept. As the second step, in order to identify variances between the accounting system of the Czech Republic and IAS/IFRS, the comparative analysis in the area of accounting, valuation and reporting of cryptocurrencies was performed. After these two steps, authors focused on assessing to what extent will variances in the mentioned accounting systems affect the financial position and performance of corporations. For this purpose, corporations based in the Czech Republic were selected in Albertina database (see Dun & Bradstreet, 2021), whose:

1. primary activity is production business, but in the balance sheets, still show the state of goods and in the profit and loss statement, sales of goods,
2. primary activity is provision of services, but in the balance sheets, still show, in addition to material, other items of inventory – such as goods or work in progress.

By selecting this research sample, the authors tried to identify accounting units that are more likely to deal with cryptocurrencies. This way was compiled the research sample of 430 enterprises of different sizes belonging to several NACE activities. These corporations were asked questions focused on detection of their cryptocurrency ownership and determination of type, method and amount of their investment in cryptocurrencies. Questions were, after a repeated request for a response, answered by 127 corporations. Full information was delivered by 118 respondents. The research, consisting of three closed and one open question, was conducted in 2021. Solutions are summarized in chapter 3.5.

3. Results

As written above, this article is focused on analyzing approaches to dealing with cryptocurrency in the field of accounting. The authors try to observe the possibilities of

recording cryptocurrency under the Czech accounting legislation and legislation framework set for this issue by the IAS/IFRS. The original hypothesis is that the Czech accounting legislation will be, similarly as in other areas, set with respect to the directives compiled by the European commission.

3.1. Initial Information to Cryptocurrencies – Background to Accounting and Tax Approaches

The cryptocurrency as such is characterized by three characteristics set by IFRS Interpretations Committee (2019). Cryptocurrencies are explained as:

- a digital or virtual currency recorded on a distributed ledger that uses cryptography for security,
- not issued by a jurisdictional authority or other party,
- does not give rise to a contract between the holder and another party.

In practice, there are two views on cryptocurrencies. It seems to be logical to deal with them as with (Kocourková & Trnková, 2020):

- the kind of legal tender,
- the kind of intangible thing (asset).

Those two approaches are further studied in the environment being subject to two various (but very close) legislative frameworks:

- Czech legislative framework (mainly area governing accounting),
- IAS/IFRS.

3.2. Cryptocurrencies under the Czech Legislative Framework

As was written in the previous section of the contribution, there may exist two approaches to cryptocurrencies considered under the Czech legislation:

- cryptocurrency as the kind of legal tender,
- cryptocurrency as the kind of intangible thing (asset).

If the cryptocurrency is taken as the kind of legal tender it will be necessary to meet the definition of legal tender (banknotes and coins) mentioned in the Act no. 136/2011 Coll., Act on the Circulation of Banknotes and Coins and on the Amendment of Act no. 6/1993 Coll., On the Czech National Bank, as amended:

"*A domestic banknote is a Czech koruna banknote issued by the Czech National Bank that is valid or that can be exchanged for a valid one; a banknote denominated in another currency that is valid or that can be exchanged for a valid one is a foreign banknote.*"

"*A domestic coin is a coin denominated in Czech koruna, issued by the Czech National Bank, which is valid or which can be exchanged for a valid one; a coin denominated in another currency that is valid or that can be exchanged for a valid one is a foreign coin.*"

If the cryptocurrency is taken as the kind of intangible thing (asset) it will be necessary to meet the definition of intangible thing (asset) mentioned in the Act no. 89/2012 Coll., Civil Code, § 496, (Currently changed, but not in the part dealing with intangible things, by Act no. 192/2021 Coll., Act amending Act no. 89/2012 Coll., The Civil Code, as amended, Act no.

99/1963 Coll., The Code of Civil Procedure, as amended, and Act no. 292/2013 Coll., on special court proceedings, as amended):

"Intangible things are rights, the nature of which allows it, and other things without material substance."

Cryptocurrency is in the Czech Republic taken as the kind of thing (legal concept). Its reporting is not set by the legislative norm. Currently are available brief information on reporting cryptocurrencies compiled by the Czech National Bank (Hampl, 2017) and also by the Ministry of Finance of the Czech Republic (MFCR, 2018), but the approach may also change, because the observation of cryptocurrencies still and with high frequency reveals new findings.

Cryptocurrency is recommended to be classified, evaluated and accounted for as follows:

- Classification … Cryptocurrencies are with respect to § 9 of the Decree no. 500/2002 Coll. classified as inventory "of its kind".
- Evaluation … Cryptocurrencies are evaluated with respect to § 25 of the Act no. 563/1991 Coll., Accounting Act. and § 49 and § 55 of the Decree no. 500/2002 Coll. In the case of cryptocurrencies, it is also necessary to carry out an inventory (§ 29 of the Act no. 563/1991 Coll., Accounting Act.).
- Reporting … Cryptocurrencies should be reported in the balance sheet. Used can be items:
  - "C.I.2. Work in progress",
  - "C.I.3.1. Products",
  - "C.I.3.2. Goods".

With respect to § 4 of the Decree no. 500/2002 Coll., the cryptocurrencies can be reported separately from other items of inventories (MFCR, 2018). The notes related to the cryptocurrencies should also be visible in the annex to the financial statements.

In accounting, there is in association with cryptocurrencies also considered the situation of the new type of currently used cryptocurrency – fork. This is understood in accounting as additions to the breeding animals (or animals).

3.3. Cryptocurrencies under the IAS/IFRS

This part of the contribution will be structured similarly as the previous one. The authors focus again on two possibilities of understanding of cryptocurrencies.

Cryptocurrency is under the IAS/IFRS (IAS 2, 2003; IAS 38, 2004) taken also as the kind of thing (legal concept). Its reporting is given by the legislative norm (IAS 38 – generally, IAS 2 – when the cryptocurrencies are held for sale in the ordinary course of business). With respect to this legislative framework is cryptocurrency classified, evaluated and accounted for as follows:

- Classification … Cryptocurrencies are with respect to IAS 38 classified as "intangible asset", because by IAS 38:
  - "it is capable of being separated from the holder and sold or transferred individually",

- "it does not give the holder a right to receive a fixed or determinable number of units of currency".

  or, in the case when the cryptocurrencies are held for sale in the ordinary course of business, with respect to IAS 2 as "inventories".

- Evaluation … Cryptocurrencies should be evaluated with respect to IAS 38 (fair value) or IAS 2 (fair value less costs to sell).

- Reporting … Cryptocurrencies have to be reported in the financial statements (balance sheet).

With respect to IFRS Interpretation Committee (2019) is an entity required "to disclose details of any material non-adjusting events, including information about the nature of the event and an estimate of its financial effect (or a statement that such an estimate cannot be made)." The accounting unit have to consider if changes in the fair value of cryptocurrencies after the reporting period are significant and therefore may influence the economic decisions done by the users of financial statements.

3.4. Results of a Comparative Analysis in the Area of Valuation, Accounting and Reporting of Cryprocurrencies According to the Accounting System of the Czech Republic and IAS/IFRS

This part of the contribution summarizes, in the form of chart (Table 1), the findings coming mainly from the literary research focused on approaches to cryptocurrency in two close systems of accounting.

Table 1. Comparative matrix for solving cryptocurrencies

Solved issue	Czech accounting legislation	IAS/IFRS
Classification	Inventory	Intangible asset
		Inventory (when the cryptocurrencies are held for sale in the ordinary course of business)
Evaluation	Act no. 563/1991 Coll. Accounting Act, § 25 (purchase price, own costs)	IAS 38 (fair value)
	Further rules - Decree no. 500/2002 Coll. (§ 49 and § 55)	IAS 2 (fair value less costs to sell)
Reporting	Financial statements	Financial statements
	Annex to the Financial statements	Disclosure

3.5. Results of Determining the Extent of the Effect of Variances in the Accounting Systems of the Czech Republic and IAS/IFRS in the Area of Cryptocurrencies

From the final research sample consisting of 118 respondents were, based on the answers obtained during the research, identified 7 accounting units investing to the cryptocurrencies. It represents 5.93% share of accounting units – investors into cryptocurrencies – from the whole research sample. Four corporations from the whole mentioned amount are bitcoin holders, 2 of them hold ethereum and one hold another kind of cryptocurrency (category called „other". The following table (Table 2) shows the method of investing in the cryptocurrencies used by individual subjects belonging to the research sample:

Table 2. Method of investing in the cryptocurrencies used by individual subjects belonging to the research sample

Method of investing	Frequency of the answer
One time investment	2
One time investment and then regular payment	2
One time investment and then irregular payment	3
Only regular investments	0
Only irregular investments	0
Other possibility	0

Average value of investments in the cryptocurrency declared by individual accounting units, investors, is 300,000 CZK. Based on these findings, it can be deduced that investing in cryptocurrencies in accounting units, investors in cryptocurrencies, increases the value of current assets of these accounting units keeping accounting records and reporting with respect to the Czech legislation, by this value on average and this value also reduces operating cash flow at the time of investment. This is in contrast with accounting units keeping accounting records and reporting in accordance with the IAS/IFRS accounting system, whose investments are reported in fixed assets and at the time of payment, with the greatest probability, they reduce the investment cash flow. It is probable that the value 300,000 CZK exceeds for most corporations the materiality limits and will therefore significantly affect both, the ratio between long-term and current assets and the value of operating and investment cash flow. However, classification of cryptocurrencies in the balance sheet does not affect the performance of the accounting unit, because the disposal of cryptocurrency means decrease in economic benefits and the sale of cryptocurrency itself means increase in economic benefits in both accounting systems. Different results may be seen in the calculations of the ratio indicators of the financial analysis if (especially in the denominator) the values of long-term or current assets are entered.

4. Discussion

Authors of this contribution have no intention to disprove the idea that cryptocurrencies are an asset, as they are aware that cryptocurrencies meet all aspects of the definition of an asset as set by the Conceptual Framework of the IAS/IFRS accounting system. (In the legislation of the Czech Republic, especially in the primary legal norm Act no. 563/1991 Coll., Accounting Act, is not the definition of asset included.)

However, it is possible to discuss with the classification of cryptocurrencies according to the Czech accounting system (in current assets) and to find arguments that are controversial with the classification of cryptocurrencies according to the IAS/IFRS accounting system.

For example, Petrova, Nikiforov, Klochko, Litti, Stepanova, and Protasov (2020) state in their article that the only argument for inclusion of cryptocurrencies to intangible assets is the absence of the substance of materiality. Their further characteristics are, however, controversial. This team of authors suggests to deal with incoming payments in cryptocurrencies by traders as „barter transactions". In their opinion, barter is a form of non-cash settlement that fits well with the concept that cryptocurrency is not cash or its equivalent.

5. Limits of Conducted Research

Conducted research is limited by clear identification of the sample of companies. Authors went through the pre-selection of enterprises from the Albertina database (Dun & Bradstreet, 2021), even it is not clear if this pre-selection influenced anyhow the probability of selecting a corporation investing in cryptocurrencies. With respect to the fact that the authors were mainly interested in the answers of respondents who invest in cryptocurrencies, this pre-selection was a logical step. It would be suitable for further research to specify the research sample more precisely. For example, to limit selected activities belonging under NACE or to conduct research just using the research sample consisting only of enterprises based in the Czech Republic. Without this, the share of corporations in the total sample of enterprises included in the research has no explanatory power.

6. Conclusions

Dealing with cryptocurrencies is nowadays quite widespread. Traders in this area of business take it as the common thing and tries to take advantage of all the benefits that cryptocurrencies offer. However, it has to be said that all these new types of currencies could be invented only in the environment that the world represents today, only with the existence of developed technologies that are spread all over the world. Even if there are still many places with not so comfortable conditions for activities based on the existence of access to the internet, the scientists are still searching for ways how to change this situation (Ogurčáková, 2022).

The authors do not dare to judge whether the solution of this technical problem (how to create this "currency" and how to use it) has been a shift in the right direction or not. But it is certain that after solving the technical problem appeared other questions related to the transactions for which this kind of "money" can be used. What was originally just the technical problem, brought the consequences to other disciplines like accounting and taxes that had and still have to solve setting up the supporting processes for recording cryptocurrency-related transactions.

The intentions related with keeping accounting records and approaches to cryptocurrency generally have also undergone changes over the years. This contribution focused on current, mainly accounting, understanding of cryptocurrencies, its classification and dealing with them during keeping accounting records about transactions associated with them, even if the authors know that this issue is not still resolved on national and international basis. Worldwide still appear new ideas that will certainly contribute to setting clear rules for reporting cryptocurrencies in accounting in the future.

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The Development of Photovoltaics in the Visegrad Group Countries

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Abstract: The countries of the Visegrad Group (V4) face serious challenges related to increasing the share of renewable energy sources (RES) and the energy mix. One of the elements connected with the achievement of higher use of RES is the development of photovoltaics. The countries of the Visegrad Group still have untapped potential to increase energy production based on photovoltaic installations. However, this will require the implementation of solutions that will, on the one hand, encourage investors to choose this type of RES, and on the other hand, invest in obsolete transmission networks and energy storage. The aim of the article is to analyse the conditions related to the development of photovoltaics in the Visegrad Group countries, with particular emphasis on the further development of RES until 2030. The article also demonstrates the potential of solutions associated with the adaptation of industrial networks to the changing conditions in this sector (e.g. the growing number of prosumers). Moreover, the importance of storing energy from photovoltaic installations was emphasized, which will allow the stabilization of the energy system.

1. Introduction

Recent years have brought an increase in the importance of photovoltaics as one of the fastest growing renewable energy sources. The development of this RES had a significant impact on the achievement by the Visegrad Group countries of the targets for the share of energy from renewable sources set for 2020 in the final gross energy consumption (Directive 2009/28/WE, 2009). The national targets for the share of energy from renewable sources in gross final energy consumption for 2020 set out in Directive 2009/28/EC was already achieved in 2019 by all Visegrad Group countries except Poland (Figure 1).

It should be noted that Poland committed that in 2020 the share of renewable energy sources would be 15% in gross final energy consumption (Dzikuć & Tomaszewski, 2016), in the case of Hungary and the Czech Republic it was 13%, and in Slovakia 14% (Table 1). Ultimately, Poland reached the 2020 target, which was largely due to the dynamic increase in the number of photovoltaic installations and the economic slowdown caused by the coronavirus pandemic (Rokicki et al., 2022). The limitations related to the epidemiological situation in Poland resulted in a reduction in energy consumption in 2020 (Mik et al., 2021). This reduction occurred mainly during the production of energy based on conventional
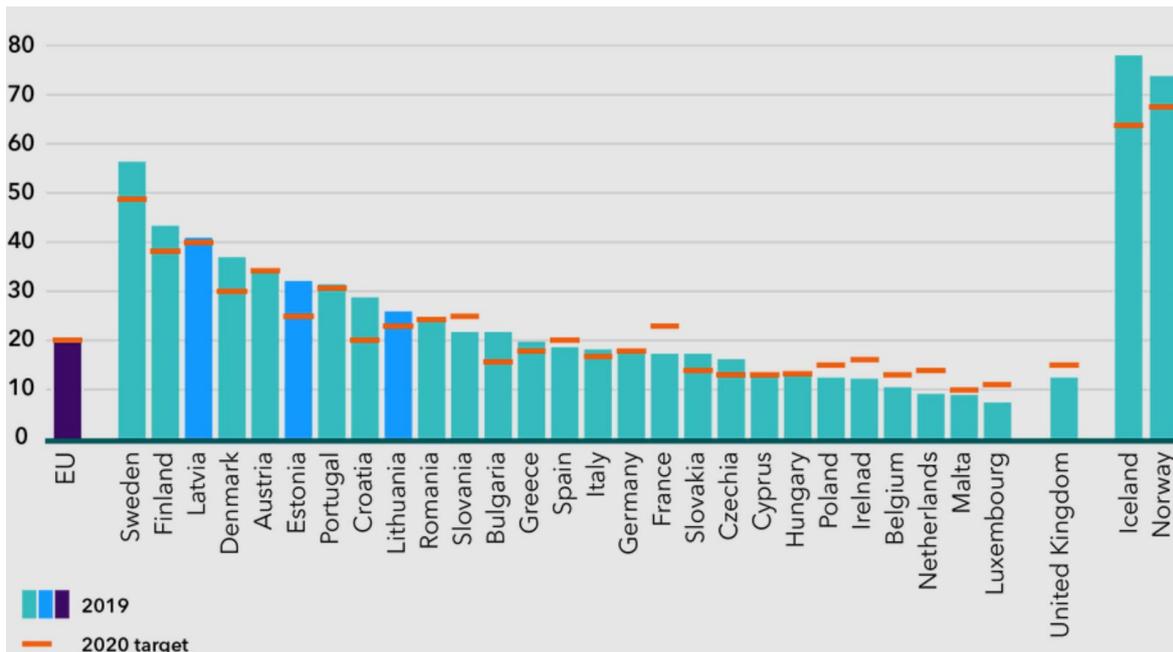
Figure 1. Overall share of energy from renewable sources 2019 (The European Bank for Reconstruction and Development, 2022)

energy resources such as lignite and hard coal. It should be emphasized that the development of RES, including photovoltaic installations, is consistent with the idea of low-carbon development (Zarębska & Dzikuć, 2013).

2. Methodology

The aim of the article is to analyse the conditions related to the development of photovoltaics in the Visegrad Group countries, with particular emphasis on the further development of RES until 2030 (Janda, 2018). The article also demonstrates the potential of solutions associated with the adaptation of industrial networks to the changing conditions in this sector (e.g. the growing number of prosumers). Moreover, the importance of storing energy from photovoltaic installations was emphasized (Kuceba et al., 2021), which will allow the stabilization of the energy system (Olczak et al., 2021).

The methodology of own research is closely related to the purpose of the analyzes. The indicated research goal was a determinant of the use of methods that are characteristic of social sciences (Poór et al., 2015). In order to effectively achieve the research goals, the following research methods were used:

- deductive method,
- analysis of source documents,
- analysis of the literature on the subject,
- methods of descriptive and mathematical statistics,
- tabular and descriptive charts.

The collected data was helpful in analyzing the development of photovoltaics in the countries of the Visegrad Group. The conducted research was helpful in trying to define the prospects for the development of photovoltaics in the coming years. Data obtained from the

central authorities of individual countries were used during the analyzes. The article analyzes statistical data and other important information related to the development of photovoltaics. The statistical data and other information used during the research were the basis for the economic characteristics of the analyzed renewable energy source (photovoltaics). The research methods and techniques used in the manuscript made it possible to achieve the assumed goal.

3. Analysis of Factors Influencing the Functioning of Photovoltaics in the Countries of the Visegrad Group

The countries of the Visegrad Group have a lower share of renewable energy in the total energy balance than in the entire European Union (Gnatowska & Moryń-Kucharczyk, 2021). Compared to other countries of the Visegrad Group, Poland generates the most energy based on RES (Figure 2). However, Poland is by far the largest country of the entire Visegrad Group, and if the number of inhabitants of individual countries is taken into account, these differences become blurred (Olczak & Komorowska, 2021). The Czech Republic and Slovakia in 2019 achieved the share of renewable energy planned for 2020, which may have contributed to the fact that the authorities of these countries were not willing to create conditions for the development of, among other things, photovoltaics (Duda et al., 2022).
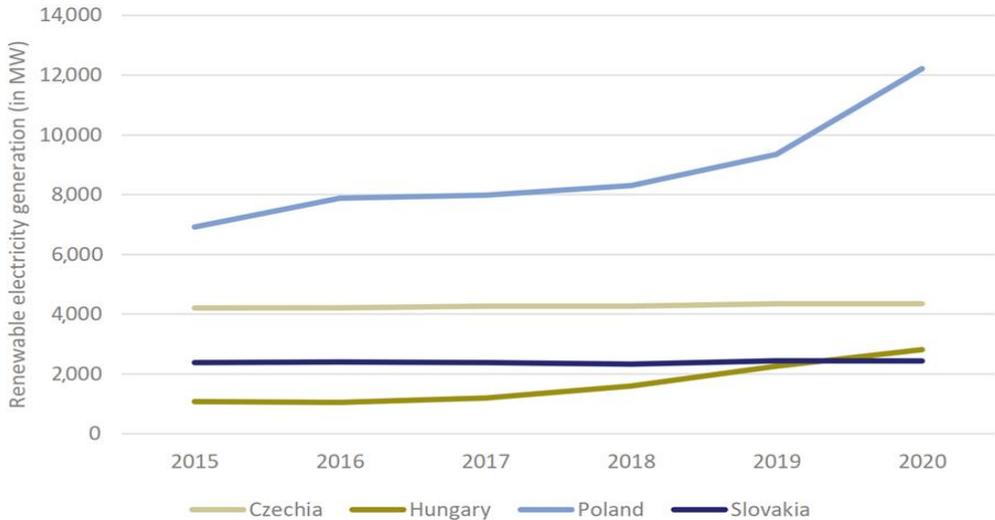
Figure 2. Production of electricity from renewable sources in the countries of the Visegrad Group in 2015-2020

Hence, the development of photovoltaics in recent years in the Czech Republic and Slovakia has been moderate. On the other hand, Poland and Hungary in 2019 were in a worse situation. In 2019, Hungary was close to the target of RES share in the energy balance for 2020, and Poland had a significantly lower share of RES and was forced to take measures that would lead to faster RES development. On the other hand, Poland and Hungary in 2019 were in a worse situation. In 2019, Hungary was close to the target of RES share in the energy balance for 2020, and Poland had a significantly lower share of RES and was forced to take measures that would lead to faster RES development. Therefore, Poland and Hungary were

exposed to sanctions by the European Union in the event of failure to meet the commitments made. Possible penalties that could be imposed on Poland and Hungary for failure to achieve the assumed share of RES could constitute a serious burden for these countries. It should be noted that increasing the installed capacity in photovoltaics, due to the relatively short period of investment implementation (Franz & Piringer, 2020), was one of the best solutions allowing Poland to achieve and Hungary to maintain the assumed RES share in the total energy balance (Hałacz et al., 2020).

The climatic conditions in the Visegrad Group countries related to the possibilities of obtaining electricity through photovoltaic installations are varied. The most favourable are in Hungary and in the southern part of Slovakia (Figures 3 and 4). However, they are less favourable in the Czech Republic and Poland (Figures 5 and 6). Yet, this does not mean that the climatic conditions in the Czech Republic and Poland lead to the lack of profitability of the operation of photovoltaic installations (Solargis, 2022). Maps showing data related to Photovoltaic Power Potential (PVOUT) for the Visegrad Group countries have been published by Global Solar Atlas, the World Bank and by Solargis. PVOUT maps provide the estimated power generation potential and provide information on the long-term average daily and annual potential electricity production from a grid-connected PV plant with a peak power of 1 kWp (kWp – the amount of electricity at the peak, i.e. at the peak of production). When estimating the potential of photovoltaics in individual countries, it was assumed that the configuration of the photovoltaic system is made of ground-based, free-standing structures that consist of photovoltaic modules made of crystalline silicon and are mounted in an optimal inclination position to maximize the annual energy production (Angowski et al., 2021). The estimates also take into account the use of inverters with optimal efficiency. Furthermore, the simulation assumes that the losses in energy production by photovoltaic installations due to their contamination amount to 3.5%. At the same time, it is assumed that the influence of the remaining losses due to cabling and shading is 7.5%. When estimating the photovoltaic potential, it was also assumed that the availability of the photovoltaic installation is 100%. When developing maps of the photovoltaic potential for the Visegrad Group countries, the temperature of the air above the ground was also taken into account (Solargis, 2022).

It is assessed that the average number of sunny hours in Hungary is around 2,000 per year. For Budapest it is approx. 1,990 hours, while for Bratislava (the capital of Slovakia) the number of sunny hours per year is similar and amounts to approx. 2,040. In the Czech Republic and Poland, however, the number of sunny hours is lower, usually in the range of 1,400-1,800 hours during the year. As previously noted, all countries of the Visegrad Group have good weather conditions for the production of energy by photovoltaic installations (Solargis, 2022). On the other hand, the most favourable weather conditions are from April to September, when the vast majority of energy is produced. It should be emphasized that the differences between Poland and the Czech Republic and southern Slovakia and Hungary are significant (Global Solar Atlas, 2022).
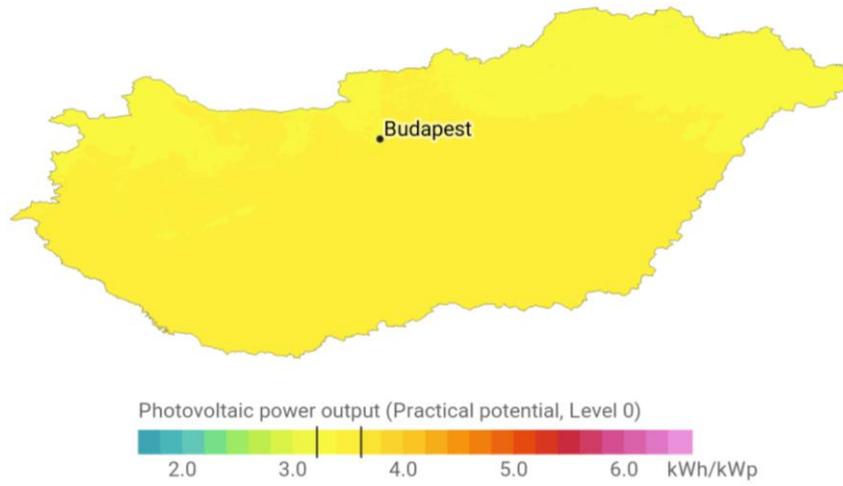
Figure 3. Photovoltaic power output in Hungary (Global Solar Atlas, 2022)
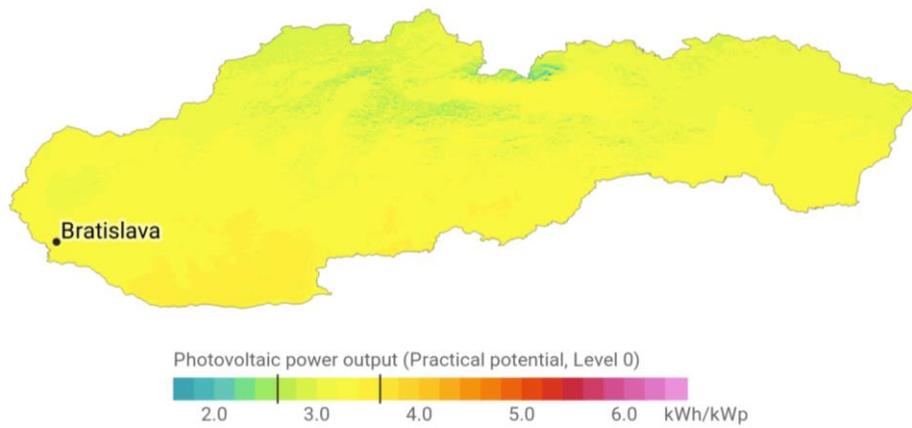
Figure 4. Photovoltaic power output in Slovakia (Global Solar Atlas, 2022)
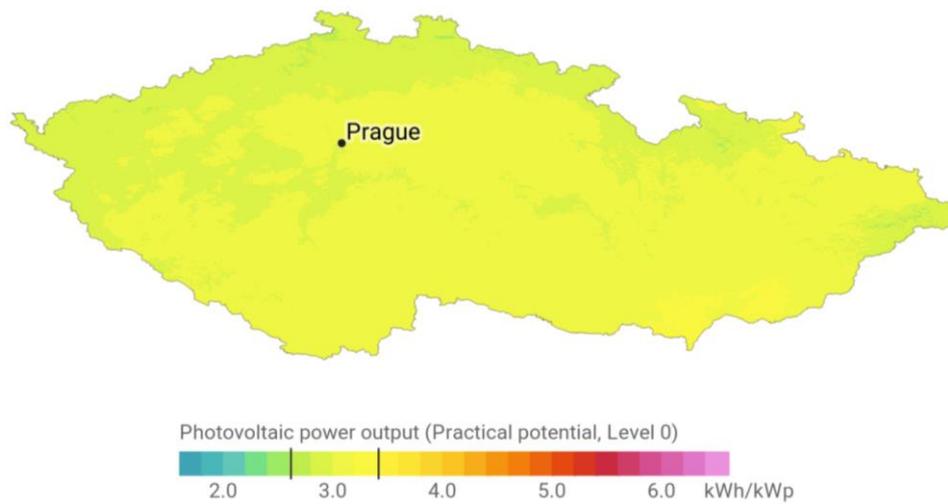
Figure 5. Photovoltaic power output in Czech Republic (Global Solar Atlas, 2022)
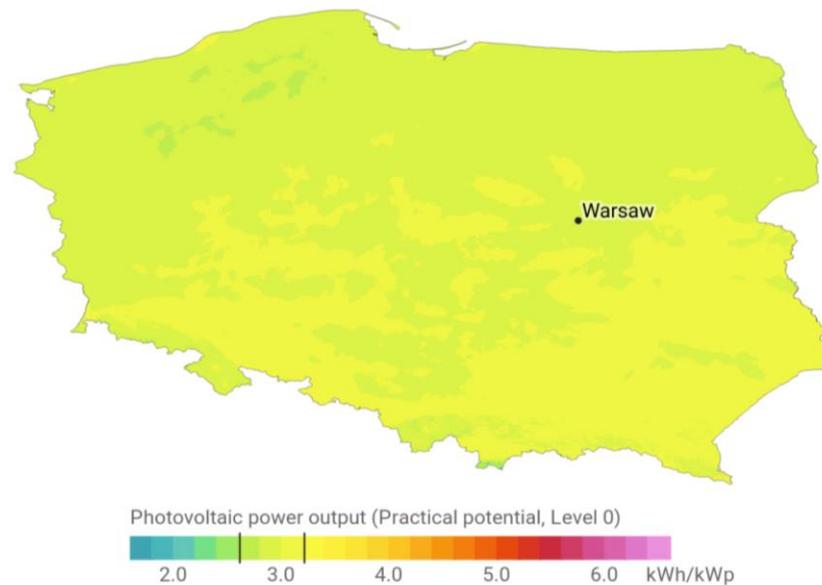
Figure 6. Photovoltaic power output in Poland (Global Solar Atlas, 2022)

4. Prospects for the Development of Photovoltaics in the Visegrad Group Countries

The state authorities of the Visegrad Group countries independently develop a national policy for the development of RES. In line with the assumptions for the National Energy and Climate Plan, Poland envisages an increase in the maximum capacity of photovoltaic installations to approx. 7.3 GW in 2030 and approx. 16 GW in 2040 (Kulpa et al., 2022). National contribution for energy efficiency (primary energy consumption and final energy consumption) of most Visegrad Group countries should be assessed as modest or low ambition. Apart from Hungary, whose national contribution for energy efficiency should be estimated as very low (Table 1).

When planning the future development of photovoltaic installations, the authorities of individual countries should take into account climatic conditions in order to maximize the efficiency of using the potential of solar energy. The example of Hungary shows that photovoltaic installations could be located in the southern part of the country, which is the area with the most favourable solar conditions (Figures 3 and 7).

It should be emphasized that the appropriate legal solutions that existed, among other things, in the Czech Republic more than ten years ago and the favorable conditions in Poland in the last few years allow us to achieve a dynamic increase in installed capacity in photovoltaic installations. However, in the case of Poland, the dynamic development of photovoltaics may weaken after April 1, 2022 due to the introduction of less favorable legal regulations, when the owners of newly built photovoltaic installations will not be able to use the energy system as a virtual energy storage (as has been the case so far). Prosumers in Poland who build photovoltaic micro-installations by April 1, 2022 will be able to use up to 80% of the energy that they sent to the energy system early. Nevertheless, after this period, they will sell unused electricity to the energy system. Currently, the prices at which prosumers will be able to sell surplus electricity produced are not known yet, but most likely

Table 1. Objectives, targets and contributions under the Governance Regulation of countries of the Visegrad Group (European Commission, 2021; European Union, 2018)

National targets and contributions	Countries of the Visegrad Group	Latest available data	2020	2030	Assessment of 2030 ambition level
Binding target for greenhouse gas emissions compared to 2005 under the Effort Sharing Regulation (ESR) (%)	Czech Republic	**4% (2018)**	**9%**	-14%	**As in ESR**
	Hungary	-10%	10%	-7%	As in ESR
	Poland	21%	14%	-7%	As in ESR
	Slovakia	-5%	13%	-12%	Ambitious (national target of -20%)
National target/contribution for renewable energy: share of energy from renewable sources in gross final consumption of energy (%)	Czech Republic	**15% (2018)**	**13%**	22%	**Unambitious (23% is the result of RES formula)**
	Hungary	12.5%	13%	21%	Unambitious (23% is the result of RES formula)
	Poland	11.3%	15%	21-23%	Unambitious (25% is the result of the RES formula)
	Slovakia	11.9%	14%	19.2%	Unambitious (24% is the result of the RES formula)
National contribution for energy efficiency: a) primary energy consumption (Mtoe) **b) final energy consumption (Mtoe)**	Czech Republic	a) **40.4 (2018)** b) **25.3 (2018)**	a) **43.3** b) **23.9**	a) **41.43** b) **23.65**	a) L**ow ambition** b) M**odest ambition**
	Hungary	a) 24.5 Mtoe b) **18.5 Mtoe**	a) 24.1 Mtoe b) **14.4 Mtoe**	a) No target set **785 PJ** b) **(18.7Mtoe)**	a) **Very low** b) **Very low**
	Poland	a) 100.9 Mtoe b) 71.8 Mtoe	a) 96.4 Mtoe b) 71.6 Mtoe	a) 91.3 Mtoe b) 67.1 Mtoe	a) Modest b) Modest
	Slovakia	a) 15.8 Mtoe b) 11.1 Mtoe	a) 16.4 Mtoe b) 9.0 Mtoe	a) 15.7 Mtoe b) 10.3 Mtoe	a) Low ambition b) Low ambition
Level of electricity interconnectivity (%)	Czech Republic	**26.6% (2018)**	**29.6%**	**44.1%**	**N.A.**
	Hungary	50%	55%	60%	N.A.
	Poland	4%	4%	8.7%	N.A.
	Slovakia	43%	59%	52%	N.A.
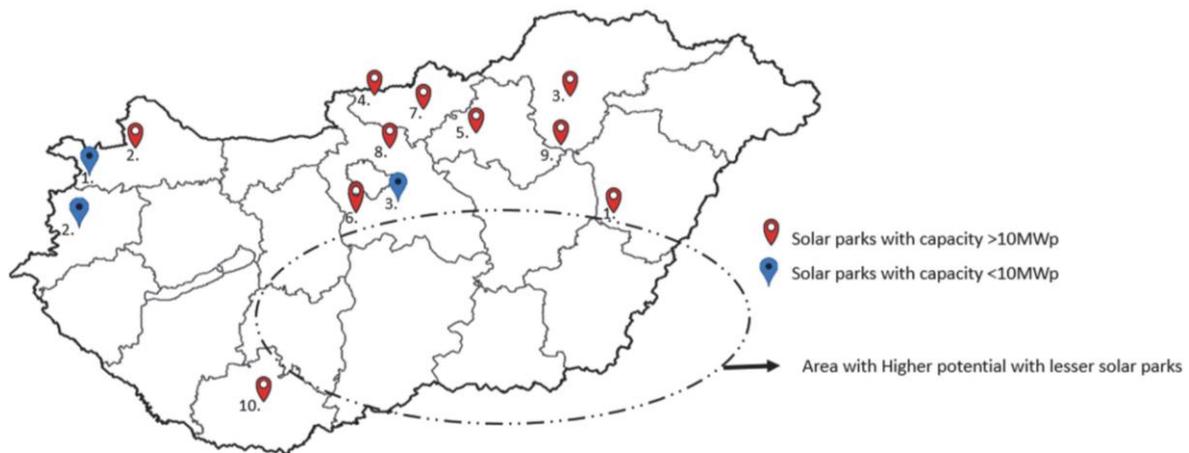
Figure 7. Solar park presence in various regions of Hungary based on power capacity (Kumar et al., 2021).

it will be a price much lower than the price they will have to pay for the electricity taken from the grid (Wciślik & Kotrys-Działak, 2021).

It should be emphasized that public economy is related to the development of photovoltaics. Central authorities decide on the co-financing of individual RES. In addition, the government authorities set the conditions for the sale of the energy produced from the photovoltaic installation (Klepacki et al., 2021). These solutions have a large impact on the decisions of investors, because they affect the economic efficiency of the operation of photovoltaic installations.

5. Conclusions

Geospatial analyses demonstrate the potential of the Visegrad Group countries in the further development of photovoltaics. Even though the climatic conditions are not identical in all analysed countries. In the southern part of Slovakia and in most of Hungary (especially the southern region of Hungary), there is the greatest potential for locating solar PV installations.

It should be noted that the factor influencing the increase in the share of renewable energy by the Visegrad Group countries may be the increasing fees for CO_2 emissions, which in December 2021 reached a price of approx. EUR 90 per ton. This may be particularly important in the case of Poland, which has the highest share of coal in the energy mix of all the countries of the Visegrad Group. Moreover, for the development of photovoltaics to be possible, actions will be needed to stabilize energy networks, which are often outdated.

In addition to the obvious solutions consisting in the modernization of power grids, it will be necessary to build local energy storage facilities that will help to relieve the power grid during summer days, when the largest amount of energy is produced by photovoltaic installations. The countries of the Visegrad Group are moderately decisive in their approach to a significant increase in the share of energy from RES in the energy mix.

The development of photovoltaics is closely related to public administration. An example may be the decisions of the central authorities in Poland, which led to the

creation of 850,000. micro-installations within three years. Similar examples of the influence of governmental decisions on the development of renewable energy sources (including photovoltaics) can be found in other EU countries.

Conflicts of Interest: none

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The Effect of Preferred Return of Venture Capital Fund on VCs' Accredited Director Assignment

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Abstract: Preferred return as key component of compensation contract for Venture Capitalists (VCs), have significant impact on compensation return for VCs. This paper collected the investment announcements issued by listed companies when they were investing in Venture Capital (VC) funds as limited partners from 2010 to 2018, to construct a data set of preferred return of VC funds. Samples were built based on portfolio companies to study the impact of preferred return on the post-investment management behavior of VCs. Results showed that the higher the preferred return of VC fund, the higher the probability of VCs assigning accredited directors to the invested companies; off-site investment behavior has opposite effect on above trends, while "CEO duality" enhances the probability. This paper provides theoretic evidence for the effect of VCs' compensation contract clause. The conclusion of this study has certain guiding significance for VC fund compensation contract establishment, VCs' post-investment management and VC capital selection.

1. Introduction

The management fee and carried interest of Venture Capital (VC) funds are the most significant sources of financial income for Venture Capitalists (VCs) as fund managers (Gompers & Lerner, 1999; Yasuda & Metrick, 2010), and preferred return is the key factor that determines the financial return of VCs. As widely used in practice, preferred return refers to the minimum return for VCs must achieve before getting carried interest (Sorensen et al., 2014; Buchner & Wagner, 2017; Finnerty & Park, 2018), which was defined by the VC institution (i.e., general partner, GP) and its investors (i.e., limited partner, or LP) when the VC fund was established. However, only few studies have investigated the effect of preferred return on investment preferences of VCs (Humphery-Jenner, 2012; Buzzacchi et al., 2015), especially rare for theoretical and empirical studies on the function of this compensation clause. Post-investment management, as a key stage for VCs to cope with the uncertainty of enterprise growth and the risk of asymmetric information, plays an irreplaceable role in improving enterprise performance and fund investment return (Dong et al., 2017). This raises an important topic to be explored: What influence does preferred return have on the post-investment management behavior?

Although there are many post-investment management methods for VCs, the assignment of accredited directors to portfolio companies has been widely concerned by many scholars (Rossenstein et al., 1993; Chen et al., 2017; Amornsiripanitch et al., 2019; Ewens & Malenko, 2020). As the board of directors is the most critical decision-making and monitoring organization in a company, if VCs occupy a seat on the board of directors of portfolio company, then they can involve in the management of the company directly, that's why it attracts extensive attention among major post-investment activities. However, in practice, most VCs manage at least one fund and each fund usually invested in multiple companies, it will be costly for VC institution to assign accredited director to every company. (Lerner, 1995). Therefore, assigning accredited directors depends on the balance between the benefits and costs brought by this action. For VCs, the VC fund preferred return can result in changes in the final return expected to be earned after accredited director assignment. According to existing studies, carried interest accounts for more than one-third of the compensation return of VCs (Finnerty & Park, 2018), and VCs can only extract carried interest if the fund return meet the preferred return specified in the compensation contract. It can be concluded that the higher the preferred return, the harder it is for VCs to get the total financial return.

If VCs are present on the board of directors of portfolio companies, then they can not only directly participate in the formulation of corporate development strategies and business decisions, but also supervise the management behavior of the companies (Rosenstein et al., 1993; Lerner, 1995; Bruton et al., 1997; Bonn, 2009), and ensure the good operation of the companies, which are conducive to improve the exit return of VC funds. Which leads to that assignment of accredited directors to portfolio will increase the possibility of higher return for VCs. In addition to this, writer introduced two scenarios: off-site investment and "CEO duality". Studies have shown that off-site investment leads to higher costs of director assignment (Lerner, 1995), which weakens the incentive of VCs to assign accredited director to firms. Meanwhile, "CEO duality" will make the portfolio companies face the threat of value reduction (Fooladi & Shukor, 2012; Liu, 2020; Zhang, 2018), and external supervision can help to avoid the opportunistic behavior of "CEO duality" to a certain extent, thus it will reinforce the incentive of VCs to assign accredited directors to portfolio companies.

Based on above analysis, the primary hypotheses to be certified in this article listed as below: Frist, whether preferred return has a facilitating effect on VCs' assignment of accredited directors to portfolio companies? Second, will off-site investment negatively adjust the relationship between preferred return and accredited director assignment, and "CEO duality" enhance the probability?

The main contribution of this paper as following two aspects. On the one hand, the relationship between VC fund preferred return and VCs' post-investment management behavior was found. Previous theoretical studies about preferred return mainly focus on the relationship between preferred return and VCs expected salary return as well as investment preferences. According to Humphery-Jenner (2012), the higher preferred return will lead VCs to become passive after experienced the initial investment failure, and give up follow-up investment. Other scholars believe that the compensation structure with higher preferred return will motivate VCs to choose high-risk investment projects, in order to increase the

return of the fund through risky investment (Buchner & Wagner, 2017; Buzzacchi et al., 2015). This study links preferred return to post-investment management behavior and finds a significant positive relationship between preferred return and accredited director assignment. On the other hand, this study enriches the theoretical research on the post-investment management behavior of accredited director assignment. The existing researches about accredited director assignment from VCs can be divided into the following categories: 1) Discussing the impact of VCs accredited directors on portfolio companies' innovation (Chen et al., 2017). 2) Analyzing the determinants of VCs' seats on companies' boards (Amornsiripanitch et al., 2019). 3) Analyzing the role of VCs in the board of directors of portfolio companies, such as employing their own network to recruit managers and external board members for the companies (Amornsiripanitch et al., 2019), or playing advisory and resource-provider role (Ewens & Malenko, 2020). The findings of this paper indicate that the compensation contract affects the probability of VCs to assign accredited directors to portfolio companies.

2. Methodology, Model Settings and Data Description

2.1. Samples and Data Sources

The data of this paper comes from multiple databases, and the details are as follows. The fund-level data retrieval procedures: Firstly, search the Private Equity Database (PEDATA) for VC funds with listed companies as LPs and related investment events from 2010 to 2018. Total 327 funds and 1,885 investment events were obtained by excluding the events where the names of portfolio companies weren't announced. Secondly, writer obtained the terms of Limited Partnership Agreements (LPAs) of VC funds through the investment announcements issued by listed companies when investing in VC funds, to solve the problem of obtaining data on preferred return. Search through the CNINFO website for investment announcements issued by listed companies when they were investing in VC funds as LPs, and obtained the announcements text of 130 VC funds in total. Thirdly, the preferred return information of VC funds was obtained through the terms of LPAs in the texts, the announcements with incomplete information were removed, and the preferred return data of 104 VC funds and corresponding 364 investment events were finally determined.

The data of accredited director assignment from VCs were further compiled manually by the following steps. First, the director change records of portfolio company after receiving investment from VC funds were inquired in the Tianyancha website; and then, if the enterprise had new director, following two methods were adopted to determine whether he/she is accredited director from VCs: 1), search the name of the new director in the change record in the PEDATA, and determine whether the director is related to the VCs based on the tenure history provided in the database; If the information about the director is not included in the database, then the director's employment history will be searched on the Tianyancha website to determine whether the director is accredited director from the VCs; 2), if the information of the director couldn't be found on neither the PEDATA or Tianyancha website, then the keyword search method will be applied by searching the name of the

director and VCs on Baidu website, and judge whether there is interest correlation between them according to the search results.

The information of VC funds, VC institutions and LPs was obtained from the PEDATA, and other information related to the portfolio companies was collected through the PEDATA and the Tianyancha website.

2.2. Definition of Variables

1. Preferred Return,

The data collection of VC fund preferred return is an obstacle in the empirical research, mainly due to that LPAs for VC funds are usually not public, and the major commercial databases which popularly used do not contain the information as well. This paper obtained the preferred return data by the investment announcements issued by listed companies when they were investing in VC funds, and defined the variable of the preferred return in two ways: First, an index $preferred1$ was defined with the integer of the result by multiplying actual percentage of VC fund preferred return rate with 100. Second, in order to avoid empirical results bias caused by too high or too low the index value, this paper only used samples with preferred return rate of 0% and 8% and defined a dummy variable $preferred2$. When the preferred return rate is 8%, the indicator of $preferred2$ is 1 and 0 otherwise.

2. Assignment of Accredited Director,

This paper referred to Chen et al. (2017) and created a dummy variable $board$ to measure the assignment of accredited director by VCs. The indicator takes 1 if the portfolio company has at least one VC institution that invested in it joined its board of directors after received investment from VC funds, otherwise it takes 0.

3. Off-site investment and "CEO duality",

The first adjustment variable is to define whether VCs and the portfolio companies locate in the same city, which was represented by the virtual variable Off_site. If the VC institution and the portfolio company do not locate in the same city, then the value will be taken as 1 and 0 otherwise. The second adjustment variable is to define whether the portfolio company is under the situation of "CEO duality", which was represented by $ceo\_duality$. If the CEO of the portfolio company also holds the position of chairman, then the value is 1, otherwise it is 0.

4. Control variables.

Based on the research of Gompers and Lerner (1996) and Amornsiripanitch et al. (2019), with considering of the data availability, this paper introduced control variables in the regression to control the other factors that may influence the results. The variables are defined and calculated as shown in the following table.

Besides the control variables listed in the table above, the dummy variables of the year when the VC fund investment happened and the province where the portfolio company is located were also added to the model to control for time and area effects that may influence the results.

Table 1. Definitions and measures of control variables

Variables' Name	Variables	Definitions and measures
Size of Funds	$size\_fund$	Actual total amount of fundraising completed by VC funds (billion yuan)
co-investment or not	syn	If the VC fund co-invests with other VC funds, this variable is defined as 1 and 0 otherwise
GPs' reputation	$repu\_gp$	The cumulative number of GP exits via IPO
GPs' management experience	$funds$	The cumulative amount of funds managed by GP
Number of outside directors	out_boards	The number of outside board members when the company receives VC investment
Age of the company	$age\_company$	The age at which the company received VC funding
High-tech company or not	$high\_tec$	If the industry in which the company is located belongs to the "key high-tech field supported by the state" as stipulated in the Measures for the Identification and Administration of High-tech Enterprises, the variable is set as 1 and 0 otherwise
Early-stage company or not	$early\_stage$	1 if the sample company was in the start-up or growth stage when it received venture capital, 0 otherwise

2.3. Basic Model

The first topic in this paper focused on the effect of preferred return of VC fund on accredited director assignment from VCs. As the explanatory variable is about whether VCs assign accredited director or not, which is a dummy variable, the Logit model in the binary discrete choice model was adopted, as shown in equation (1).

$$logit(board) = \beta_0 + \beta_1 preferred + \sum \lambda_i \times control_i + year + area + \varepsilon \quad (1)$$

The second focus was on the moderating role of off-site investment and "CEO duality" in the relationship between VC fund preferred return and VCs accredited director assignment, drawing on the previous research (Wen et al., 2005), the following model of regulation effect testing was proposed:

$$logit(board) = \beta_0 + \beta_1 preferred + \beta_2 off\_site + \beta_3 preferred \times off\_site + \sum \lambda_i \times control_i + year + area + \varepsilon \quad (2)$$

$$logit(board) = \beta_0 + \beta_1 preferred + \beta_2 ceo\_duality + \beta_3 preferred \times ceo\_duality + \sum \lambda_i \times control_i + year + area + \varepsilon \quad (3)$$

where, $preferred$ represents the preferred return of VC fund; and it's divided into $preferred1$ and $preferred2$ in regression respectively, which represent the preferred return value of VC fund and whether the preferred return exists. The variable $board$ indicates whether the VCs assigned accredited director to the portfolio company or not; $control_i$ represent a series of control variables, $year$ represents the year in which the sample company received VC investment, and $area$ represents the province the company is located.

3. Regression Results and Empirical Analysis

3.1. Descriptive Statistical Analysis

Table 2 shows the descriptive statistics of the main variables. It's showed in the Panel A that the mean value of $preferred1$ is 4.786, the standard deviation is 4.150, the minimum value is 0, the maximum value is 20, which indicate that the difference among the preferred return values of sample companies is significant. The average index values of the Off_site investment and the $ceo\_duality$ are 0.514 and 0.266 respectively, indicate that around half of the VC funds invested off-site companies, and approximately 26.6% of the portfolio companies have CEOs holding position as chairman.

Table 2. Statistical description of variables

Variables	Obs	Mean	Std. Dev.	Min	Max
Panel A: All the samples					
$preferred1$	364	4.786	4.150	0	20
$preferred2$	266	0.474	0.500	0	1
$board$	364	0.475	0.500	0	1
Off_site	364	0.514	0.500	0	1
$ceo\_duality$	364	0.266	0.443	0	1
$size\_fund$	364	6.979	8.295	0.100	32.100
syn	364	0.187	0.390	0	1
$repu\_gp$	364	0.585	4.762	0	87
$funds$	364	5.470	16.065	0	265
out_boards	364	2.931	1.951	1	9
$age\_company$	364	5.393	4.629	0	22
$high\_tec$	364	0.821	0.384	0	1
$early\_stage$	364	0.396	0.490	0	1
Panel B: $preferred1 \neq 0$					
$board$	224	0.571	0.496	0	1
$same\_area$	224	0.451	0.501	0	1
$ceo\_duality$	224	0.299	0.459	0	1
$size\_fund$	224	7.112	7.929	0.3	28
syn	224	0.165	0.372	0	1
$repu\_gp$	224	0.710	5.907	0	87
$funds$	224	6.214	19.694	0	265
out_boards	224	2.772	1.945	1	9
$age\_company$	224	5.665	4.845	0	22
$high\_tec$	224	0.835	0.372	0	1
$early\_stage$	224	0.330	0.471	0	1
Panel C: $preferred1 = 0$					
$board$	140	0.321	0.469	0	1
$same\_area$	140	0.614	0.489	0	1
$ceo\_duality$	140	0.214	0.412	0	1
$size\_fund$	140	6.766	8.875	0.1	32.1
syn	140	0.221	0.417	0	1
$repu\_gp$	140	0.386	1.782	0	13
$funds$	140	4.279	7.030	0	40
out_boards	140	3.186	1.940	1	8
$age\_company$	140	4.957	4.241	0	17
$high\_tec$	140	0.800	0.401	0	1
$early\_stage$	140	0.500	0.502	0	1

Comparing the results of Panel B and Panel C, it is showed that the sample companies invested by VC funds with preferred return have higher mean value (0.571) and variance (0.496) for accredited director assignment, which indicates that VCs are more likely to assign accredited directors to portfolio companies under the restriction of preferred return.

3.2. Baseline Regression Analysis

1. The effect of preferred return on the VCs accredited director assignment,

Columns (1) and (2) of Table 3 report the test results of the effect of preferred return on the VCs accredited director assignment, and column (1) examines the effect of preferred return level on the accredited director, with a regression coefficient of 0.152, which is positive and significant at the 1% level, indicates that the higher the preferred return, the higher the probability for the VCs to assign accredited director to the portfolio company. Column (2) showed the results of the impact of existence of preferred return on the director assignment, which are based on the samples with preferred return rate as 0% and 8%. The regression results show that the coefficient of $preferred2$ is 1.086, which is positive and significant at the 1% level, indicating that VC funds with preferred return are more likely to have accredited director assigned to portfolio company. The above conclusion proves that VCs are willing to expend more effort and bear higher costs to assign accredited directors to portfolio companies under the motivation of preferred return.

2. Analysis of Moderating Effect,

Columns (3) and (4) of Table 3 report the moderating effect of off-site investment on the relationship between preferred return and accredited director assignment from VCs, and the coefficient of cross-multiplier is an important indicator of the moderating effect. Column (3) shows that the cross-multiplication coefficient of $hurdle1$ and the moderating variable is significantly negative at the 5% level, and column (4) shows that the cross-multiplication coefficient of $preferred2$ and the off-site investment variable is -1.676, which is significant at the 5% level as well. Above results indicate that if VCs and portfolio companies are not located in the same area, which will reduce the probability for manage institution of VC fund with preferred return to assign accredited director to company, thus, off-site investment negatively moderates the relationship between preferred return and accredited director assignment, mainly due to geographical non-contiguity which will make it costlier for VCs to assign director.

Columns (5) and (6) of Table 3 report the moderating effect of "CEO duality" on the relationship between the preferred return and the accredited director assignment. From the results, the coefficients of $preferred1 \times ceo\_duality$ and $preferred2 \times ceo\_duality$ are 0.296 and 3.926 respectively, both are positive and significant at the 5% level, indicating the phenomenon of "CEO duality" existed in portfolio company will increase the probability that VCs with high preferred return restriction assign accredited director to portfolio company. According to the previous analysis, as the value of portfolio companies will directly affect the

return of VC funds, which determines whether VCs can obtain the carried interest, thus, the preferred return of VC funds will make VCs more sensitive to the growth and performance

Table 3. Baseline regression results

	（1）	（2）	（3）	（4）	（5）	（6）
$preferred1$	0.152***		0.033		0.124***	
	(4.12)		(0.61)		(3.10)	
$preferred2$		1.086***		-0.021		0.545
		(3.03)		(-0.04)		(1.24)
$board$						
Off_site			-0.478	-0.626		
			(1.08)	(1.18)		
$ceo\_duality$					1.806***	1.502**
					(3.24)	(2.49)
$preferred1 \times Off\_site$			-0.179**			
			(2.45)			
$preferred1 \times ceo\_duality$					0.296**	
					(2.25)	
$preferred2 \times Off\_site$				-1.676**		
				(2.30)		
$preferred2 \times ceo\_duality$						3.924**
						(2.52)
$size\_fund$	0.008	0.003	0.012	0.012	0.015	0.010
	(0.45)	(0.12)	(0.60)	(0.51)	(0.77)	(0.37)
syn	0.725**	1.110***	0.632	1.131**	0.515	0.948**
	(2.05)	(2.62)	(1.63)	(2.42)	(1.42)	(2.01)
$repu\_gp$	0.060**	-0.306*	0.065**	-0.225*	0.041*	-0.326*
	(2.27)	(-1.71)	(2.24)	(-1.67)	(1.73)	(-1.75)
$funds$	-0.014**	-0.005	-0.014	-0.003	-0.010	0.001
	(-2.13)	(-0.71)	(-1.17)	(-0.36)	(-1.62)	(0.15)
out_boards	-0.169**	-0.241**	-0.183**	-0.261**	-0.137*	-0.170
	(-2.05)	(-2.13)	(-2.12)	(-2.12)	(-1.67)	(-1.53)
$age\_company$	0.000	0.003	0.000	-0.003	0.008	-0.001
	(0.01)	(0.07)	(0.01)	(-0.07)	(0.22)	(-0.02)
$high\_tec$	1.561***	1.706***	1.536***	1.577**	1.743***	1.911***
	(3.59)	(2.85)	(3.35)	(2.43)	(3.23)	(3.09)
$early\_stage$	0.697**	1.171***	0.574*	1.132***	0.586*	1.307***
	(2.38)	(3.46)	(1.91)	(3.14)	(1.77)	(3.21)
year fixed effect	YES	YES	YES	YES	YES	YES
area fixed effect	YES	YES	YES	YES	YES	YES
Constant	0.745	-0.793	0.562	-0.555	1.631	-1.652
	(0.59)	(-0.53)	(0.46)	(-0.34)	(1.31)	(-1.11)
N	364	266	364	266	364	266
R^2	0.246	0.326	0.303	0.383	0.382	0.474

Note: *, * *, * * * are significant at the level of 10%, 5% and 1% respectively; in parentheses, there is the value of t statistic. Table 4 and 5 are the same.

of portfolio companies. As the "CEO duality" may lead to improper intervention by the management of company, which could cause decline of companies' value, in which case the accredited director from VCs is assigned to the company to achieve higher return.

3.3. Robustness Test

1. Excluding the impact of carried interest on baseline results,

The carried interest is an important component of VC institutions' compensation. This compensation mechanism is incentive-based, designed to reward VCs' fund management skills and align the interests between LPs and VCs more closely (Buchner & Wagner, 2017). The higher the carried interest rate, the VCs would be able to obtain larger share of the fund's profits. A common VC compensation structure in the industry is with 20% carried interest rate, but in practice, the carried interest rate may be higher or lower. Existing literature has addressed whether fund compensation contracts reward fund managers for risk-taking post-investment action or management skills enhancement (Buchner & Wagner, 2017), from which it can be speculated that changes in carried interest may directly affect fund managers' investment management behavior. Based on above, this paper didn't consider the effect of carried interest in the baseline regression, which may lead to biased regression: whether the carried interest is affecting the behavior of accredited director assignment instead of the preferred return. In order to exclude the possible interference caused by this factor, this paper selected the companies invested by VC funds with fixed carried interest rate of 20% as samples, repeated the regression in Table 3, and the regression results are shown in Table 4, which still support previous conclusions.

Table 4. Subsample regression results of VC fund with carried interest rate of 20%

	（1）	（2）	（3）	（4）	（5）	（6）
*preferred*1	0.149***		0.014		0.106**	
	(3.76)		(0.24)		(2.20)	
*preferred*2		1.025***		-0.326		0.549
		(2.70)		(-0.47)		(1.07)
board						
Off_site			-0.200**	-0.361		
			(2.52)	(0.61)		
ceo_duality					1.745***	1.933***
					(3.03)	(2.86)
*preferred*1 × *Off_site*			-0.200**			
			(2.52)			
*preferred*1 × *ceo_duality*					0.313**	
					(2.36)	
*preferred*2 × *Off_site*				-1.941**		
				(2.33		
*preferred*2 × *ceo_duality*						3.686***
						(2.64)
Control variables	YES	YES	YES	YES	YES	YES
year fixed effect	YES	YES	YES	YES	YES	YES
area fixed effect	YES	YES	YES	YES	YES	YES
Constant	1.211	-0.798	1.020	-0.506	2.051	-1.747
	(0.94)	(-0.52)	(0.78)	(-0.31)	(1.60)	(-1.16)
N	300	227	300	227	300	227
R²	0.253	0.333	0.317	0.389	0.406	0.507

2. Excluding the impact of management fee on baseline results,

The management fee of VC funds is another important component of VCs compensation. Unlike carried interest, management fee is a fixed part of VCs' income, and the payment criteria are determined in the compensation agreement signed at the fund's inception. Existing researches show that most VC fund management fee account for between one-third and two-third of VCs' total compensation return (Yasuda & Metrick, 2010; Finnerty & Park, 2018). If higher management fee is agreed upon, the VCs expect to receive higher risk-free compensation return. By extension, another thought is that when the agreed management fee is low, VCs expect to receive lower return on risk-free compensation, and obtaining higher financial income can only rely on higher performance sharing. In other words, lower management fee may cause VCs to work harder to enhance the investment return of VC funds by investing more energy and cost in fund management. Based on the above discussion, the level of management fees may also affect the baseline regression results of this paper. In order to avoid the bias caused by the management fee to the baseline result, this paper excluded the samples with too low management fee for robustness test. Considering that the important factor affecting VC fund management fee is the agreed management fee rate, which is usually 2%, thus, this section excluded the samples of companies invested by VC funds with management fees below 2% and repeated the regression in Table 3 in the remaining samples. The regression results are shown in Table 5. Through the results of the report, it's showed that the conclusions of this paper are still valid.

Table 5. Subsample regression results of VC fund with management fee rate above 2%

	（1）	（2）	（3）	（4）	（5）	（6）
*preferred*1	0.152***		0.020		0.116***	
	(3.98)		(0.34)		(2.80)	
*preferred*2		1.086***		-0.126		0.428
		(2.96)		(-0.22)		(0.95)
board						
Off_site			-0.541	-0.723		
			(1.18)	(1.30)		
ceo_duality					1.580***	1.164**
					(2.90)	(2.05)
*preferred*1 × *Off_site*			-0.190**			
			(2.51)			
*preferred*1 × *ceo_duality*					0.318**	
					(2.39)	
*preferred*2 × *Off_site*				-1.803**		
				(2.42)		
*preferred*2 × *ceo_duality*						4.478***
						(2.63)
Control variables	YES	YES	YES	YES	YES	YES
year fixed effect	YES	YES	YES	YES	YES	YES
area fixed effect	YES	YES	YES	YES	YES	YES
Constant	0.811	-0.465	0.658	-0.131	1.680	-1.443
	(0.64)	(-0.30)	(0.53)	(-0.07)	(1.33)	(-0.94)
N	353	256	353	256	353	256
R^2	0.248	0.332	0.314	0.398	0.377	0.476

4. Discussion and Conclusion

This paper discussed the relationship between VC fund preferred return and VCs accredited director assignment, by collecting data on preferred return through investment announcements made by listed companies when they were investing in VC funds, taking companies invested by VC funds whose limited partners included listed companies from 2010-2018 as samples.

The results show that, the management institutions of VC funds with preferred return (higher preferred returns) are more likely to assign accredited directors to portfolio companies than VCs without preferred return (low preferred returns) constraint. Other than that, the paper introduces two scenarios: off-site investment and "CEO duality", and examined the moderating effects of above variables on the relationship between preferred return and accredited director assignment respectively. It is found that the negative effect of off-site investment on the relationship between preferred return and accredited director assignment, and "CEO duality" moderates the relationship positively.

The policy implications of this paper listed as follows: 1), for fund investors, it is important to realize that the preferred return in compensation contract has an incentive effect on the post-investment management behavior of VCs. When formulating the compensation system of VCs, the funds' investors and VCs should consider not only the incentive effect of management fee and carried interest to VCs, but also should make proper use of the compensation mechanism of preferred return. By setting the preferred return, VCs are encouraged to form interest association with VC fund investors, and work harder to improve the investment return of VC funds. 2), for VCs, they should recognize that by assigning directors, they can participate directly in the management of companies and have in-depth communication with the portfolio companies, take the advantages of their own industry knowledge, investment experience and others, VCs could play a greater role. Therefore, when facing the pressure of large return requirement, VCs should try to obtain the membership of the board of directors of the portfolio companies. 3), for companies, when choosing or accepting VC funds investment, they should pay attention not only to the agreement signed by VCs and themselves, but also to the compensation contract of the funds, and select funds with higher requirement for VC investment return.

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Searching Efficient Project Portfolios Using Data Envelopment Analysis

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Abstract: Project management is a discipline for effective resource management in order to meet the specific goals of the organization. Organizations usually implement several projects at once, which form a project portfolio. In time, possible projects come in organizations, which are characterized by the required resources and the achievement of the organization's goals. The required resources form the inputs and the achieved level of fulfillment of the organization's goals forms the outputs of the created model. Efficient projects can be then determined using the basic data envelopment analysis (DEA) method. Total resources are available in the organization in limited amounts. A portfolio composed only of effective individual projects may not always provide an effective portfolio due to maximizing overall output with limited resources. The article suggests a new method for project portfolio forming based on a generalized DEA model. The efficiency of the portfolio and the effectiveness of outputs are used as performance measures of the designed project portfolio. Useful extensions of the procedure are considered and analyzed.

1. Introduction

Project management is a tool for successful promotion of the organization's goals by planning and organizing a set of interconnected activities, the implementation of which is ensured by drawing on available resources. Nowadays, the principles of project management are increasingly used as the life of products is shortened. Everything changes, and this creates pressure on organizations to complete new products faster, less expensive r and with low risk. There is a very extensive literature on the management of individual projects and project portfolios (see e.g. Kerzner, 2013; Turner, 2016). Project management can be described as a managerial process (Larson & Gray, 2013).

A multi-project environment is typical for project organizations. Organizations need to address the interdependence of projects and the sharing of common resources over time. Projects are tools for enforcing an organization's strategy. Strategic alignment of projects has a major impact on the efficient use of resources to achieve the goals of the organization. Project portfolios must be formed to contribute to this as a whole.

The first Data Envelopment Analysis (DEA) model was developed by Charnes, Cooper, and Rhodes (Charnes et al., 1978). The DEA consist of a number of models and methods to performance evaluation of units (Cooper et al., 2006; Charnes et al., 2013). The DEA model uses aggregation by weights of multiple inputs and multiple outputs into one combined input and one combined output. The DEA can be taken as a method of precise determination of weights.

The aim of the paper is to propose a procedure for searching effective projects and project portfolios. The DEA can be used to determine efficient projects, where possible projects are determined using inputs and outputs. The inputs capture the required resource levels for project implementation. Outputs measure the achieved levels of goals using multiple criteria. A portfolio composed only of effective individual projects may not always provide an effective portfolio due to maximizing overall output with limited resources. The article suggests a new method for project portfolio forming based on a generalized DEA model. Portfolios are considered as a combined project consisting of a selection of possible individual projects. The model calculates weights that maximize the efficiency of the entire project portfolio.

The article is arranged as follows. Section 2 deals with the formulation of the project portfolio problem. Searching efficient projects using the DEA method is described in Section 3. Section 4 provides a generalized DEA model for searching efficient project portfolios. A simple example is solved in Section 5. Discussion and conclusion are given in Section 6.

2. Project Portfolio Management

Project portfolio management is dedicated to the organization and management of all projects of the organization with regard to the coordination of projects, sharing common resources for projects, up to the level of individual projects (Enoch, 2015; Levine, 2005). The project office is a project portfolio management department that connects strategic management, through tactical management, to the level of operational project management.

Potential projects appear over time and it is necessary to consider whether they are suitable for inclusion in the project portfolio or not (Figure 1).
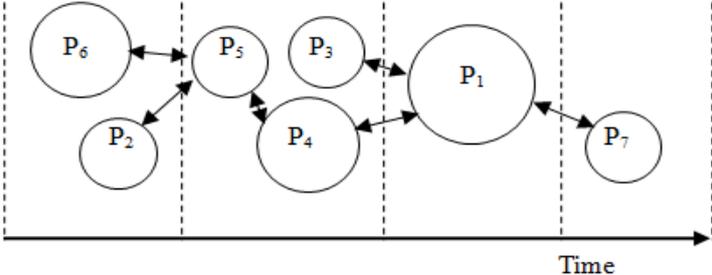
Figure 1. Dynamic flow of projects

The dynamic flow of projects (Figure 1) significantly affects the overall efficiency of project portfolios. The project portfolio consists of a group of projects that are evaluated in the organization at a given time. It is also necessary to consider whether projects that are already

in the portfolio that are not effective need to be removed from the portfolio. The main goals of the project portfolio management contain:

- Monitoring the achievement of the organization's strategic goals,
- Total project portfolio optimization and not sub-projects,
- Identification of starting projects,
- Rejection of inappropriate projects,
- Interruption or termination of ongoing inappropriate projects,
- Setting project priorities,
- Resource sharing and coordination.

Measuring the fulfillment of the organization's strategic goals is associated with the use of multi-criteria evaluation procedures. Because the main goal is to increase the value of the organization, financial criteria are mainly used (e.g. net present value, internal rate of return, etc.) Of course, in addition to the financial criteria, other criteria should also be considered for the effective evaluation of project portfolios, such as:

- Goals consistency (from strategic to operational ones),
- Balancing between available resources of all kinds and their efficient use,
- Monitoring time-dependent use of resources,
- Ensuring links between projects (in terms of continuity, preferences, resource sharing),
- Optimization of project portfolios in terms of goals, time, costs, use of resources, risks.

Many researchers and managers are working in various sophisticated ways to improve project portfolio management. Less work is devoted to quantitative analysis of the efficiency of projects and project portfolios. The procedures are based on the modification of DEA models (Cook & Green, 2000; Lengacher & Cammarata, 2012). The procedure proposed in this paper looks for project portfolios with maximal efficiency ratios with restrictions given by number of projects or by maximizing overall output with limited resources.

3. Efficient Individual Projects

The organization considers the set $P = \{P_1, P_2, \ldots, P_n\}$ of n potential projects, each of which needs values of r inputs and provides values of s outputs; (r, n)-matrix X and (s, n)-matrix Y are the measured input and output values, u_i, v_i are the weights of outputs and inputs for projects. Inputs are resources (human, material, financial and others) for project implementation. Outputs are the results (tangible, intangible, financial and others) provided by projects. The CCR (Charnes, Cooper, and Rhodes) model with constant return to scale is a useful tool that is also suitable for measuring the efficiency of projects. This model was chosen because it satisfies the property that a change in the amounts of inputs leads to a similar change in the amounts of outputs. The ratio of the weighted combined output to the weighted combined input is taken as an efficiency measure. The relative efficiency e_k of the project P_k is maximised with constraints that the relative efficiency of each project is less than or equal to one.

The DEA-based model evaluates the relative efficiency of individual projects with respect to all considered potential projects. This model forms the linear fractional programming problem:

$$e_k = \frac{\sum_{i=1}^{s} u_i y_{ik}}{\sum_{j=1}^{r} v_j x_{jk}} \rightarrow max, \quad k = 1, 2, \ldots, n \tag{1}$$

$$\frac{\sum_{i=1}^{s} u_i y_{ih}}{\sum_{j=1}^{r} v_j x_{jh}} \leq 1, h = 1, 2, \ldots, n \tag{2}$$

$$u_i, v_j \geq 0, \quad i = 1, 2, \ldots, s, \quad j = 1, 2, \ldots, r \tag{3}$$

A project is called efficient if there are weights for which the efficiency ratio e_k of the project is equal to one. In this way, a set of effective projects is selected. Projects with an efficiency ratio of less than one are considered inefficient.

The Charnes-Cooper transformation changes the solution of the fractional programming problem to the easy solution of the linear programming problem:

$$e_k = \sum_{i=1}^{s} u_i y_{ik} \rightarrow max, k = 1, 2, \ldots, n, \tag{4}$$

$$\sum_{j=1}^{r} v_j x_{jk} = 1 \tag{5}$$

$$\sum_{i=1}^{s} u_i y_{ih} - \sum_{j=1}^{r} v_j x_{jh} \leq 0, h = 1, 2, \ldots, n \tag{6}$$

$$u_i, v_j \geq 0, \quad i = 1, 2, \ldots, s, \quad j = 1, 2, \ldots, r \tag{7}$$

The order of the projects is then given by the values of the efficiency scores e_k. A portfolio composed only of effective individual projects may not always provide an effective portfolio due to maximizing overall output with limited resources.

4. Efficient Project Portfolios

A project portfolio is defined as a subset C of the set of possible projects P ($C \subseteq P$). The portfolio is modelled as a single combined project. The combined project is given by a combination of outputs and a combination of inputs. The combinations are given by a vector $\lambda = (\lambda_1, \lambda_2, \ldots, \lambda_n)$ where $\lambda_i = 1$ (the individual project P_i is a part of the portfolio) or $\lambda_i = 0$ (the individual project P_i is not a part of the portfolio). Total inputs of the combined project marked with the symbol $x_j(C) = \sum_{h=1}^{n} \lambda_h x_{jh}, j = 1, 2, \ldots, r$, and total outputs marked with the symbol $y_i(C) = \sum_{h=1}^{n} \lambda_h y_{ih}, i = 1, 2, \ldots, s$, are given by the combination vector λ. The set of all combined projects is the so-called power set of the set of potential projects P. The power set is marked with the symbol $R(P)$ and the number of elements in the set $R(P)$ is equal to $2^n - 1$, which is the number of nonempty subsets of a set of n elements.

The DEA method may be specified for the evaluation of each project portfolio with respect to the power set $R(P)$.

$$e_C = \sum_{i=1}^{s} u_i \sum_{h=1}^{n} \lambda_h y_{ih} \rightarrow max \tag{8}$$

$$\sum_{j=1}^{r} v_j \sum_{h=1}^{n} \lambda_h x_{jh} = 1(\tag{9}$$

$$\sum_{i=1}^{s} u_i \sum_{h=1}^{n} \lambda_h y_{ih} - \sum_{j=1}^{r} v_j \sum_{h=1}^{n} \lambda_h x_{jh} \leq 0, \ C \in R(P) \tag{10}$$

$$\lambda_h \in \{0, 1\}, h = 1, 2, \dots, n \tag{11}$$

$$u_i, v_j \geq 0, \qquad i = 1, 2, \dots, s, \qquad j = 1, 2, \dots, r \tag{12}$$

The order of the projects is then given by the values of the efficiency scores e_k. A portfolio composed only of effective individual projects may not always provide an effective portfolio due to maximizing overall output with limited resources.

That model (8) - (12) is nonlinear with variables λ_h, u_i, v_i where λ_h are the elements of the combination vector of projects and u_i, v_i are the weights of outputs and inputs for projects. However, the model is difficult to solve for the large number of constraints (10).

The introduction of new variables

$$c_{ih} = u_i \lambda_h, \ d_{jh} = v_j \lambda_h, i = 1, 2, \dots, s, \qquad j = 1, 2, \dots, r, \qquad h = 1, 2, \dots, n \tag{13}$$

allows to create the linear problem. Portfolios with their combined inputs and outputs are compared with the set of all $R(P)$ portfolios. Portfolio constraints (10) are only an additive combination of constraints for individual projects and therefore these constraints can be replaced by constraints (16) that only compare projects from the set P of all projects (Cook & Green, 2000).

Restrictions for portfolios that are given by a combination of projects are superfluous. The restrictions (19) and (20) define the relations between new variables c_{ih}, d_{jh} and old variables u_i, v_j, λ_h, where M is a large number. The restrictions (19) define the relationships between the variables c_{ih}, u_i, λ_h: if the binary variable $\lambda_h = 1$, then $0 \leq c_{ih} \leq M, u_i = c_{ih}$ and if the binary variable $\lambda_h = 0$, then $0 \leq u_i \leq M, c_{ih} = 0$. The restrictions (20) analogically define the relationships between the variables d_{jh}, v_j, λ_h.

The task is therefore defined as follows:

$$e_C = \sum_{i=1}^{s} \sum_{h=1}^{n} c_{ih} y_{ih} \rightarrow max \tag{14}$$

$$\sum_{j=1}^{r} \sum_{h=1}^{n} d_{jh} x_{jh} = 1 \tag{15}$$

$$\sum_{i=1}^{s} u_i y_{ih} - \sum_{j=1}^{r} v_j x_{jh} \leq 0, h = 1, 2, \dots, \tag{16}$$

$$\lambda_h \in \{0, 1\}, h = 1, 2, \dots, n \tag{17}$$

$$\sum_{i=1}^{s} u_i y_{ih} - \sum_{j=1}^{r} v_j x_{jh} \leq 0, h = 1, 2, \dots, n \tag{18}$$

$$c_{ih} \geq 0, c_{ih} \leq M\lambda_h, \ u_i \geq c_{ih}, u_i \leq c_{ih} + M(1 - \lambda_h), i = 1, 2, \dots, s, h = 1, 2, \dots, n \tag{19}$$

$$d_{jh} \geq 0, d_{jh} \leq M\lambda_h, \ v_j \geq d_{jh}, v_j \leq d_{jh} + M(1 - \lambda_h), j = 1, 2, \dots, r, h = 1, 2, \dots, n \tag{20}$$

The task (14)-(20) can be used for detailed project portfolio analysis, to calculate the maximal efficiency ratios for different project portfolio structures for a specified number of projects.

5. Simple Numerical Example

We will show a simple numerical example on which we will demonstrate the proposed method for the detailed analysis of project portfolio structures for a specified number of projects. An organisation considers a set of 5 potential projects $(P_1, P_2, \ldots, P_5)$ that have two inputs $(I1, I2)$ and two outputs $(O1, O2)$ assigned to them. Data for the set of potential projects are presented in Table 1.

Table 1. Data for a set of potential projects.

	P_1	P_2	P_3	P_4	P_5
$I1_i$	6	3	8	9	5
$I2_i$	8	4	2	4	6
$O1_i$	9	7	6	10	8
$O2_i$	12	10	15	8	12
e_i	0.643	1	1	1	0.761

An analysis of project portfolios will be done at one specific point in time. With a dynamic flow of projects, such an analysis would be made at each time a new project arrives or an existing project ends. The solution of the model (4)-(7) provides the efficiency ratios e_i of all projects. The efficiency ratios with value one determine efficient projects. The set of efficient projects is formed by the projects P_2, P_3, P_4. There are $2^5 - 1 = 31$ possible project portfolios, which can be organized into structures according to the number of projects, from 1-project structure (individual projects) to 5-projects (all projects) structure.

The task (14)-(20) determined efficiency ratios for project portfolios for all structures. Table 2 contains portfolio structures, a number of portfolios for a given structure, maximal efficiency ratios eC in the structure, and the project portfolios with maximal efficiency ratios, which may not be equal to one, as it may not only contain effective projects.

Table 2. Portfolio structures

Structure	Number	Max e_C	Portfolios
1-project	5	1	P_2, P_3, P_4
2-projects	10	1	$(P_2, P_3), (P_2, P_4), (P_3, P_4)$
3-projects	10	1	(P_2, P_3, P_4)
4-projects	5	0.920	(P_2, P_3, P_4, P_5)
5-projects	1	0.838	$(P_1, P_2, P_3, P_4, P_5)$

6. Discussion and Conclusion

The article proposes a new method for finding efficient project portfolios. The method is based on the solution of a linear program with binary variables. This method is a useful tool for detailed analysis of project portfolios and brings important conclusions in comparison with

other methods. However, project portfolios are compared not only according to efficiency, but also according to the ability to implement as many projects as possible with respect to the consumption of available resources. Related to this is the applicability of multi-criteria approaches.

This method is flexible and can be used for all types of projects. It is also possible to use the proposed procedure for the analysis and search for suitable elements of other systems, such as the search for efficient supply chain links (Fiala, 2016).

This method also provides possible extensions. In the basic DEA model, the weights are not limited in any way, but it is possible to easily limit them due to preferences. Analytic Hierarchy Process (AHP) (Saaty, 1990) is a suitable tool for expressing the preferences of the decision maker using scales. The estimates are entered in the comparison matrix $C = (c_{jk})$, where elements c_{jk} are weight ratio estimates w_j/w_k.

The basic DEA model works with accurate data, but in reality, the data are imprecise. To get closer to reality, imprecise DEA with interval data for inputs and outputs can be used (Smirlis et al., 2004). The proposed method can be supplemented by other procedures, as De Novo optimization (Fiala, 2018). The search for effective project portfolios can be followed due to several criteria. Dual problem analysis can provide managers with important information for more detailed portfolio analysis (Fiala, 1981) Stakeholders with different interests follow the search for efficient project portfolios. A consensual solution can be found in the negotiation process while monitoring the values of multiple criteria (Fiala, 1999).

Possible extensions of the proposed method will be the subject of further research and we believe that their combinations will provide an even richer tool for project portfolio and other analysis.

Conflict of interest: none

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Social Media Marketing Strategy in a Small Company

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Abstract: The social media is growing rapidly, and it is therefore necessary to mention their impact on marketing. Promoting a company on social media is important not only for international companies but also for small and family businesses. Posting content to social media must have a clear concept and strategy to be successful. The main aim of this paper is to present and create a social media marketing strategy for a small company. Communication in social media is a big opportunity for any company. It is a tool for PR communication, brand building or image improvement. This paper describes the procedure of making the marketing strategy to increase brand awareness. The strategy is applied to social media in a small company manufacturing custom goods. If this strategy is successful, the whole strategy could be applied to other small companies manufacturing custom goods. The main steps of suggested marketing strategy consist of self-determination of the company, the aim of marketing strategy, content marketing and the evaluation of these activities. The paper focuses especially on online marketing on Facebook and Instagram. The data used in the paper was collected for a period of five months.

Keywords: social media; marketing; strategy; small company, SWOT analysis, insights

JEL Classification: M31; M37

1. Introduction

A social network is a service on the Internet that usually allows registered members to create a private or public profile. These users make virtual relationships with other users, with whom they want to be connected in the selected network. This internet service allows them to communicate with each other, share videos, links, information, photos, plan events and activities. The users themselves mostly create the content. Social media connect institutions and people with the same working interests, friendly relations, or interested in the same activities (Havlová, 2014). The data available from social media provide a large amount of information about user behaviour, their opinions, relationships and attitudes. Based on this data, it is possible to predict the human characteristics of users, predict their behaviour and then use this data to set up a marketing strategy (Lima & Castro, 2014).

Social networks ensure the rapid extension of posts on the Internet. There are billions of active users on these media every month (Chen et al., 2019). Hundreds of thousands of photos are uploaded to the Internet every minute through these platforms (Ding et al., 2019). The potential of social networks for marketing is clear from the number of their users (Svobodová & Hedvičáková, 2018). The largest social network, according to the number of active users, is Facebook, which has 2,603 million active users. Twitter closes the top 15 most used networks with 326 million active users. Tsur and Rappoport (2012) showed that that hashtags play an

important role in this network. The other most used social networks can be seen in Figure 1. All numbers of active users are valid for July 2020 (Statista, 2020).
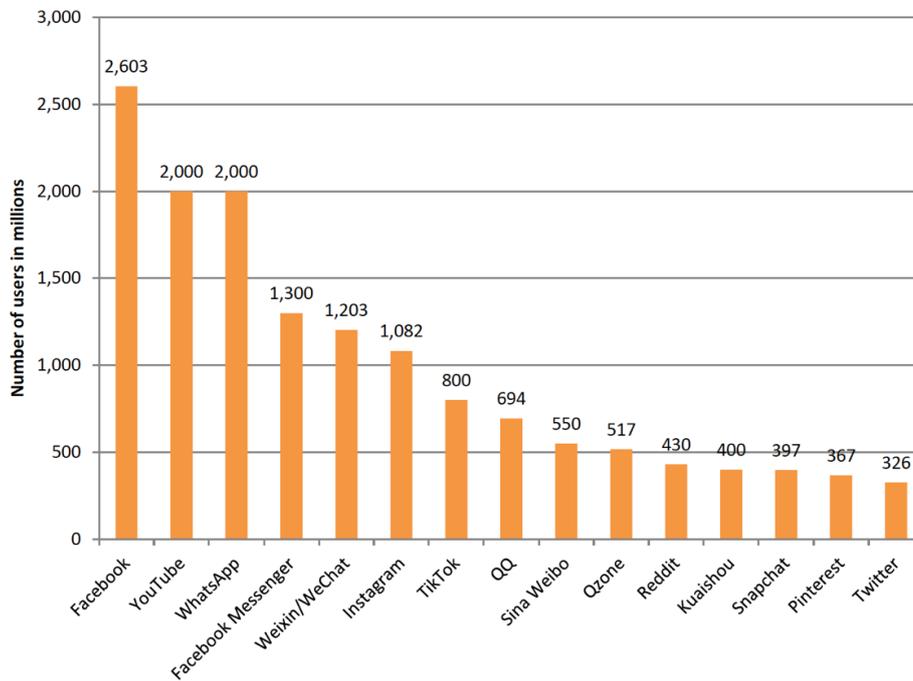
Figure 1. Active users of social media in July 2020 worldwide in millions. Own processing based on (Statista, 2020)

In the Czech Republic, the order of social networks, i.e. according to the number of users, is different from the world. Most users are on Youtube, specifically 5.7 million, followed by Facebook with 5.3 million users and Instagram, which has 2.3 million users. Other social networks are LinkedIn, Pinterest, TikTok, Snapchat and Twitter. The number of users of social networks in the Czech Republic is summarized in Figure 2 (Michl, 2019).
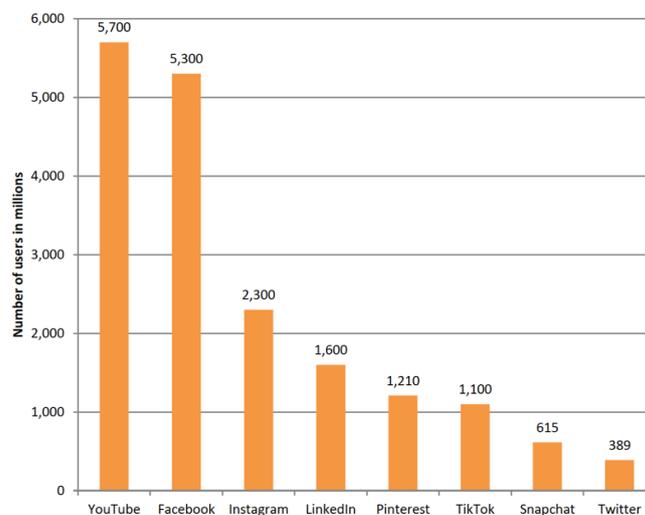
Figure 2. Users of social media in Czech Republic in 2019 in thousands. Own processing based on (Michl, 2019)

The main aim of this paper is to present the case study of a marketing strategy for a small company manufacturing custom furniture goods. This strategy could be generalized to all companies manufacturing custom furniture goods. For the strategy to be successful in other small businesses, manufacturing different custom goods, factors that affect a small company need to be considered. Factors such as product, price, market segmentation, location and sales channel and others. After considering all these factors, it should be possible to apply the strategy with small changes to all small companies manufacturing custom goods.

2. Methodology

The paper describes the creation of the strategy and its subsequent application on Facebook and Instagram. Primary and secondary data were used for the paper. Secondary data from professional literature and professional papers were used to introduce current users of social media in the Czech Republic and the world. These data were also used in the literature review to summarize current knowledge in the field of marketing on social media and the creation of strategies for them. To implement the strategy, company profiles of a small company were established on Facebook and Instagram, on which theoretical knowledge was applied. Then the strategy was evaluated with metrics of social media. This primary data was obtained from the outputs of social networks, which provide the reach of post, geographic and demographic data, if the account is set as corporate.

3. Literature Review

Marketing on social media is a form of marketing that is presented on social platforms. This marketing model can take many forms, from formal advertising to informal user involvement. As number of users grows on social media, so does the importance of this marketing. When social media marketing is successful, it leads to increased sales, building a WOM (word of mouth) reputation, improved customer support, improved customer awareness of products, events and discounts, or increased website traffic (Bandari et al., 2012). Social networks become the most important channel for communication with clients (Szabo & Huberman, 2008). The following steps need to be completed to succeed in social media (Severa & Krška, 2013):

- Find the ideal customer,
- bring the customer to the company profile,
- convince of the remarkability of the product or service,
- eliminate buying doubts,
- invite to purchase,
- make a deal,
- keep a satisfied customer.

3.1. Creating a Marketing Strategy on Social Media

The first step is to think about who the company is and what it does. The second step is to clarify the company's goals and the third is to plan a strategy for social networks. Each strategy takes a certain amount of time, but the result is saving money, saving time. The

company clarifies the strategy, what the company does, what the main aim is. Finally yet importantly, company will have more customers, the company will have something to evaluate and improve, and the whole team will know what to do. The ideal strategy for communication on social networks should follow the higher company levels. The first level is the company's strategy, the second is the business and marketing strategy and these strategies must be followed by the strategy on social networks (Losekoot & Vyhnánková, 2019). A good strategy helps to achieve goals, control social activities and maximize the benefits of the chosen social network (Ballings et al., 2016).

Self-Determination of the Company

Before a company creates content on social networks, it should realize who it is, what it produces or what services it provides, what gap on the market it fills with its products, what benefits brings to customers. The company also needs to determine what future plans are, how customers know the company, what they say about it and what they think. The company must gather as much information as possible about the current situation. This is the starting point of the whole strategy. It will also show the strengths and weaknesses (Losekoot & Vyhnánková, 2019). It is advisable to use SWOT analysis for this step. (Sinha, 2020)

The definition of the brand needs to be thought from the beginning. A good brand is characterized by being consistent. The company needs to determine what people want to imagine under its name. The strategy should start with a definition of what the brand contains and how it affects the public. The survey can also reveal weaknesses. The company can find out people's opinion of itself from employees or from social networks. First, employees should be asked to describe the company, and next, customers should be asked to do that. However, this marketing research is challenging and should be carried out by a professional agency. In addition to data collection, monitoring tools can also be used. The agency is able to obtain clear information about how the company is being talked about. Another option is to explore hashtags that relate to the category, or even the company itself. Google Alerts, BrandMentions or Talkwalker Alerts can be used if the company is mentioned in the online environment. This is also related to where the company is talked about. The company should find out how and where their products are talked about, on which social networks, discussion forums, where the target group is. For social media to be successful, the company must know who it is talking to. The company must determine: who the target group is, what the definition of the person is, what the relationship between customers is, what groups it needs to reach, where it is possible to reach customers, where they are potential customers on social networks, what customers and influencers publish on social networks, where conversions are currently taking place (Losekoot & Vyhnánková, 2019).

Aim of Marketing Strategy

An important point of the strategy is what the company is trying to achieve through social media, what their goal is. The business goals that the company wants to achieve can be as follows (Losekoot & Vyhnánková, 2019): increase brand awareness, build a community, increase website traffic, increase sales, get to download an application or program,

implement successful fundraising, increase voting preferences, improve customer support, get customers to events, increase fan engagement, give them a reason to program registration.

The objectives listed above are general. Each company can have completely different and individual goals. It is necessary to make the goal according to the SMART rule, which means that the goal should be specific, measurable, achievable, relevant and time framed. If the company's self-determination is defined and the goals are set, then the strategy can be determined. It is a sketch of the path to the goal. If the previous information is correctly described and there is a sufficient amount of it, it should not be difficult to compile a specific strategy. The steps that need to be completed are the following: selection of social networks, establishment of a profile, selection of a network administrator, security of social networks, determination of the financial amount and schedule (Losekoot & Vyhnánková, 2019).

Content Marketing

Zeman, 2019, claims that the definition of content marketing is a form of marketing focused on the systematic creation, publishing and distribution of such content that satisfies the user's intention and fulfils the set goals. Content marketing is based on sharing information, know-how through websites, social networks or other tools on the Internet (Zeman, 2019). The content is shared for free and the primary goal is to attract and engage the target audience with quality content. The company tries to keep the attention of its target groups and create a confidential relationship with them. Quality social media content is the intersection between what people want to hear and what the company wants to tell them. Posts should be well designed, grammatically correct, accurate, fresh, playful, funny and different for each social network, and the same posts should never be added to different social networks. Each social network has its own specifics and it is necessary to think about them separately. Posts can be illustrations, videos, summaries, tutorials, studies, reviews, memes, articles, photo galleries and others. (Losekoot & Vyhnánková, 2019). As for social media, the rule is that posts should be added so often that it is enough for fans, but not bothering them. Spams and floods are not desirable. The frequency of posts differs from the industry in which the company operates. If the content is annoying for followers, they unfollow the profile. It is also important to add posts at the part of the day where there are the most fans online. Each user uses the social network at a different time. In general, most users are online in the early evening. It is important that the company has something to publish. Company must have something to say to the fans (Losekoot & Vyhnánková, 2019).

Content planning is also important. Excel or Google Tabs can be used to schedule social network posts. The point is to specify the time, hour, label or hashtags for each post. The advantage of planning is gaining enough time to create the content itself, gaining an overview with regard to the following post and budget allocation. This also save time for the person who adding the posts on social media. When the content is created, the best option is to categorize all the topics, determining what is appropriate for which social network. The social network administrator must also decide whether to use graphics, a photographer, a copywriter, etc. for the proposed posts or to create the posts himself. Publishing the same posts on all social networks does not have much effect (Losekoot & Vyhnánková, 2019).

4. Results

The design of the marketing strategy was implemented at XY Joinery. The company has 8 employees and is located in the Liberec region in the Czech Republic. The company has been engaged in the custom production of furniture since 1992. The company belongs to the category of small businesses. Joinery has no profile on social networks. To apply the strategy, the company decided to create a company profile on Instagram and Facebook. Reasons why the profiles were created:

- The company wants to get more orders in periods when it has few orders. These are mainly the months of February, June and July.
- The company wants people to know that custom furniture is better than mass-produced furniture.

This should be achieved by raising brand awareness. The strategy for this company consists of several steps:

- Self-determination of the company,
  - o The company's self-determination was performed based on a SWOT analysis, which is shown in Figure 3.

Table 1. SWOT analysis of the small company

STRENGTHS	WEAKNESSES
Tradition and experience	Website
Quality products	Long production time
Individual approach to customers	Absence of social media
Established contacts with customers and suppliers	Limited access to capital
Almost zero complaints	Maximum utilization of production (most months)
Modern machines	Graphic designs
Own production space	Absence of a marketing expert
Cooperation with residential architects	Location of the company in an unfrequented place
OPPORTUNITIES	THREATS
Higher savings of people during a pandemic	Lack of quality carpenters
EU grant programs	A decrease in pupils' interest in the craft
Rapid development of technologies and machines for joinery production	Introduction of anti-noise measures in the municipality
Sustainability trend	Closure of production in the event of an infection of COVID-19 employees
Support for regional companies	Requirement for fast delivery by customers
Trade fairs for craftsmen	Rising energy prices
Procurement	Competition
Low mortgage rates	Chains with cheap furniture

- Aim of the marketing strategy,
  - o The aim of marketing on social networks of a small company is to increase brand awareness in the Liberec, Středočeský Region and Prague in the Czech Republic. The increase in brand awareness on social networks should be achieved within one year.

- Content marketing,
    - Content marketing was set up individually for each social network. The posts are mainly in the form of photographs of already made furniture. Aesthetic and inspiration posts would bring greater awareness of the brand. Social network administrator follows rules by Losekoot and Vyhnánková (2019) about content marketing that states what a post on social media should look like. Company respected knowledge gained by this literature review.
- Evaluation of marketing activities.
    - Specific metrics provided by social networks will be used to evaluate the company's activities on company profiles.

4.1. Evaluation of Marketing Activities

This chapter shows all overviews and evaluations of marketing activities on Facebook and Instagram. The goal of social media marketing was to raise brand awareness. It was evaluated based on metrics and reports whether the goal was achieved. The following metrics were monitored the marketing activity on both company profiles:

- page reach,
- content interactions,
- users,
- number of followers,
- media specific metrics.

To understand the evaluation, it is necessary to show the goal of marketing for the company:

- The goal of social media marketing is to increase brand awareness in the Liberec, Středočeský Region and Prague. To increase brand awareness in the form of reach and interaction on social networks should be achieved within 1 year. The measurement was performed by evaluating marketing on social networks. Network reach, content interactions, users, number of followers and other specific metrics were monitored. The first evaluation was carried out five months after the creation of the company profiles. Interim evaluations were monitored every month.

The above metrics were observed for five months from 1 November 2020 to 1 April 2021. An ongoing evaluation of the activity on social networks was carried out each month. Just after five months, a comprehensive evaluation of Joinery XY's activities on the social networks Facebook and Instagram was carried out. This evaluation is given below for each social network separately.

Evoluation of Facebook activities

The company profile on Facebook was created on October 19, 2020 by publishing the first post with the introduction of the company. The following posts are aesthetic, inspiring and show the finished furniture. The evaluation took place on April 1, 2020. During this period, the profile received a total of 88 likes. Number of followers is 91. Demographic data in the

reports can be displayed from up to 100 followers. For this reason, demographic indicators such as age and gender and capitals are not available. For clarity and demonstration of development, the metrics will be shown on a monthly basis. All metrics are observed from November 1, 2020 to April 1, 2021.

The first metric to track is page reach. This metric shows the number of people who viewed the content on the company profile. The individual impacts from November 2020 to March 2021 are summarized by months in Figure 3.
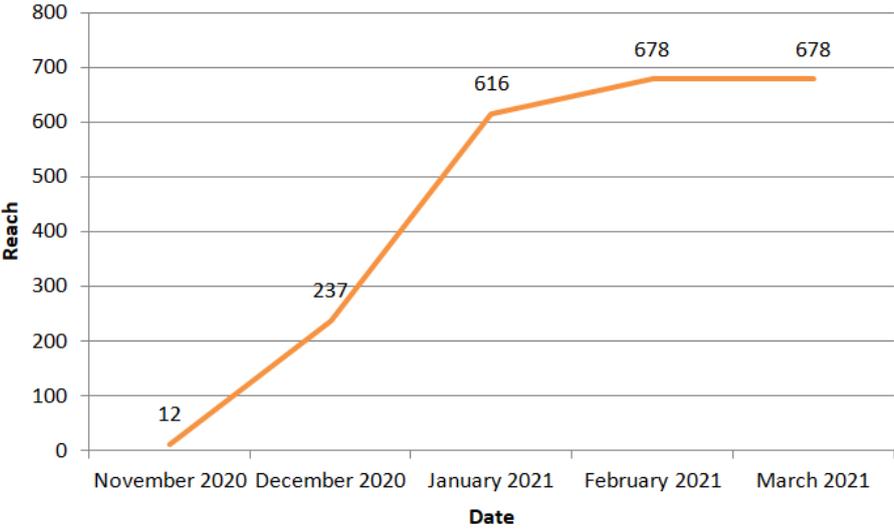
Figure 3. Reach of the company profile on Facebook in November 2020 – March 2021.

Another indicator is the interaction with the content. This is the number of likes and comments. Points measured success. Like is rated 1 point and the comment is rated two points. The comment takes more time for the user, so it has a higher score. The most successful post is a photo of the table from January 1, 2021. Post received a total of 27 likes and one comment. The second most successful post is a photo of the interior, where XY Joinery made the table, stairs and kitchen. The photo was published on February 5. This post received 20 likes. The number of comments was three. These photos are in Figure 4. The least successful post is the photo of the built-in wardrobe, which received only 4 likes and no comment. This post was published on December 14, 2020. The least successful post was the introduction of the company from November 2021. This post received three likes and no comments. Therefore, earlier posts have a lower number of interactions. The interactions show that users are most interested in photos of products, especially kitchens and modern furniture. The description is not important. It is obvious that users mainly watch photos. The number of content interactions also grew with increasing reach. The conclusion is that the most interactions with the content are in the posts of the product (especially kitchen type) with a short description.

Figure 4. Photos of the most successful posts on Facebook business page

Evaluation of Instagram activities

Instagram profile of XY's company was established on November 2, 2020. All metrics are observed from November 1 to April 1. For this given period, the XY Joinery profile gained 1,013 followers. The composition of followers on Instagram by gender is 57% women and 43% men. The age composition varies according to gender, as can be seen in Figure 5.
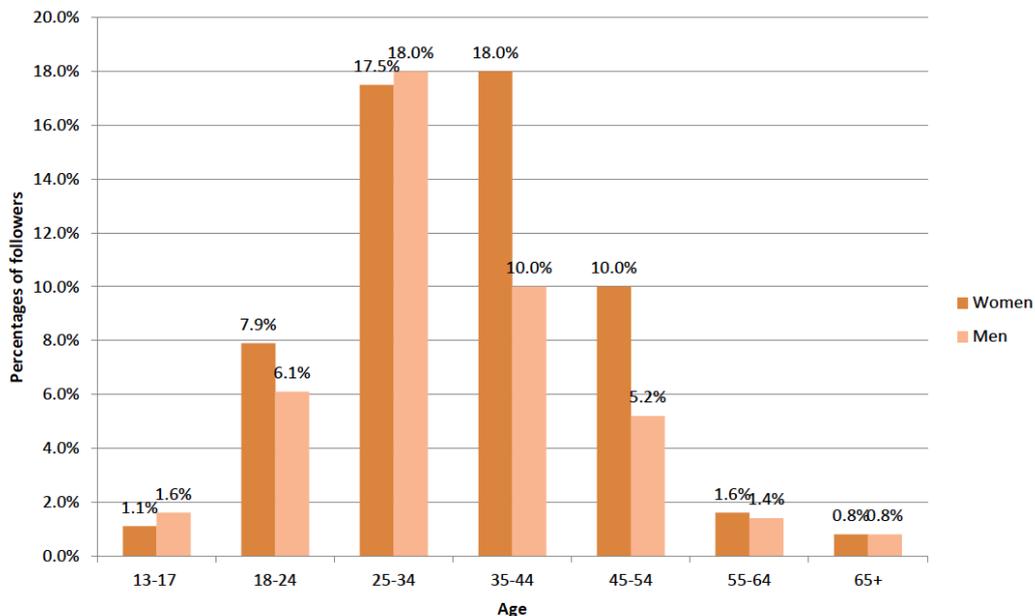
Figure 5. Reach of the company profile on Facebook in the period of November 2020 - March 2021.

Followers can also be divided according to the location where the highest concentration of followers can be found. Followers are the most concentrated in Prague, specifically 8.4% of total users. There are 6% of followers coming from Turnov, 3.9% from Liberec, 2.4% from Brno and 1.6% from Mladá Boleslav. The remaining users are from other cities, or their location is not allowed to be shared. If it is possible to find out the location from users, it is also possible to determine which country they are from. The highest number of followers of Joinery XY on Instagram is from the Czech Republic, it is 63.3%. It is followed by the Slovak Republic with 3.9%, the USA with 1%, Germany with 0.5% and Poland with 0.4%. Another metric is reach that shows the number of people who have viewed the content on the

company profile. The profile reach from November 2020 to March 2021 is summarized by months in Figure 6.
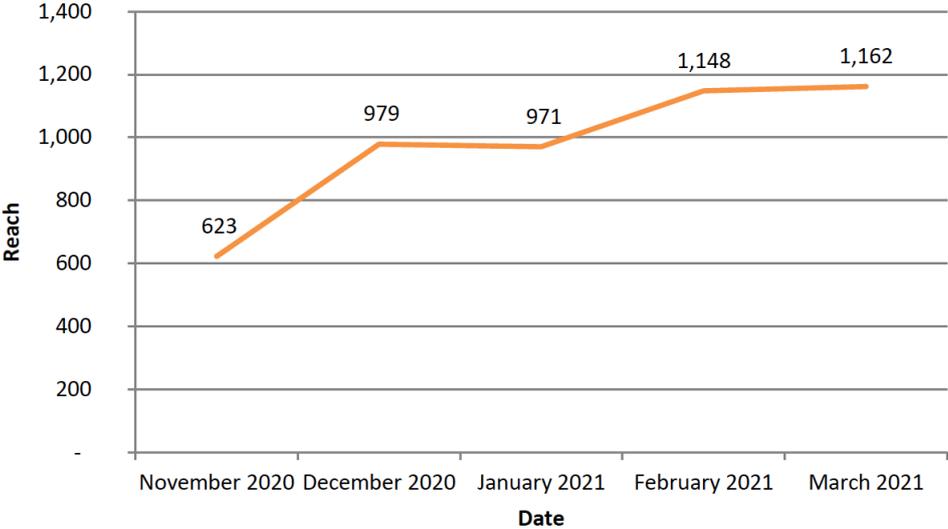
Figure 6. Reach of the company profile on Instagram in the period November 2020 - March 2021.

Another indicator is the interaction with the content. For content interactions, the number of likes and comments judges success. A sample of the content is shown in Figure 7.

Figure 7. Sample of the content on Instagram.

Like is rated one point and the comment is rated two points. Out of 44 posts on Instagram, the most successful photo is grey furniture that was published on January 27, 2021. The post had no comment, but it got 94 likes. The second most successful post is a photo of the furnished interior. This post received 82 likes and one comment. The post was published on February 3. On the other hand, photos of white wardrobe are the least

successful posts published on the XY Joinery company profile. In penultimate place was the post of a low white wardrobe with 35 likes, and no comments. This post was published on January 7. The least successful post is a photo of a large white closet that got 34 likes and no comments. The interaction with the content on the Instagram shows that users prefer posts with photos of furniture and products. Posts showing the operation of Joinery XY did not place at the top of the table of interaction with content. The most successful posts were in warm and cosy tones. The least successful were photographs of white furniture.

5. Discussion

The established theoretical procedure is described on Facebook and on Instagram. The same metrics are evaluated, including page reach, content interactions, user audiences, followers, and network-specific metrics. Applying the above strategy to the corporate profile of a small business, it turned out that the company profile on Instagram achieved better results than on Facebook. Therefore, an identical strategy for different social networks does not work the same way. In their article, Chawla and Chodak (2021) prove that the increase profitability and greater clicks under a link in a post can be achieved by the link in the comment below the post, not in the post description. Zhang and Yamasaki (2021) also state that 90% of people buy from companies they follow on social media. They claim that the most important is the image, its quality, location, promotion and style for marketing on social media. The company tried to adhere to the knowledge above gained in literature research when publishing posts. Above all, the company follows all the knowledge of Losekoot and Vyhnánková (2019).

6. Conclusions

Social media are playing an increasingly important role in marketing. The number of users on social networks is constantly growing and it can be assumed that they will be an important tool for corporate communication with customers in the future. The article describes how to plan a successful strategy and content marketing for social networks for a small business. Subsequently, this strategy was applied to the small company manufacturing custom goods. Criteria such as reach, number of followers, demographics of followers, and user interactions with content were assessed. Facebook profile received 91 followers in five months. The reach of this profile increased up to 678 after five months. The company profile on Instagram was evaluated as more successful than the Facebook profile. In five months, it gained 1,013 followers and the range in the last evaluated month reached 1,162. The company could increase its reach on Facebook by connecting with influencers in the form of cooperation or sponsored posts. After the evaluation, the profiles were handed over to the XY Joinery. Through profiles on social networks, during the five months period, customers requested five orders. The presented strategy on social networks is also applicable to other small businesses manufacturing custom goods.

Conflict of interest: none

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Cross-border Cooperation Between Local Action Groups from Poland and the Czech Republic: Three Case Studies

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Abstract: The paper presents three case studies of cooperation projects involving Local Action Groups (LAGs) from Poland and the Czech Republic. The research involved an analysis of the content of documents, LAG websites and interviews with LAG representatives. The projects were financed from the funds of "Sub-measure 19.3" of the 2014-2020 Rural Development Programme (RDP) in Poland. The aims of the projects concerned, among others: promoting the area of the LAG by exchanging experiences related to tradition, culture, including the promotion of healthy or traditional local dishes; promoting methods of waste segregation and processing; and developing local tourist services through international promotion and networking of services. As the main difficulty the respondents indicated differences in the principles behind accounting the projects, which had to be settled separately with regard to national RDP programmes, even though they are components of a single cooperation project. Czech respondents pointed to a high level of limitations regarding the scope of financing LAG activities. The COVID-19 pandemic, language barriers and geographical distance were mentioned much less. Cross-border cooperation between the LAGs remains relatively weak as partnerships tend to focus on local issues and needs. This may limit the diffusion of innovation and good practices between rural areas.

Keywords: community led-local development; rural development programme; local action groups; cross-border cooperation; Poland; Czech Republic

JEL Classification: O21; D71; L31

1. Introduction

Much attention is paid in contemporary development policies to both the participatory methods of resource management at the local level (Castro et al., 2020; Silva, 2020) and the international cooperation of local communities (Baldersheim et al., 2002; Handley, 2001). Community-Led Local Development (CLLD), derived from European Union (EU) LEADER-type initiatives and programmes (Masot & Alonso, 2017), is nowadays an important method of increasing the participation of local communities in managing local resources and supporting sustainable socio-economic development (Konečný, 2019; Kostalova & Vavra, 2021). In literature on economy it is often analysed as neo-endogenous development, within which an attempt is made to combine local (bottom-up) and supra-local (top-down) aims and needs (Bosworth et al., 2020; Furmankiewicz et al., 2020, 2021a). This results in the forming

of territorial partnerships known as Local Action Groups (LAGs), which receive EU funds for the preparation and implementation of local development strategies (Boukalova & Kolarova, 2014; Furmankiewicz et al., 2021b). One of the important principles of CLLD is cooperation and networking, which means initiating cooperative relations and information exchange between LAGs (European Commission, 2006; Zajda, 2013a) and between local stakeholders within the partnership (Doitchinova & Zaimov, 2015). This principle allows for activity at four levels: the European, the national, the regional and the sub-regional (Magryś, 2009). The first level covers the activities of organizations with a European scope, such as the European LEADER Association for Rural Development (ELARD), which supports about 2,200 LAGs from 26 countries, including non-EU states that implement the LEADER methodology (Marhoff, 2019). Examples of national level organizations include the Polish LAG Network - Federation of Regional LAG Networks based in Łagów, and the National Network of LAGs in the Czech Republic based in Hradec nad Moravicí. The Lower Silesian LAG Partnership Network (Poland) in turn is a regional level example. Both national and international rural networks facilitate access to intangible resources of rural communities such as skills, knowledge or social networks (Magryś, 2009; Skrzypczyński et al., 2021). Literature on the subject often considers cross-EU CLLD approach, as well as European trans-border networks and information transfer as a form of "Europeanisation" processes (Furmankiewicz et al., 2020; Heidenreich, 2019; Maurel, 2008).

Individual LAG engagement in national and international cooperation projects, involving from two to a dozen LAGs, may also be of great importance for local development (Pylkkänen et al., 2020). Collaboration projects usually consist of joint activities over a specified period of time and are financed by the EU or using other sources. Such projects may include both LAGs located in one region (creating, for example, a single marketing product, promoting innovation in short food supply chains), as well as supra-regional and international agreements between LAGs located in many different countries (implementing, for example, the exchange of experiences and information). Territorial partnerships focus on local development, hence literature on the role of international cooperation in the transfer of knowledge and innovation between LAGs is relatively poor. Information on international LAG cooperation projects appears mainly in descriptions within the context of general, national cooperation of local communities. In this paper, we try to contribute to the popularization of the subject of international LAG cooperation, which has so far been relatively rarely discussed in European literature. We focus on regional cross-border cooperation and discuss three examples of projects involving LAGs located in the Lower Silesia region in Poland, and the Liberec and Hradec Králové regions in the Czech Republic.

2. International Cooperation of LAGs in Literature

Local Action Groups, both in Poland and the Czech Republic, are associations of partners representing the public sector (municipalities, municipal budgetary units such as museums, community centres), the economic sector (enterprises, businesspeople, farmers) and the social sector (non-governmental organizations and private persons). They can operate in a selected functional region covering several municipalities in rural areas or several units (districts) in the

city, in accordance with the principles of the CLLD approach promoted by the EU (European Commission, 2014; Furmankiewicz, 2021; Kola-Bezka, 2020; Konečný, 2019). They prepare local development strategies and receive funds (incl. from the EU) for local initiatives supporting social activity and economic development in line with local needs. Such form of territorial governance is one of the possible ways to increase the effectiveness of managing local resources (Babczuk et al., 2017; Boukalova et al., 2016). In addition to local activities the EU documents also draw attention to the "networking" and "collaboration" of LAGs (European Commission, 2018), allowing support for the creation of national and regional LAG networks (Magryś, 2009), as well as their voluntary individual cooperation within so-called cooperation projects for which a special budget line is often allocated (De Luca et al., 2018; Zajda, 2013a). As part of the 2014-2020 Rural Development Programme in Poland, international cooperation may be carried out under Sub-measure 19.3. "Preparation and implementation of activities in the field of cooperation with the local action group". Cooperation projects may include LAGs located in one region, but also supra-regional and international agreements. They can, inter alia, exchange experiences and information on methods of stimulating development and local social activity.

Similar types of cooperation projects were implemented in the 2007-2013 programming period. According to the research by Wojewódzka-Wiewiórska (2017) 34 international and 189 national projects were implemented in the years 2007-2013 as part of the "Axis 4" of the RDP (within "Measure 421" of the LEADER approach) in Poland. Joint activities most often concerned the development of tourism and the preservation and promotion of cultural heritage. The costs and difficulties related to the coordination of activities due to geographical distance, language barriers and the diversity of legal conditions and formal requirements for LAGs in different EU countries were considered by the author to be the main barriers to international cooperation (Wojewódzka-Wiewiórska, 2017).

Hoffmann and Hoffmann (2018) presented three examples of LAG-formulated international projects concerning the development of the tourist offer in rural areas. One of the projects included the promotion of the international "European St. James Route" with cooperation between partners from Poland, Germany, Austria, Switzerland, Hungary and the Czech Republic. Studies of 22 LAGs from the Lubelskie Province (województwo lubelskie) in Poland showed only one organization to have expressed the will to implement an international project (Guzal-Dec, 2018). According to Kalisiak-Mędelska (2013) three LAGs (among 20 existing partnerships) in the Łódź Province (województwo łódzkie) in the 2007-2013 Programming Period have prepared international cooperation projects: Przymierze Jeziorsko (two projects with partners from Germany), Gniazdo (one project with a partner from Lithuania) and Mroga (one project with a partner from France). The efforts involved within these activities were focused towards, inter alia, the promotion of local tourist and cultural resources, as well as pro-ecological traditions and attitudes, including joint events integrating communities from different countries. The author assessed that the projects of interregional and international cooperation in this voivodeship have been implemented to an "insufficient degree". Similarly, Zajda (2013b) noticed a relatively weak international cooperation of LAGs from the Łódź Province (województwo łódzkie), offering insight into the cooperation project of the Mroga LAG with a partner from France (LAG Nord Meusien), which involved the

preparation of an open-air museum and the reconstruction of a historical battle aimed at tourists (Zajda, 2014).

Also, in the Czech Republic the international cooperation of LAGs attracted less attention when compared to local issues. An analysis of the content of articles related to the LEADER programme in regional newspapers indicated that only 5% of them provided information on the international activity of LAGs (Lošťák & Hudečková, 2010). According to an ex-post evaluation of the 2007-2013 Rural Development Programme in the Czech Republic, LAGs expressed more interest in inter-territorial cooperation than in transnational cooperation – an observation similarly valid in Poland (EKOTOXA & IREAS, 2016). During this period, Czech LAGs were involved in more than 40 transnational cooperation projects supported by the RDP. In more than half of these, the partner LAG was from Slovakia. Only four Czech-Polish cooperation projects have been supported by the State Agricultural Intervention Fund of the Czech Republic (State Agricultural Intervention Fund, 2021).

An analysis of European LAGs' international cooperation projects in the 2007-2013 programming period by Pylkkänen et al. (2020) found that local rural stakeholders showed little interest in developing international contacts. Krasniqi (2020) reported the cooperation of the Vitia LAG in Kosovo with the German Society for International Cooperation (GIZ) in the area of training local leaders. Similar problems have been noticed in Slovenia, which led to the conclusion that there is a need for additional efforts at promoting interregional and international cooperation among local communities operating in the LAG (Bedrac & Cunder, 2010).

The analysis of the literature discussed above shows that local communities have been involved in implementing international projects mainly in the field of knowledge and information exchange, with a prevalence of trainings and projects related to the creation of tourism products. In the following sections we analyse three case studies of Polish-Czech cooperation.

3. Methodology

Three examples of cooperation projects implemented by LAGs from Poland (Lower Silesia region) and the Czech Republic (Liberec and Hradec Králové regions) serve as the subject of the analysis detailed in this paper (Figure 1). These include:

1. Sustainable tourist traffic in the Western Sudetes on the Polish-Czech border (two LAGs from Poland and one from the Czech Republic);
2. Culinary festival: traditions cultivated in Polish and Czech villages (two LAGs from Poland and the Euroregion Glacensis association from the Czech Republic);
3. ECO LAG international cooperation project (five LAGs from Poland and one from the Czech Republic).

The projects were financed under Sub-measure 19.3 "Preparation and implementation of activities in the field of cooperation with the Local Action Group of the Rural Development Program in Poland" financed by the European Agricultural Fund for Rural Development.
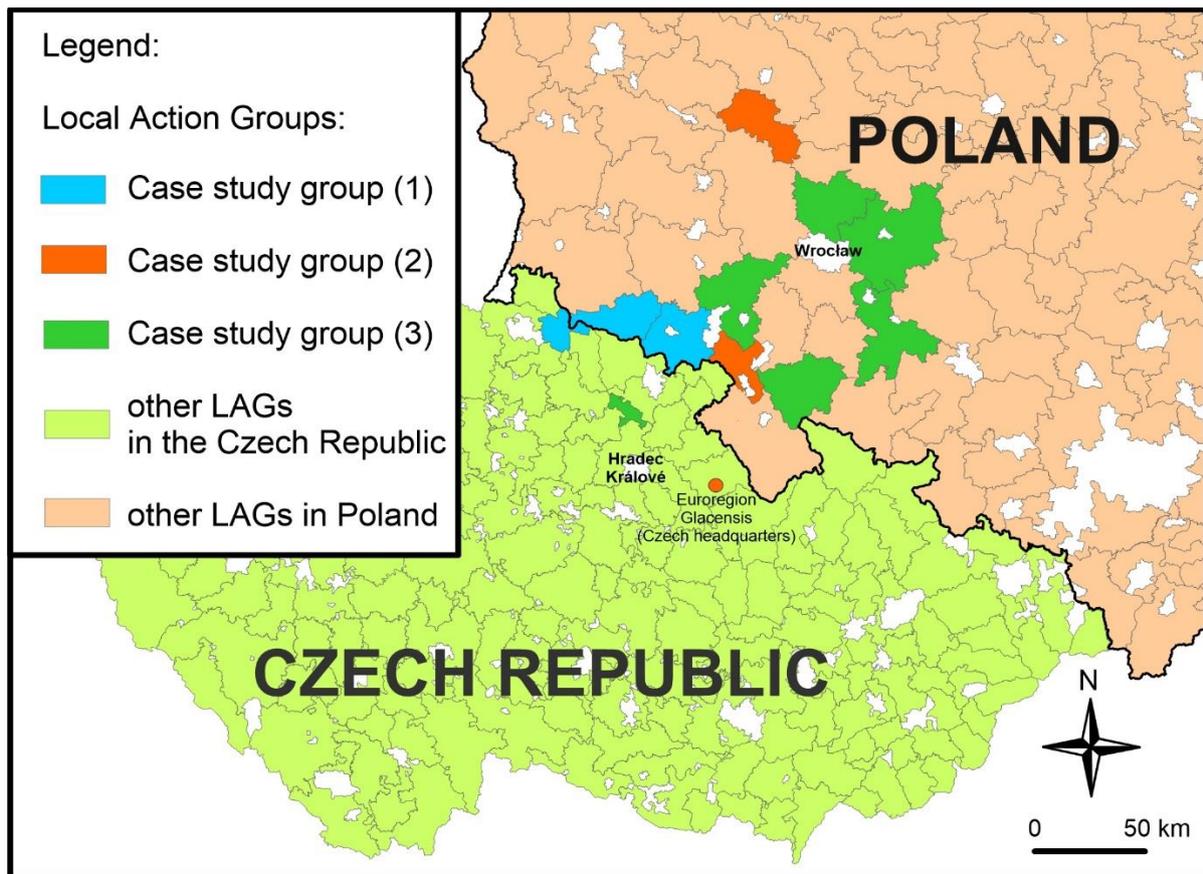
Figure 1. Case study of cooperating groups of LAGs: 1) "Sustainable tourist traffic in the Western Sudetes on the Polish-Czech border" project; 2) "Culinary Festival: Traditions cultivated in Polish and Czech villages" project; 3) "ECO LAG Project of international cooperation". Source: Authors own work based on data from the Ministry of Agriculture and Rural Development in Warsaw, Poland and the National Network of Local Action Groups of the Czech Republic in Prague.

The research made use of the methodology of analysing the content of documents formulated by LAGs for the 2014-2020 EU Programming Period (actions planned in practice most commonly for 2022 or 2023), as well as LAG websites and telephone interviews with the managers of specific projects or heads of LAG offices. The interviews on the Czech side involved each LAG participating in cooperation projects in stages of both preparation or implementation. In Poland, the interviews were carried out only in the offices of the lead partners responsible for the coordination of the entire project.

The questions included matters such as: the objectives and scope of activities in the project, and respondents' views on the following matters: to what extent have the original plans been achieved, what benefits has the LAG obtained from the project, what were the main problems regarding the cooperation, what is the possible scope of activities for the future, and why are there only relatively few LAGs involved in international cooperation. The interviews have been conducted in November and December of 2021.

Cartographic materials have been obtained from the Ministry of Agriculture and Rural Development in Warsaw, Poland and the National Network of Local Action Groups of the Czech Republic in Prague. This paper is used to present the preliminary results of ongoing research across the Polish-Czech borderland.

4. Results

The "Partnerstwo Duch Gór", "Kwiat Lnu" LAGs (Poland) and "Rozvoj Tanvaldska" LAG (Czech Republic) implemented a project named "Sustainable tourist traffic in the Western Sudetes on the Polish-Czech border" (case study group 1). The main goal of this project was the international promotion and networking of services in lesser-known places in the area of operation of all 3 partners. Part of the project involved the preparation of joint advertising material and the organization of joint conferences. The partnerships operate in the attractive tourist area of the Karkonosze/Krkonoše Mountains and the Izerskie/Jizerské Mountains, where tourism is an important element of income for local communities (Böhm & Šmída, 2019; Przybyła & Kulczyk-Dynowska, 2017).

The objectives and tasks of the project on the Polish side were considered by the representative of the "Partnerstwo Duch Gór" Partnership to have been successfully achieved. Nevertheless, great difficulties have also been indicated in the implementation of the project, as each task involved had to be separately approved by the national RDPs. Despite many meetings and arrangements, the Czech side did not receive financial support from its RDP, while the project on the Polish side had already been approved and could boast a signed contract, which made it impossible to adjust the scope of the ultimate enterprise. As stated by the project manager: "The Czechs had not abandoned us, but they had to carry out tasks using their own resources. Had they not done so, we would have a problem with settling the project". As a result of these problems with financing joint actions, the respondent expressed the opinion that she did not see the possibility of further cross-border and international cooperation due to the unfavourable way of financing the projects. The LAG also does not intend to implement cross-border projects using funds distributed by the Nisa/Nysa Euroregion, due to the lack of funds for pre-financing activities and the long time it takes to have funds reimbursed after the completion of a project. The LAG's own income as an association's is insufficient to finance such activities.

On the Czech side, a mutual meeting, such as a conference, is the only sort of activity which can be considered a valid project output. It should be emphasized that the project was not financed from the Czech RDP and the entire affair was perceived by "Rozvoj Tanvaldska" LAG representative as "bringing about costs without much benefit for the Czech side". He saw no potential for further development of cooperation under the current conditions of the Czech RDP. The existing collaboration with Polish partners is implemented mainly through the Nisa/Nysa Euroregion. The LAG representative identified the main problem as resulting from the difference in conditions set by the RDP for the Czech Republic and for Poland. For the Czech Republic these rules exclusively allow "nothing more than meetings and the creation of promotional materials".

The "Partnerstwo Sowiogórskie" and "Ujście Baryczy" LAGs (Poland) pursued the "Culinary Festival: Traditions cultivated in Polish and Czech villages" project (case study group 2). Initially, the Polish LAGs planned to work in cooperation with the "Sdružení Splav" LAG (Czech Republic). The project was aimed at promoting the area of operation of the respective partners and exchanging experiences related to tradition, culture and local

heritage, including the promotion of healthy eating and culinary workshops on local dishes. Ultimately, the Czech LAG did not participate in the project because they could not reach an agreement with the Polish partners on the particular activities and outputs. The project leader (the "Partnerstwo Sowiogórskie" LAG) turned to the Czech association of the Glacensis Euroregion for assistance, as the organization had experience in the implementation of cross-border projects. It eventually agreed to help and provide cooperation on the condition that it would act as a cost-free partner and would not be involved in financial settlements. The resulting project yielded the following results: a promotional film, a set of video clips on the preparation of local dishes (available online), and a publication in the form of a culinary book entitled "Tastes of the past". A series of workshops with public participation was planned but ultimately abandoned due to the COVID-19 pandemic.

A representative of the "Sdružení Splav" LAG stated that there is ongoing cooperation with the various Polish organizations (e.g., with regard to environmental projects in collaboration with the Polish Ecological Club), but that they are not receiving support from the Czech RDP. This leads the respondent to conclude that: "there would certainly be room for cooperation in a number of activities", indicating that the main obstacle towards the successful implementation of the project was that the thematic definition of the supported activities was too narrow. As a result of the demands by the Czech RDP the projects were difficult to prepare and there were difficulties in the cooperation with the State Agricultural Intervention Fund of the Czech Republic. Support was offered mainly with regard to soft projects (educational events, creation of promotional materials, brochures), without the possibility of undertaking actions based around investment. This was considered a significant limitation.

Five LAGs from Poland (the "Qwsi" LAG, the "Dobra Widawa" LAG, the "Szlakiem Granitu" LAG, the "Kraina Wzgórz Trzebnickich" LAG, the "Brzesko-Oławska Wieś Historyczna" LAG) and the "Královédvorsko" LAG (Czech Republic) participated in the "ECO LAG Project of international cooperation" (case study group 3). This particular project was educational in nature and was devoted to promoting useful methods of segregating and processing (upcycling) waste among LAG residents. A total of 107 upcycling workshops were held in the Polish LAGs participating in the project, with the additional publication of an educational brochure. Representatives of the Polish LAGs participated in two-day study trips in the Dvůr Králové nad Labem municipality. They became familiar, inter alia, with the operation of the municipal waste segregation and utilization system, including the waste segregation plant in Rychnovek. The Polish participants of the project also learned about modern techniques of waste processing, as well as the consequences of incineration and storage of waste in illegal places, and the correct way of segregating waste and upcycling. The project leader intends to further enhance the Polish-Czech cooperation with regard to developing tourism. The Polish respondent mentioned the following major obstacles to cooperation: the COVID-19 pandemic, language barriers and geographical distance resulting in a lack of opportunity for frequent personal contacts with the foreign partner.

No mutual international meeting has taken place on the Polish side. According to the Czech LAG representative, the exchange of experience served as the only practical benefit

drawn from the project. He believed that Poland enjoyed better conditions within the RDP than the Czech Republic in terms of transnational cooperation projects. The Czech LAG representative saw no potential for further development of Czech-Polish cooperation.

5. Discussion and Conclusions

The analysed cooperation projects concerned mainly know-how exchange, educational events, and the development of tourist and local gastronomic products. The recognized obstacles were related mainly to differences in RDP procedures observed in both countries and the lack of own funds to finance the cooperation. The COVID-19 pandemic, language barriers and the geographical distance between the partners were less frequently mentioned difficulties in cooperation. The feeling of no tangible benefit discouraged further cooperation.

The implemented projects often involved LAGs located in the mountainous area of the Sudetes, which is an important cross-border tourist region on the border of Poland, the Czech Republic and Germany (Dołzbłasz, 2017; Jędruch et al., 2020; Potocki et al., 2014). Such activities undoubtedly favour the diversification of rural development towards undertakings other than those typically related to agriculture and are considered an important direction of development in contemporary EU rural development policy (Stacherzak & Hełdak, 2019; Struś et al., 2020; Trnková, 2021). Areas located in the Sudetes, struggling with unfavourable social and economic phenomena like depopulation, decapitalization of fixed assets and development difficulties in the protected border zone, were referred to in the 20th century as a "problematic area", in large part also due to their peripheral, border location (Ciok et al., 2006; Sikorski et al., 2020). Currently, due to the far-reaching integration of Poland, the Czech Republic and Germany within the European Union, the border is no longer a strong administrative barrier, also in the Sudetes. This ensures the relative technical ease of developing tourism, establishing economic links and fostering the cooperation of local communities in border regions, with the added boon of support from EU funds (Kachniarz et al., 2019; Kulczyk-Dynowska, 2018). The Czech Republic has the second longest border with Poland. However, while individual cooperation between Polish and Czech towns is developing intensively (Böhm et al., 2021; Furmankiewicz, 2007), LAGs as formal associations enjoy relatively little involvement in such activities.

The conducted questionnaire survey shows an asymmetry in the perception of the benefits from collaborative projects. The activities within the case study groups were financed by the Polish RDP and were seen as beneficial mainly by Polish LAGs. The Czech LAGs expressed dissatisfaction with the established rules for providing support from the Czech RDP within the measures made available in the current programming period. In their opinion, the supported activities were very narrowly defined and limited only to educational events, meetings or the producing of promotional materials. The preparation of the project was substantially difficult and the supported undertakings were not perceived by the Czech LAG representatives as beneficial. The interviewed Czech managers stated that the Czech-Polish cooperation is an ongoing process, but it continues outside any support from the RDP. Under the conditions of the Czech 2014-2020 RDP the three interviewed Czech LAG representatives did not anticipate any further significant development of cooperation.

The respondents recognized differences in the procedures of the national RDP as a significant barrier to the implementation of international cooperation projects. This problem has already been noticed in the evaluation of the 2007-2013 LEADER programme in the Visegrád Group countries (Dvořáková Líšková et al., 2019). This should be alarming for policy makers, who specify the goals and rules of programmes that support the networking of LAGs. Analyses suggest that the current RDP procedures provide very limited actual support to the promotion of international networking. This is not conducive to European integration understood as an increase in social ties (networking) and an increase in positive attitudes between local communities from different countries. Our and also other researchers´ outcomes suggest that most LAGs focus on local traditions and are internally socially closed, i.e., they rarely engage in international contacts (Pylkkänen et al., 2020; Schiller, 2008). This subject requires further research on a larger scale.

Conflict of interest: none

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How and Why Exploitative Leadership Influences Followers' Organizational Commitment: Integrating Social Exchange and Justice Lens

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Abstract: Exploitative leadership (EL) is one type of emerging leadership behavior that is destructive in organizations. However, little was known about a more concrete mechanism. Based on social exchange theory and justice theory, we posit that exploitative leadership (EL) may influence followers' organizational commitment (OC) though affecting followers' perceived interactional justice (IJ), while employees' justice sensitivity (JS) being the moderator. With a sample of 172 employees, we found that (1) EL is negatively related to employees' organizational commitment, (2) employees' perceived interactional justice partly mediated the relationship between EL and OC, and (3) JS moderates the relationship between IJ and OC, and when the level of JS is high, employees reacted more intensely to their experienced injustice, showing less OC. Our findings extend the understanding of the relationship between EL and employees' OC with individual difference concerns, specifying how and why EL can influence employees' organizational commitment. Our findings provide significant theoretical contributions, with practical implications and future directions discussed.

Keywords: exploitative leadership; organizational commitment; interactional justice; justice sensitivity

JEL Classification: M19

1. Introduction

Considerable studies have highlighted the variance, complication, and uncertainty that COVID-19 brought to the economy and industrial development (e.g., Papadopoulos et al., 2020; Craven et al., 2020). Within a pressurized and uncertain environment, organizations are facing intensive demands for survival and competition to maintain their development, enhancing the essential role of employees in maintaining organizational effectiveness. Employees' organizational commitment (OC) has long been a key managerial topic, indicating a positive condition for pleasant workplace outcomes, and previous studies indicated the significant relationship between employees' OC and their job satisfaction, organizational citizenship behaviors, and turnover intention (e.g., Meyer et al., 2002; Riketta, 2002). The existing conclusions highlighted the importance of OC in the workplace under a changing context.

Leadership is a key component in the workplace, influencing the work experience of subordinates and organizations' effectiveness (Lok & Crawford, 2003). In recent years, leadership research showed a broader scope investigating the detrimental effect of leadership,

regarded as destructive leadership (Schyns & Schilling, 2013). Exploitative leadership (EL) is a new form of destructive leadership, referring to leader's actions that shows a primary intention to extend leaders' interest (Schmid et al., 2019), attracting academic attention by its self-interest nature noted as a fundamental motive of human (Montada & Maes, 2016); the abuse of power and leaders' personal goals drives the emergence of EL (Williams, 2014; Julmi, 2021). To achieve personal goals or force others to work for their benefits, EL rely on power which presents legitimate control by coercion and manipulation. When using power to prioritize personal benefits, leaders are perceived exploitative, and more likely to result in destructive consequences (Schmid et al., 2019; Williams et al., 2014).

Previous studies have demonstrated the potential negative effect of EL (e.g., Schmid et al., 2019; Wang et al., 2020; Abdulmuhsin et al., 2021). On the one hand, EL can lead to negative consequences including employee burnout, workplace deviance (Schmid et al., 2019), psychological distress (Majeed & Fatima, 2020), and knowledge hiding behaviors (Guo et al., 2020). On the other hand, EL can hinder positive outcomes such as knowledge creation, sharing and utilization (Abdulmuhsin et al., 2021), innovative behaviors (Wang et al., 2020), service performance (Wu et al., 2021), work satisfaction, and affective commitment (Schmid et al., 2019).

Despite the destructive nature of EL predicting negative effects on employees, as indicated by the decreased OC, we are still constrained in understanding the mechanism of EL to such outcome. Self-interest motive is one of the fundamental motives of humans (Montada & Maes, 2016). As for leaders, the self-interest intentions may manifest through their prioritized demands for personal goals; while for employees, the self-interest intentions may manifest via their justice demands and related actions, since people tend to perceive increased justice demands for personal benefits and interests intuitively when they possess a relative deprivation position in exchange relationship (Crosby, 1976). Besides, exploitativeness was argued to violate the reciprocity norm, driven by self-interest motives (Brunell et al., 2013), and conflicting employees' self-interest requirements. However, limited research has discussed the "crash" of leaders' and employees' self-interest manifested through organizational justice issues. With the integrated perspective of justice and the social exchange, present research intended to empirically examine how and when exploitative leadership predicts employees' OC, to address the above gap.

This article has two major research goals. First, although previous research has illustrated the detrimental influence of EL in organization, few studies have examined the mechanisms particularly under a changing and uncertain environment in the current era. A critical question is how and why EL are detrimental to employees' OC. Justice can be an essential mechanism since COVID-19 has inevitably created more threats and uncertainty to organizations and employees, intuitively raising people's self-interest motives to protect personal benefits in exchanges, motivating exploitation and justice restorage. Interactional justice (IJ) is an essential and representative element supporting long-term exchange relationships (Cropanzano & Mitchell, 2005) due to its prevalence in the work environment (Le Roy et al., 2012). Therefore, denoting leadership as a source of justice experience (Tepper, 2000), we propose employees' perceived IJ as a mediator between EL and OC.

Second, since researchers tend to ignore the individual difference in facing and responding to workplace injustice, our second purpose was to examine the effect of justice-related personal factors in affecting employees' reactions. Justice sensitivity (JS) indicates how much an individual concerned about justice, predicting a more significant reaction of justice-sensitive individuals towards injustice threats compared to less justice-sensitive people (Baumert & Schmitt, 2016), implying the innate strength of employees' self-interest motive combatting injustice experiences. We thus propose that employees' JS may moderate the effect of individuals' justice perception on OC, that the relationship will be stronger when employees are more justice-sensitive than less justice-sensitive.

In conclusion, with a sample of 172 employees in China, we empirically examine: (a) the relationship between EL and employees' OC; (b) the mediating effect of perceived IJ in linking EL with employees' OC; (c) the moderating effect of justice sensitivity on the relationship between IJ and OC. Figure 1 shows the overall proposed model and hypotheses.
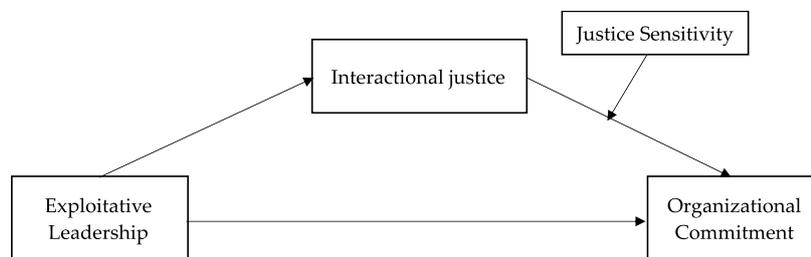
Figure 1. The proposed model

1.1. EL and OC

EL refers to the leadership behaviors that intentionally extend leaders' self-interest, capturing the intentionality and the 'exploitativeness' in their leadership behaviors (Williams, 2014; Schmid et al., 2019). Exploitative leaders mainly exploit others by (1) acting egoistically, (2) pressurizing and manipulating followers, (3) making followers overburdened, or, on the contrast, (4) unchallenged and undeveloped. Leaders' formal power to enforce their will over others comes from their position (French & Raven, 1959; Sturm & Antonakis, 2015), which EL abused to serve their benefits (Sankowsky, 1995), distorting the exchange relationship between leader and employees.

OC is an important attitudinal response in the workplace indicating the affective ties between employees and their organization (i.e., affective commitment, Meyer & Allen, 1997). Employees with stronger OC express more desire to stay in their current organization (Meyer & Allen, 1991), predicting OCBs, well-being, and performance (Meyer et al., 2002; Riketta, 2002). Previous research identified leaders as essential agents of the organization, explaining how leaders' actions influence employees' attitudes toward their organization by the "spill over" effect (Levinson, 1965; Eisenberger et al., 2001; Katz & Kahn, 1978), we thus indicate EL as a potential influencer to followers' OC.

OC served as a favorable resource by the organization in general exchanges with employees. As a destructive leadership, EL is argued to undermine the social exchange relationship with employees. According to the reciprocity norm, employees evaluate leaders'

contributions in exchanges and decide their returns (Cropanzano & Mitchell, 2005). Employees are encouraged to invest favorable resources to prolong positive exchange relationships when they are perceived to benefit from the exchanges (Eisenberger et al., 1986), and OC is one of the forms. On the contrast, they will reduce investment or behave destructively to reciprocate the adverse relationship with leaders (Perugini et al., 2003; Cropanzano & Mitchell, 2005; Schyns & Schilling, 2013; Schilling, 2009). For example, exploitative leaders were aimed to take without returns, such as stealing team achievement for personal use and prioritize prioritizing self-interest over collective goals, realizing with more negative treatments to followers, harming followers' trust in leaders and loyalty to their exchange relationships (Schmid et al., 2019). In sum, we predict a negative relationship between EL and OC:

Hypothesis 1: EL will negatively influence OC.

1.2. The Mediating Role of IJ

Organizational justice is defined as employees' perceived fairness at the organizational level (Greenberg, 1987). Researchers focused on employees' justice judgments in the workplace and how these justice perceptions further predict attitudinal and behavioral outcomes (e.g., Colquitt, 2008). For humans, justice requirement reflects a concern of personal interest, as people are motivated to protect justice so that they will be fairly treated (Montada & Maes, 2016); for organizations, justice is identified as a basic element for work effectiveness and performance (Greenberg, 1990; Bakhshi et al., 2009). Organizational justice was claimed to include three dimensions: (1) distributive justice, refers to the fairness perception on the work results; (2) procedural justice, refers to fairness perceptions on work processes, including the perceived 'process control' and 'decision control' in decision-making; (3) Interactional justice, referring to the justice perceptions on interactional treatments received by individuals (Colquitt, 2008). In the present research, we focus on the role of interactional justice due to its prevalence in work experience and high frequency in employees' justice evaluation.

Individuals tend to experience IJ when the treatments they receive did not embrace respect, honesty, propriety, and sensitivity rules (Bies & Moag, 1986; Greenberg & Cropanzano, 1993). EL can negatively influence employees' IJ with its disrespect on employees' effort, such as stealing group achievements for personal use (e.g., promotion and rewards). In addition, EL may perform hidden aggressive behaviors like manipulation and lying to use employees, masking their real self-interested intentions (Schmid et al., 2019; Watson & Morris, 1991), violating the respect and honesty rules. As demonstrated, the unfriendliness of leaders will negatively influence employees' IJ experience and perception (Tepper, 2000), we then argued that exploitative leaders will be negatively related to employees' IJ experiences:

Hypothesis 2a: EL will negatively influence employees' perceived IJ.

Perceived IJ can affect employees' attitudes towards the organization. According to social exchange theory, people tend to reciprocate in exchanges when receiving benefits and tend to be committed to positive and beneficial social exchange relations (Cropanzano & Mitchell, 2005). IJ was perceived as an essential condition, encouraging willingness of employees to tie closely with the organization for the support they perceived (Masterson et al., 2000),

representing a form of the benefit provided by leaders or organizations for the exchanges, satisfying employees' expectation (Colquitt, 2008), forming positive reciprocal relation. Therefore, a positive relationship between employees' IJ and OC is proposed, that when employees perceived more IJ, they show higher OC. Contrarily, when employees perceived less IJ, they perceive less benefited from the social exchanges, thus reduce their investment and involvement in such relationships, leading to lower OC. Accordingly, we argue a positive relationship between IJ and OC:

Hypothesis 2b: Employees' perceived IJ is positively related to OC.

Based on the social exchange theory, people tend to reciprocate accordingly based on the rewards of the benefits people received from exchanges (Cropanzano & Mitchell, 2005). Since EL is argued to harm employees' IJ perceptions and generates a sense of reduced benefits, it is reasonable to expect a reduction in employees' job satisfaction, making employees unwilling to maintain and involve in such exchange relationship and then undermining their affective tie with the organization (Folger & Konovsky, 1989; Aryee, Budhwar, & Chen, 2002). Thus, we propose that exploitative leadership can negatively influence OC by undermining employees' IJ experience and perceptions. Combing the above arguments, we propose the mediating hypothesis to specify the indirect relationship between EL and OC:

Hypothesis 2c: Employees' IJ will mediate the influence of EL on employees' OC.

1.3. The Moderating Role of JS

Justice sensitivity (JS) is a justice-related disposition indicating people's concern for justice, capturing the stability and consistency of people's perception and strength of reactions to injustice (Schmitt et al., 2010). Researchers identified JS as a key feature in understanding the difference of people in injustice experience and the strength of reaction and restoration for the injustice (Baumert et al., 2010). To some extent, it indicated individuals' self-interest motives by showing a protective intention and reaction of personal benefits. People who are more justice-sensitive will have more attitudinal and behavioral responses to perceived injustice (Schmitt & Dörfel, 1999).

Based on the social exchange approach in justice, employees are argued to reciprocate fair treatment with positive attitudes and behaviors in works (Scott & Colquitt, 2007). For employees who are more sensitive to injustice, memories about injustice experience can be more easily retrieved, leading to unpleasant information-processing and stronger attitudinal and behavioral reactions (Baumert et al., 2010; Baumert & Schmitt, 2016). We further propose that high justice-sensitive employees are more likely to reduce affective investment when perceiving reduced justice in an unfair exchange relationship with leaders. Therefore, we propose:

Hypothesis 3: JS moderates the relationship between perceived IJ and OC, that is, when JS is higher, the above positive relationship will be stronger.

2. Methodology

2.1. Sample and Data Collection

We collected 203 questionnaires for employees from May to August 2021 in China, and finally obtained 172 valid responses, yielding a response rate of 84.7%. We conducted the surveys with the help of corporate HRs, and the questionnaires were distributed to general employees via an online platform. Participants were guaranteed that their survey results would be confidential and anonymous, collected for scientific research use only. The valid samples were all regular employees in 8 Chinese companies from various industries (finance, IT, and education). The average age of the participants was 28.9, 76.2% of the respondents were male, and all respondents had an undergraduate and higher degree.

2.2. Measures and Analysis

We applied established scales to measure all variables. Respondents provided their answers on a 5-point Likert scale ranging from 1 (= strongly disagree) to 5 (= strongly agree) for EL, OJ, and OC, while a 6-point Likert scale ranged from 0 (= not at all) to 6 (= Exactly) for JC. El was measured with a 15-item scale developed by Schmid et al. (2019), Cronbach α for this scale was 0.935. OC was measured with a 6-item scale developed by Bentein et al. (2005), Cronbach α for this scale was 0.799. IJ was measured with a 9-item scale indicating how justice an individual experiences in interaction, revealing one's IJ judgment for both sides (justice vs. injustice, see a similar method in Schmitt & Dörfel, 1999), Cronbach α for this scale was 0.890. JS was measured with 10-item scales developed by Schmitt et al. (2010), Cronbach α for this scale was 0.885. In addition, employees' age, gender, education, and organizational tenure were the control variables in this research. The full questionnaire includes 44 questions in total. To analyze the proposed model and examine the main effect hypothesis (H1), mediation hypothesis (H2), and moderation hypothesis (H3), we applied SPSS 25.0 with PROCESS Macro (Hayes et al., 2018), and Mplus 8.0.

3. Results

3.1. Common Method Variance Control

The present study applied self-reported survey, and the data was collected from a single source, implying a potential common method bias (Friedrich et al., 2009). Therefore, we applied both procedure control and statistical control to eliminate the common method bias (Zhou & Long, 2004). For example, we collected the data twice in 3 months, explicitly claimed the research objective before releasing the questionnaires, guaranteed anonymity, etc. In addition, we use Harman's single-factor test to detect CMV, the results indicated an acceptable common method bias with the first unrotated factor can explain the variance by 48.36% (<50%), CMV (Hair et al., 1998).

3.2. Descriptive Statistics Results

We firstly conducted descriptive statistics and correlation analysis with SPSS. The results showed that exploitative leadership was negatively related to organizational commitment (r=–

0.916, p<.01) and perceived interactional justice (r=-0.922, p<.01), and perceived interactional justice was positively related to organizational commitment (r=0.890, p<.01). The results were presented in Table 1.

Table 1. Descriptive statistics and correlations among variables

Variables	Mean	SD	1	2	3	4	5	6	7	8
1 Age	28.93	4.24	1	-0.039	0.004	0.698**	-0.022	0.062	0.075	-0.039
2 Gender	1.24	0.43	----	1	-0.007	-0.055	0.167*	-0.124	-0.179*	0.225**
3 Education	3.47	0.58	----	----	1	-0.066	0.123	-0.154*	-0.155*	0.144
4 Tenure	2.77	1.17	----	----	----	1	-0.018	0.063	0.042	-0.026
5 EL	2.28	0.81	----	----	----	----	1	-0.916**	-0.922**	0.936**
6 OC	3.74	0.76	----	----	----	----	----	1	0.890**	-0.885**
7 IJ	3.80	0.80	----	----	----	----	----	----	1	-0.900**
8 JS	2.83	0.96	----	----	----	----	----	----	----	1

Note: Two-tailed test; EL: Exploitative leadership; OC: Organizational commitment; IJ: Interactional justice; JS: Justice sensitivity; *** $p < .001$, ** $p < .01$, *$p < .05$; N = 172

3.3. Hypotheses Testing Results

We use Mplus 8.0 to conduct confirmatory factor analysis (CFA) to test the discriminant validities of EL, IJ, JS, and OC. The result shows that the hypothesized four-factor model yielded a better fit (χ^2/df=1.646<3, RMSEA=0.061<0.08, CFI=0.973>0.095, TLI=0.968>0.095, SRMR=0.028<0.08), Above results showed an acceptable level of discriminant validity of four variables in our study.

We use SPSS PROCESS to examine the main effect and mediation effect. We examine Hypothesis 1 predicting the negative relationship between EL and OC. As shown in Table 2, EL had a negative effect on OC (γ=-0.863 p<0.001, see Model 1 in Table 2), providing support for H1. Then we tested mediating effect of IJ on OC for H2a, H2b, and H2c. The results indicate that EL is significantly and negatively related to IJ (γ=-0.901, p<0.001), and IJ is significantly related to OC (γ=0.288, p<0.001) (See Model 2 and Model 3 in Table 2). Moreover, according to the mediation test, both direct effect and indirect of EL on OC shown to be significant (total effect=-0.863, [LLCI=-0.922, ULCI=-0.805]; direct effect=-0.604, [LLCI=-0.747, ULCI=-0.461]; indirect effect=-0.259, [LLCI=-0.405, ULCI=-0.115]), supporting H2a, H2b, and H2c. The results further show the partial mediation.

We use SPSS PROCESS to examine the moderation effect of JS. Regarding moderation model results, the interaction effect of JS and IJ in predicting OC is positive (γ=0.176, p< 0.001, Model 4 in Table 2). When JS is at a low level, the effect of IJ on OC does not exist (Effect=0.131, [LLCI=-0.091, ULCI=0.353]); when JS is at a standard level, the effect of IJ on OC is significant (effect=0.301, [LLCI=0.143, ULCI=0.460]); when JS is at a high level, the effect of IJ on OC is significant (effect=0.471, [LLCI=0.338, ULCI=0.604]). That is, when JS is in a higher level, the less (more) IJ employees perceived, the less (more) committed they are. To better comprehend the moderation of JS, we plotted the effect in Figure 2, and the results supported H3. Additionally, the results also indicated that JS also moderated the mediating effect of IJ between EL and OC (γ=0.102, p<0.05, see model 5 in Table 2). When JS is at a low level, the mediation effect does

not exist (effect=0.090, [LLCI=-0.122, ULCI=0.302]), while when JS is at a high level, the mediation effect become significant (effect=0.288, [LLCI=0.135, ULCI=0.440]).

Table 2. Results of model tests

	Model 1: OC	Model 2: IJ	Model 3: OC	Model 4: OC	Model 5: OC
Intercept	5.647***	5.778***	3.984***	5.251***	5.360***
Control variables					
Age	0.004(0.008)	0.015(0.008)	-0.001(0.008)	-0.002(0.008)	0.001(0.007)
Gender	0.055(0.056)	-0.050(0.056)	0.070(0.054)	0.119*(0.056)	0.092(0.054)
Education	-0.052(0.041)	-0.065(0.042)	-0.033(0.040)	-0.024(0.041)	-0.034(0.039)
Tenure	0.020(0.028)	-0.023(0.028)	0.027(0.027)	0.024(0.028)	0.023(0.027)
Hypothesised variables					
EL	-0.863***(0.030)	-0.901**(0.030)	-0.604***(0.073)		-0.419***(0.099)
IJ			0.288***(0.074)	-0.198(0.192)	-0.101(0.184)
JS				-0.926***(0.162)	-0.492**(0.185)
Interaction variables					
JS*IJ				0.176***(0.048)	0.102*(0.049)

Note: Two-tailed test; EL: Exploitative leadership; IJ: Interactional justice; JS: Justice sensitivity; OC: Organizational commitment; *** $p < .001$, ** $p < .01$, *$p < .05$; N = 172
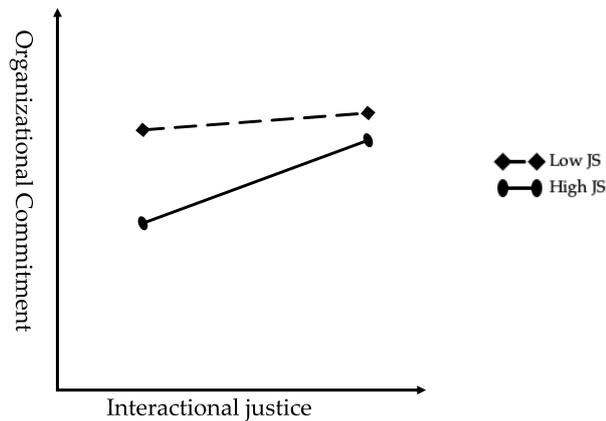
Figure 2. Interaction between JS and IJ on OC

4. Discussion

Using multi-point data collection method, the present study revealed three major findings with an integrated social exchange and justice lens: (1) EL negatively related to employees' OC; (2) employees' IJ partly mediated the relationship between EL and OC; and (3) JS moderate the relationship between IJ and OC, that when employees are higher in JS, the relationship between perceived interactional justice and OC will be stronger.

4.1. Theoretical Implications

Our research at least makes three contributions as proposed. First, our research has tested the relationship between EL and OC, showing a consistent result with previous studies, which further strengthens an important conclusion of EL research or even destructive leaderships field (Schmid et al., 2019). Moreover, based on the integrated lens, the study has provided a theoretical explanation for the effect of EL on employees' outcomes. Negative reciprocity,

indicating 'cost' exchanges in which people respond to bad with bad, or reduction of goodness (Peruguni et al., 2003; Gouldner, 1960), is worth noting (Cropanzano & Mitchell, 2005).

On the other hand, exploitative leadership implied a violation of the reciprocity norm, by intentionally benefiting themselves and ignoring their obligations to return, showing a strong self-motive and injustice nature which fundamentally triggered followers' justice restorage actions (Brunell et al., 2013; Montada & Maes, 2016). For employees, the reduced emotional attachment could be a form of retortion to the injustice exchange relationship. Considering the complexity and uncertainty of the business environment, more studies pay attention to the appeared destructive leadership forms and their influence. The current study started with EL and its negative effects in the workplace, revealing the potential human motives and related behaviors in the current context.

Second, current research initially examined the influence of EL on employees' justice perceptions, enriching current literature by indicating the mechanism of how EL undermined employees' OC. With the integrated lens, our research results supported that EL can harm IJ and thus lead to lower OC. Our results also respond to Schmid et al.'s prediction (2018) about the relationship between EL with organizational justice by suggesting the violation of IJ rules. Past research has identified organizational justice as a mediator of the effects of leadership or behaviors on employee outcomes (e.g., Tepper, 2000; Cho & Dansereau, 2010; Kiersch & Byrne, 2015), we contributed by identifying a new form of leadership (i.e., exploitative leadership) and supporting its effect on employees' justice perceptions, especially referring to current insecure context.

Third, we contributed to the justice field by examining the extend of individual difference in justice motive affecting their behaviors (Schmitt et al., 2010). We found the more justice-sensitive employees are, the more reactive they are to justice distortion, driving them to recreate the balance and eliminate injustice, like reducing 'pay' (i.e., decreased emotional tie) to match the reduced 'gain' (i.e., experienced exploitation). Limited research has revealed the role of JS, which tends to be stable and hidden, shaping ones' justice-related information processing (Baumert et al., 2010). Our study has revealed the role of JS in the relationship between employees' perceived IJ and OC, extending the research to the hidden motives of employees' outcomes in the workplace and in the current context.

4.2. Practical Implications

Our findings have important practical implications. The present study indicated exploitative leaders can ruin the employees' interactional justice experience and then reduce their OC as self-interest protection. Therefore, it is important for top management to find effective ways to protect employees from interpersonal exploitation, identify destructive leaders, and make policies like building a valid complaint system and voice channels to support the construction of a justice environment. In addition, under unstable and complex contexts, it is also important to understand employees' primary requirements and stressors in the workplace, implied by their personalities and traits, such as their boundaries about injustice. Therefore, organizations should be sensitive about employees' benefits and demands, including justice requirements, which may help encourage OC.

4.3. Limitations and Directions for Future Research

Limitations also exist in this study, indicating improvement suggestions and future directions. First, the present study was limited in exploring dynamic processes with limited surveys. Longitudinal research can better capture the changes, and qualitative research can work more effectively in exploring causal relations and hidden mechanisms of dynamics, like employees' interpretation of leaders' behaviors and emotional responses. Second, the present study perceived reduced OC as employees' effort on justice restorage and negative reciprocity. Future studies may examine other forms of employees' behaviors combatting leaders' exploitation, like whistleblowing and alienation. Third, since the emergence of EL is driven by leaders' self-interests, supported by the abuse of power, further studies may find contextual factors constraining the emergence and effect of EL.

5. Conclusions

A complex environment may foster destructive leaders. The current study is empirical research aiming to explore the effect of EL on OC through employees' perceived IJ. We proposed directions for future research for a more comprehensive understanding of exploitative leadership such as its consequences and influence mechanisms and suggested research in boundary conditions and preventive factors for its effects.

Conflict of interest: none

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Assessment of Food Security in the Countries of the Visegrad Group – a Comparative Analysis

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Abstract: The goal of the article is to provide an overview of the food security state in the Visegrad Group (V4) countries and to identify the basic factors of security. The study is based on The Global Food Security Index (GFSI). The most important food-monitoring organizations such as the UN FAOSTAT, the IMF, the FAO, the World Health Organization, and the World Bank served as the data source. The target V4 countries (Poland, the Czech Republic, Hungary, and Slovakia) were evaluated by the time series that covered the years 2012-2021 (some analyses end in 2020 due to a lack of data). We employed the basic methods of statistical analysis of data, i.e. Pearson's correlation, trend lines, and dynamics indicators. The analysis indicated that there was a significant and not always positive development. The most positive dynamics were seen in the Availability factor of GFSI, unlike the Quality and safety which showed a decrease mainly in the case of Hungary. Therefore, exploring food security is becoming more and more important not only in national but also in a wider context international strategy.

Keywords: food security; food safety; GFSI; The Visegrad Group

JEL Classification: I32; O11; Q18

1. Introduction

Food is the most important product for humans. It forms the basis and provides conditions for growth and development. As it was defined in the Maslov's pyramid, there is a strict dependence in the hierarchy of meeting human needs. It is impossible to go further, if basic needs, such as oxygen, food, water or sleep are not provided. It means that providing adequate nutrition is necessary to allow people to reach any higher-order needs.

Unfortunately, in the 21st century, access to food remains not only a European but also a global problem. Last year, one tenth of the global population was malnourished. That's as many as 811 million people. There are many factors that impact food safety, for example, unstable processes in the markets, the weaknesses of our food systems, more and more frequent extreme weather phenomena, or other economic slowdowns. The situation was exacerbated by the negative effects of the COVID-19 pandemic. In the very previous UN agencies' report (FAO, IFAD, UNICEF, WFP & WHO, 2021), which has been prepared by the FAO Agrifood Economics Division in collaboration with the Statistics Division of the Economic and Social Development Stream and a team of technical experts from FAO, IFAD, UNICEF, WFP and WHO it is said that world hunger levels began to rise rapidly (FAO, IFAD, UNICEF, WFP & WHO, 2021). Moreover,

the global rate of increase in hunger has outpaced world population growth, with an estimated nearly 10% of all people being malnourished. Therefore, it is important to monitor food safety indicators and take appropriate steps to minimize the problem.

Due to the FAO definition, food security is a kind of special situation when some factors need to be ensured. First of all, people have economic, physical, social, and continuous access to a safe and nutritious amount of food. That food needs to meet their needs and preferences so they are able to live an active and generally healthy lifestyle. On the other hand, food safety means all groups of products that are free from containing any bad substances that could harm people's health or even life. It is becoming a more and more popular topic of science disciplines. The main purpose of its direction in science studies is to use only food which is safe to eat. Therefore, food security is also defined as a process or action (Szczepaniak, 2018). It is taken into account of important political decisions and has an impact not only on food issues but also on the direction of climate change.

All things considered, food security is an important research area of interest of economists all over the world. That is why one of the biggest global agriculture companies focused on it. Corteva Agriscience is publicity that provides farmers the most complete portfolio in the industry such as mix of seeds, protection of crops and even many innovative digital solutions. The agency sponsored the Economist Impact team who designed the unique Global Food Security Index (GFSI). It considers four important food issues (The Economist Group, 2021a). First of all, the availability criterion which measures aspects of the national food supply sufficiency. It cares about the risk, capacity to disseminate food, and efforts to expand agricultural output. Secondly, the affordability criterion which weighs the human ability to purchase food. It also checks the sensitivity to any implemented policies and programs supporting clients in the price shocks. The third factor is quality and safety. This one is a combination of dietary nutritional quality and its safety at the same time. Last but not least is natural resources and resilience aspect. It is about a country's susceptibility to natural resources. Moreover, it checks how countries adapt to risk as it occurs.

Although the problem is global, the Visegrad Group countries were selected as an area of research in the presented study. Poland, Slovakia, Hungary, and the Czech Republic are neighbored countries with similar geopolitical conditions, traditions, culture, social values, and shared history. They work together in many fields of common interest within the all-European integration (Kowalska & Gurkowa, 2020). Because of plenty of similarities, it is worth checking if such symptoms as the problem of food proper distribution to consumers, the problem of food losses or the increasingly serious problem of improper nutrition, leading to obesity are familiar in those countries.

The aim of the article is to show the state of food security in Visegrad Group countries and to identify the basic elements of this security. There is enough of research and analyses concerning the conditions, categories and level of value of food security issues. All of them covered a long time period. Namely, regarding Poland, we can follow Kraciuk (2018), Walaszczyk and Mnich (2021); in Czechia Slaboch and Kotyza (2017), Matkovski et al. (2020); in Slovakia Kádeková et al. (2020), Kádeková et al. (2017); in Hungary: Kovács (2020), Szabó-Bódi et al. (2018).

2. Methodology

The study used statistical materials published in the form of The Global Food Security Index. The GFSI considers the issues of 113 countries, both developing and developed, and it is related to 58 unique and dynamic indicators (The Economist Group, 2021a). Those indicators are strongly connected with the FAO's definition of food security (Figure 1).
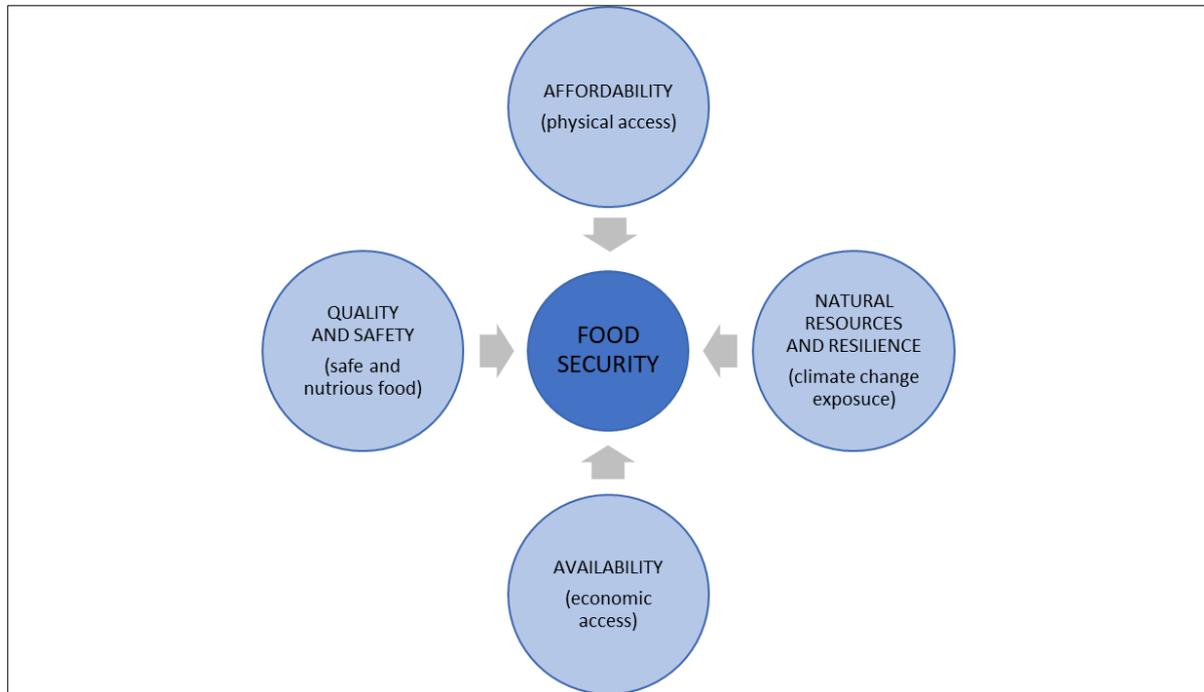
Figure 1. Food safety conditions (Source: own based on (World Food Summit, 1996))

All data came from the most important food organizations in the world incl. the UN, the IMF, the FAO, the World Health Organization, and the World Bank. Because the model is quantitative and qualitative, it is a base to analyze the problem of food security. Moreover, the 2021 edition is the tenth. As the Economist Impact team updates it annually, year-on-year, this decade is the main time of the analysis. Furthermore, data from the FAOSTAT database were also taken. The subject of the analysis included data on food security from Poland, the Czech Republic, Hungary, and Slovakia. All things considered, the basic time range of data covers the years 2012-2021 (some analyses, due to lack of data, end in 2020). The article uses the basic methods of statistical analysis of data, i.e., Pearson's correlation, trend lines, and dynamics indicators. Time series of the GFSI, its value in each country, and prevalence of undernourishment were presented for the countries of the Visegrad Group. A trend function line and a determination coefficient R^2 was determined for them. It is generally accepted that $R^2 \geq 0.70$ fits the data well.

3. Results and Discussion

Both in the modern world and EU economy, as well as in the Visegrad Group countries, the issues of food security are extremely important and up-to-date. The strong agriculture sector is essential for the highly competitive food industry, which in turn is an important part

of the economy and trade. It also has a significant impact on international markets. All decisions taken at the international or European level respond to the challenges posed by food security, climate change and the needs of rural development.

The analysis of the Global Food Security Index in the Visegrad countries, over the past ten years, indicates that it has changed significantly. However, in each of these countries, those changes were more or less intense. Even if the analyzed countries were selected for the comparative analysis due to the multiplicity of similarities between them, there is a clear differentiation in the level of food security between these countries. The GFSI developed most dynamically in Czechia, where also it was the highest (for the most part of the studied period). The worst situation has been noticed in Slovakia, as it recorded in the ranking, the lowest values of the GFSI for most of the studied period (Figure 2).
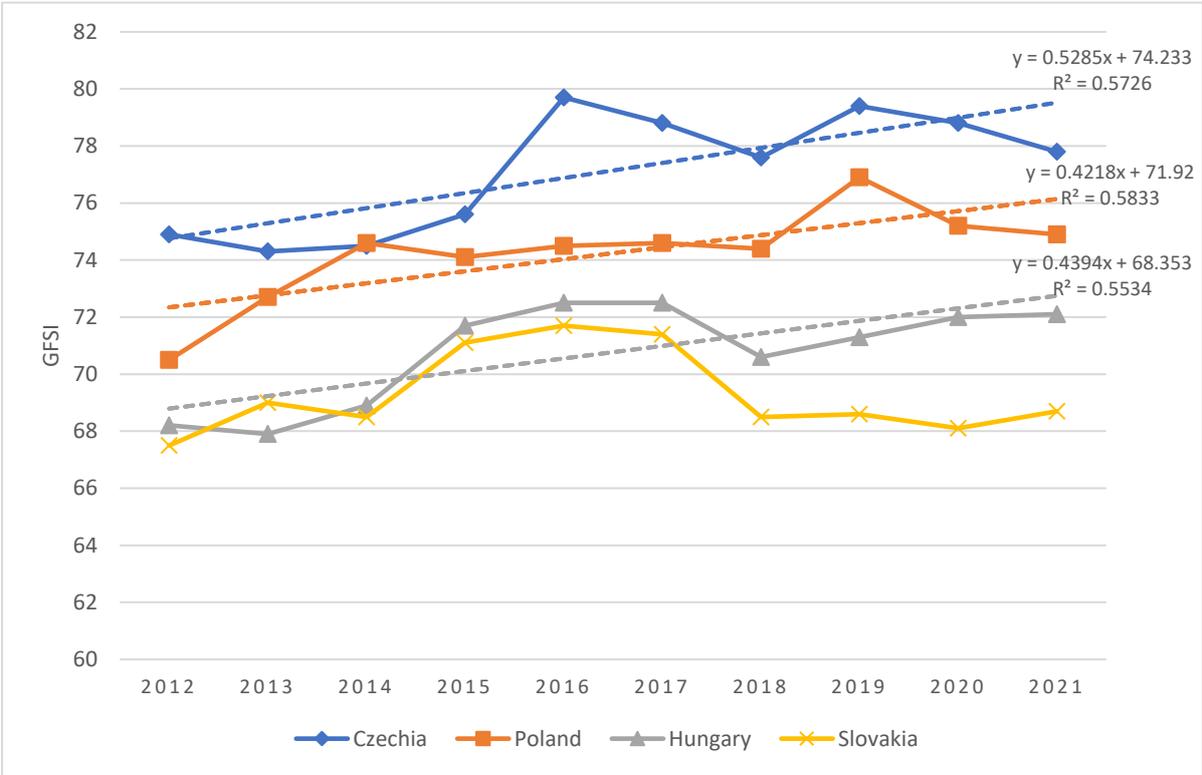
Figure 2. Values of Global Food Security Index in Visegrad Group countries in years 2012-2021– scale from 0 to 100 (Global Food Security Index, 2021b)

In Czechia, in 2012-2021, the value of GFSI increased by almost 3 points, however, the largest increase, by over 4 points (from 75.6 to 79.7 points) was recorded in the years 2015-2016. After this period, there was a decrease in the area of food security (by almost 2.5% in the last 5 years, i.e., from 79.7 points to 77.8 points) and this trend continues. Despite the decrease in the value of GFSI in Czechia after 2016, the average annual growth rate throughout the entire period studied was the highest compared to other countries of the Group. In Czechia, on average, in 2012-2021 the GFSI increased annually by over 0.5 points, with a good fit at $R^2 = 0.57$.

Czechia is the only country in the Group in which the GFSI has decreased so much. Other countries of the Group recorded an increase or slight fluctuations in GFSI throughout the

entire period studied. The GFSI in Poland increased very intensively. During the analysed period, the GFSI in this country became much larger, for about 6% (from 70.5 points to almost 75). In the case of Poland, the average annual increase in food security area during the period under consideration is over 0,4 points, with a good fit (R^2 = 0.58).

Hungary also showed a good fit of the trend line (R^2 = 0.55) over the period considered. In the case of this country, the GFSI has increased since 2012 by almost 6% (from over 68 points to 72). Despite the growing tendency, the average annual growth of the food security area in Hungary in 2012-2021 amounted to about 0.4 points. The GFSI in Slovakia was the lowest among the countries surveyed in both 2012 and 2021. It was also the country showing the lowest growth dynamics in GFSI. In the analyzed period, the value of GFSI in this country increased by only 2.2% (from 67.5 points to almost 69). The average annual rate was decreasing by about 0.2 points. Moreover, the trend line fit in this case was very low.

The 10 years change of Global Food Security Index components was also assessed (Figure 3). The obtained data shows that in the Visegrad countries, different factors have changed significantly. However, in each of these countries, those changes were less or more intense.

Figure 3. Changes of Global Food Security Index components in Visegrad Group countries in years 2012-2021 in points (Global Food Security Index, 2021)

Availability is the first component that has been considered. In Hungary, in 2012-2021, its value changed the most, it increased by more than 16 points, while in Czechia and Poland this factor almost stagnated at +3.6 and +3.4. Hungary improved very much during the last ten years, especially in the volatility of agricultural production, food security, and access policy commitments. Moreover, the food loss is on a very low level there while in both, Czechia and Poland, the value of food loss has increased. In Poland, there is a very weak level of food security and access policy commitments, which is actually similar to Slovakia, and its decreasing trend of food availability. In 2021, the food availability index in Slovakia was only 48.8 points out of a 100-point scale, which was a decrease of 1.9 points compared to 2012. The

agricultural research and development decreased there the most. Secondly, the sufficiency of supply and political and social barriers to access went worst.

On the other hand, Slovakia is the country of Visegrad Group, where the second GFSI component, which is affordability, improved the most. In the last ten years, the change in average food costs, agricultural import tariffs, market access, and agricultural financial services became better. Furthermore, again, even if Hungary improved the most in food availability, it improved its lowest indicator Food affordability only by 0.9 points. They need to focus on food market access and agricultural financial services because there was the biggest loss in that field of analysis. This does not concern Poland and Czechia. The component of food affordability changed there differently, respectively: +3.1 points, +1.8 points. Poland, in the last ten years, has improved in almost every field of food affordability. This includes indicators such as the proportion of the population under the global poverty line or food safety net programs that are very developed in these countries. Such situation is related to overall income increase rather than food prices. Prices of even basic food such as plain mixed bread were rising in a staircase pattern above an inflation rate since the summer of 2006 (Olszańska & Král, 2020). Their study also showed that it occurred in spite of the stagnating prices of an undelaying commodity – flour.

Quality and Safety is the third component that has been considered. The common thing about this indicator, among Visegrad Group countries, in the years 2012-2021, is that it decreased. In Hungary, its value changed the most, the loss is about almost 10 points, while in Czechia and Slovakia this factor was pretty similar, respectively: -4.3 and -4.7. In Hungary, nutritional standards decreased the most, for about 50 points down. It was something that decreased in Czechia also, but half as much as in Hungary. Interesting is, there is a decreasing trend in the protein quality category in Hungary while at the same time there is an increasing trend in Czechia. In Slovakia, even if the decrease was almost half much as in Hungary, both trends are similar, nutritional standards and protein quality went down. On the other hand, there is a completely different situation in Poland. This country noticed the smallest drop in point and the general situation is pretty good over there. It is the only of Visegrad Group countries where the food nutritional standards, in years 2012-2021 went up. Moreover, the food protein quality is very good in Poland. It scores 100 points in this category which is a very good result. The only thing, where the situation went worst in Poland is food safety. There were more than 15 points loss and it is something that should be considered for next years.

Last but not least, factors of Natural Resources and Resilience were analyzed. In the Visegrad countries, over the past ten years, both increased significantly. However, in each of these countries, those changes were completely different intense. The biggest development was in Poland, +13.5 points. Even if the general water condition is on a weak level there, the political commitment to adaptation is going better. At the same time, in Czechia, the was a noticeable development in water condition. This country scored almost 11 points increase, which is a good result. Almost half of it scored Slovakia. Slovakia, during the last ten years, also improved political commitment to adaptation by an outstanding margin. Unlike

Hungary in which political commitment score did not change. This made Hungary an outlier in this field with no or very little progress.

All factors displayed on a one-hundred-degree scale for the four analyzed countries resulted in scores in 2021: Czechia 77. (14th place in Global Ranking), Poland 74.,9 (22nd place in Global Ranking), Hungary 72.1 (31st place in Global Ranking), and Slovakia 68.7 (42nd place in Global Ranking). We provide Global Ranking scores for the best countries to provide a context: the best country is Ireland with a score of 84 points, the second is Austria with 81.3 points score and third place is taken by the United Kingdom with 81 points overall score (Global Food Security Index, 2021). This shows that there are still significant differences not only between V4 countries but also in Europe.

FAOSTAT data were also analyzed. The main purpose of this organization is to present the real core set of food security indicators. SDG (Sustainable Development Goals) policy and targets are becoming more and more important, especially nowadays when everything is changing very fast. The choice of the indicators has been provided by expert judgment and the availability of data with sufficient coverage to enable comparisons across regions and time was taken into consideration as well. Even if countries are more developed and food security level is higher than ever, there is still a problem with the prevalence of information about the scale of undernourishment, see Table 1. The last but not least issue in this paper is a comparison of undernourishment in Visegrad Group countries. Although Table 1 provides a three-year average value, it gives an adequate overview of the problem in the report to global indicator framework for the Sustainable Development Goals of the 2030 Agenda for Sustainable Development.

Table 1. Prevalence of undernourishment in percent over 3-year average (FAOSTAT, 2021)

	Czechia	Hungary	Poland	Slovakia
2000-2002	<2.5	<2.5	<2.5	*6.1*
2001-2003	<2.5	<2.5	<2.5	*6.2*
2002-2004	<2.5	<2.5	<2.5	*6*
2003-2005	<2.5	<2.5	<2.5	5.8
2004-2006	<2.5	<2.5	<2.5	5.5
2005-2007	<2.5	<2.5	<2.5	5.6
2006-2008	<2.5	<2.5	<2.5	5.4
2007-2009	<2.5	<2.5	<2.5	4.9
2008-2010	<2.5	<2.5	<2.5	4
2009-2011	<2.5	<2.5	<2.5	3.5
2010-2012	<2.5	<2.5	<2.5	3.4
2011-2013	<2.5	<2.5	<2.5	3.4
2012-2014	<2.5	<2.5	<2.5	4
2013-2015	<2.5	<2.5	<2.5	5.3
2014-2016	<2.5	<2.5	<2.5	*5.9*
2015-2017	<2.5	<2.5	<2.5	5.6
2016-2018	<2.5	<2.5	<2.5	4.5
2017-2019	<2.5	<2.5	<2.5	4.1
2018-2020	<2.5	<2.5	<2.5	4

In three of four of Visegrad Group countries, there is the same bellow-detection level of undernourishment of 2.5%. It suggests that Czechia, Poland, and Hungary follow the

recommendation of experts gathered in the Committee on World Food Security (CFS) on hunger measurement, which was hosted at FAO headquarters in September 2011. Hence food insecurity is not something to worry about. A different situation is in Slovakia. This country has noticed fluctuations over the last ten years. The level of the index has changed significantly, from 6.1% (2000-2002 average) to 4% (2018-2020 average). It was decreasing until 3.4% in 2010-2013 and then started to increase back to 5.9% (2014-2016 average). Now the trend is decreasing again. However, it does not mean to stop monitoring the situation.

4. Conclusions

All things considered, food security is a basic right. Ensuring it is essential. Moreover, it is the responsibility of every country. There should be activities aimed at improving the quality of consumed food products as well as promoting healthy eating. The processes of European integration contributed to the improvement of the economic situation of European countries, and thus the increase in the Global Food Security Index in the analyzed period of time. There are urgencies recognized for the broader food systems transformation. What needs attention is the purpose for getting back on track towards meeting SDG targets; which are: ensuring access to safe, nutritious, and sufficient food for all people all year round, and eradicating all forms of malnutrition. Governments should focus on transformation and policies that help in addressing the major drivers behind the growth in hunger. At the same time, they should start trying to slow down the progress towards reducing all forms of malnutrition. Therefore, exploring food security is becoming more and more important not only in national, but also in a wider context, international strategies. Provided using other scientific approaches it becomes a strategic plan for any future research and political decisions.

Conflict of interest: none

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Capital-Labor Substitution and Economic Efficiency in the Context of Industry 4.0

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Abstract: The aim of the paper is to provide an insight into the area of substitution of human labor by the capital of the manufacturing sector. First, the labor market in the Czech Republic is described and then an economic analysis of the process of replacing human labor with a robot is performed. This analysis will be reflected in the Stella Professional tool, which enables dynamic modeling of economic systems using visual diagrams. At the same time, this tool allows mathematical calculations and simulations that will be created fifteen years in advance. These simulations are used to calculate the economic return on investment in the robotization of production plants. Companies can enter their own input values in the created model and the tool calculates the payback period of the investment project and identifies the time frame when the investment is most appropriate to make.

1. Introduction

Unemployment is a key macroeconomic indicator. During the Covid-19 pandemic, unemployment was forecast to increase. However, the increase was minimal due to government measures and the unemployment rate remained below the natural unemployment rate. The demand for labor was higher than the labor supply in the Czech Republic. Companies are being forced to raise wages or offer more benefits to recruit new employees. The second way is automation and robotization of production. And it is this unfavorable situation on the labor market that can lead to a higher substitution of labor by capital and a faster onset of Industry 4.0.

The importance of the elasticity of substitution between capital and labor has been studied in many areas of economics, but this parameter has not received sufficient attention with regard to the assessment of economic growth (Mallick, 2012). The study (Gechert et al., 2021) states that the effectiveness of interest rate changes in managing inflation doubles when the elasticity between capital and labor is assumed to be lower than in the literature of 0.9. This elasticity has significant implications for monetary policy and political decision-making.

The model (Alvarez-Cuadrado et al., 2017) confirmed that as the aggregate capital-labor ratio and the wage-rent ratio increase, the sector with higher factor substitution elasticity - the more flexible sector - is in a better position to replace progressively more expensive input-labor - and gradually cheaper-capital - compared to the less flexible sector. As a result, differences in the sectoral elasticity of substitution between capital and labor evokes a process of structural change. In their article, they confirmed that there is direct econometric evidence that the

elasticity of substitution varies between sectors. And also that there is evidence that the capital-labor ratio is growing at different rates in different sectors. And third, they confirmed that factor income shares have evolved differently across sectors.

Sectoral shares of labor income (capital-labor-energy-materials) in the US have been examined by a number of studies (Alvarez-Cuadrado et al., 2017; Zuleta & Young, 2013).

A US agricultural study (Hamilton et al., 2021) points to problems, suggesting that wage-setting farmers have an incentive to "over-mechanize" or employ more than a level of capital that minimizes costs when capital and labor are substitutes but "under-mechanize", when labor and capital are technical additions.

Current technologies have made it possible to generate new products and services, both of which have led to significant transformations of personal and professional life with an emphasis on interaction between machines and people (Sima et al., 2020).

The potential effects of investing in new technologies include four dimensions: costs, benefits (business impacts), flexibility (future options created by the investment) and risk (uncertainty) (Botchkarev & Andru, 2011).

At present, fiscal (Král, 2017) and monetary policies are also important for the implementation of the installation, for example, the revaluation of the domestic currency exchange rate has implications for the substitution of labor by capital (Mačí, 2020).

Tay et al. (2018) presented Industry 4.0 as a global change for every part of society 's digitization and automation, as well as through manufacturing processes (Sima et al., 2020). Unemployment can be a negative phenomenon in Industry 4.0. There is a directly proportional relationship between the degree of production automation and the unemployment rate: the higher the degree of production automation, the higher the unemployment rate (Leonhard, 2017). As a result of machine automation, the creativity of human capital and its loss from the production process may decrease. However, new jobs will be created and there may be better environmental protection, for example by lower energy consumption of modern machinery and equipment (Sima et al., 2020). In this paper, Industry 4.0 is understood as a way to substitute labor by capital (Hedvičáková & Král, 2021).

2. Methodology

The article uses primary and secondary data. Primary data are obtained from a company operating in the field of plastic injection. For competitive reasons, the company did not wish to provide further information. Based on the data provided, a model will be created to analyze whether and when it pays to invest in new technologies and replace labor with capital. This information is supplemented by data from interviews with the country manager of the robot manufacturer KUKA, which took place in June 2021. Data from public databases such as the Czech Statistical Office, Eurostat, the Ministry of Labor and Social Affairs and the Ministry of Industry and Trade were used for labor market analysis. Czech Republic. Furthermore, information was obtained from worldwide professional conferences and workshops. The information is also supplemented by professional publications and articles from impacted journals.

The aim of the article is an economic analysis of the process of substitution human labor with a robot. This analysis will be displayed using Stella Professional software, which allows dynamic modeling of economic systems using visual diagrams. At the same time, this software will be used to allow mathematical calculations and simulations for fifteen years in advance. Based on this, the economic return on investment in the robotization of production facilities will be calculated. At the same time, calculations of payback time and net present value in the model are performed.

The proposed model will serve the private corporate sector to calculate the payback period of their investment project and the benefit will be the identification of the time frame when to implement this investment. Companies will be able to choose their input values and adjust them according to their needs.

Every company is interested in the decision to make an investment: how long it will take for the investment to return and whether the investments made in the substitution are spent efficiently. Several basic calculations are used for this. The concept of investment assumes the purchase of automated production technologies based on 6-axis robots with accessories such as various grippers, control camera systems, intelligent conveyors, sophisticated sensors, etc. Payback period and Net present value are the key economic indicators evaluating the return on investment in the company.

The NPV approach probably the most popular and most sophisticated economic valuation technique is the NPV approach. It consists in discounting all future cash flows (both in- and out-flow) resulting from the innovation project with a given discount rate and then summing them together (see Equation 1). The merit of innovation is measured considering its contribution to the creation of economic value out of the investment needed (Žižlavský, 2014).

Net Present Value (NPV) formula (Žižlavský, 2014):

$$NPV = \sum_{t=1}^{n} \frac{NCFt}{(1+i)^t} \tag{1}$$

where:
NCF_t = net cash flow generated by innovation project in year t;
i = Discount rate or return that could be earned in alternative investments;
t = Number of timer periods.

The formula was further modified for the needs of the model:

$$NPV = \sum (Savings * (1+i)^{-n}) - Investment \tag{2}$$

The second widely used tool for evaluating investment efficiency is Return on Investment (ROI). ROI is a performance measure used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. To calculate ROI, the benefit (return) of an investment is divided by the cost of the investment; the result is expressed as a percentage or a ratio (Botchkarev & Andru, 2011).

The return on investment formula (Botchkarev & Andru, 2011)

$$ROI = \frac{Gain\ from\ Investment\ -\ Cost\ of\ Investment}{Cost\ of\ Investment} \tag{3}$$

Because not all the data in the calculation formula are used in the model, it is not possible to determine the amount of profit. This quantity will be replaced by savings and it will be assumed that the savings will increase the level of profit. Profit will then be treated as a differential. Depreciation will be worked on in more complex models. Depreciation will not be considered for the first models.

The return on investment formula for model:

$$Payback\ period = \frac{Investment}{Saving} \tag{4}$$

Discounted payback period formula:

$$Discounted\ payback\ period = \frac{Investment}{(\sum(Savings + Depreciation) * (1 + i)^{-n})/5} \tag{5}$$

The formula considers 5-year depreciation periods of tangible fixed assets.

All of the above formulas have multiple definitions and modified calculation formulas (Botchkarev & Andru, 2011; Hedvičáková & Král, 2019; Žižlavský, 2014)

3. Results

3.1. Actual Situation on Labor Market in the Czech Republic

The labor market in the Czech Republic has one of the lowest unemployment rates in the European Union in recent years. Unemployment rates have been lower than the natural unemployment rate in recent years. In 2021, the general unemployment rate was 3.86% (see Figure 1) in the Czech Republic. According to Eurostat, the unemployment rate in the EU-27 was 7% and in the Czech Republic 2.8%. The Czech Republic has the lowest unemployment rate of all EU countries, the second country with the lowest unemployment rate is Poland with 3.4% (Eurostat, 2022).
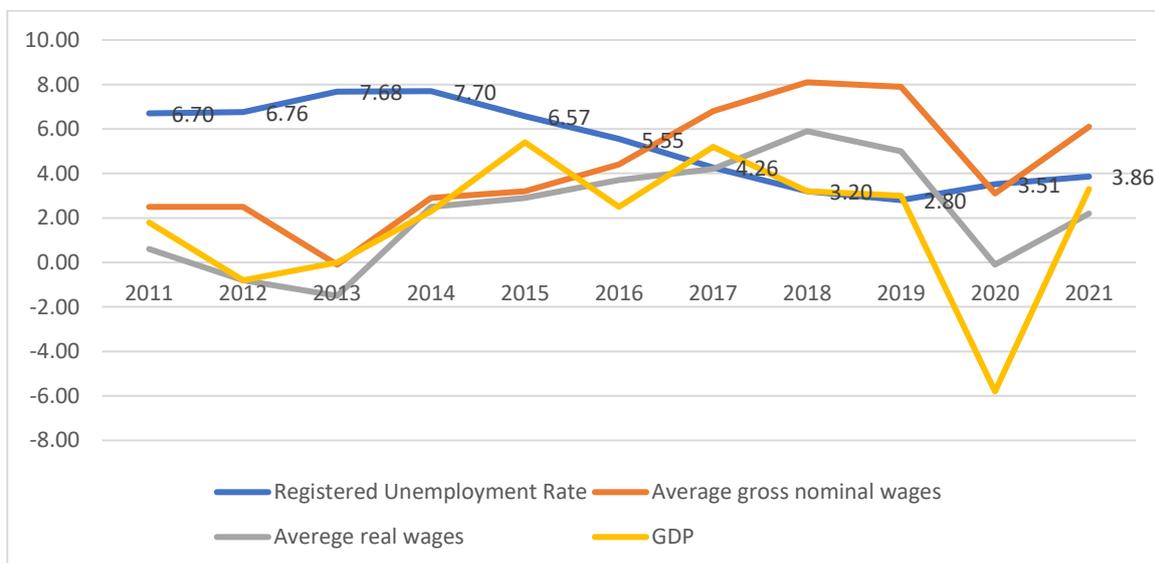
Figure 1. Key macroeconomic indicators in % (Czech Statistical Office, 2022)

Companies cannot find a sufficient number of qualified employees because labor demand is higher than labor supply. Companies have orders, but they solve problems: "How to produce?" One way is to increase wage rates and company benefits, and the other way is to invest in robotics and production automation. Companies are starting to prefer the second way, because in addition to increasing production capacity, it brings production 360 days a year, without increased wage costs for work on holidays or night shifts. Quarantine and sickness benefits also do not have to be addressed. New predictions of rising labor costs are forcing companies to look for production optimization and savings. In 2022, the rate of inflation will also rise significantly, which will increase the pressure on nominal wage growth as real wages fall. There is also a significant increase in electricity, gas and oil prices. New machines are usually more economical and environmentally friendly. Another positive aspect of production robotization is the 100% production quality, because modern machines can analyze defective pieces and eliminate them from production.

For the above economic and other reasons, companies choose to substitute labor for capital. For this reason, a substitution model has been proposed that calculates whether and when capital investment is economically efficient.

3.2. Capital-Labor Sustitution Model

When evaluating the substitution of labor by capital, it must consider the differential costs that are present in this substitution. It is not efficient to evaluate all the costs of the calculation formula and it would only complicate the evaluation mechanism. The notion of relevant substitution costs will be introduced. These costs change when labor is replaced by capital. The following relevant substitution costs were identified. Labor costs, energy costs, production quality costs. On the other hand, the investment expenditures of substitution (subsequently the costs in the form of depreciation) are included in the evaluation. The production function is considered both fixed and variable (Hedvičáková, 2021).

Based on the identified relevant costs, several models were created in the economical Stella Professional programming environment. Figure 2 presents the basic simplest model, in which only investment expenditures and labor costs are considered.

In subsequent articles, this simple model was further developed into a more complex model. Other aspects have been added, such as energy costs and low-quality production costs. The possibility of production growth due to higher production efficiency of robotic automation was also accepted.

The result of the input data of this model is a table where each row represents 1 year in which the investment can be started. The investment can be made, for example, in year 1, or in year 10 or 15. The input variables are constantly recalculated and provide information on whether it is worthwhile to realize the investment at a given time or to postpone it.

In total, the model is calculated for 15 years. In each year, input variables are calculated with a possible increase or decrease in price. It is clear from the table that, for example, the input variable the price of the work of replaced employees with an annual growth of 6% will change from the input value of CZK 782,006 to CZK 1,720,000 at the end of the modeled period during the 15-year period (see Figure 2). Return on the number of years is calculated
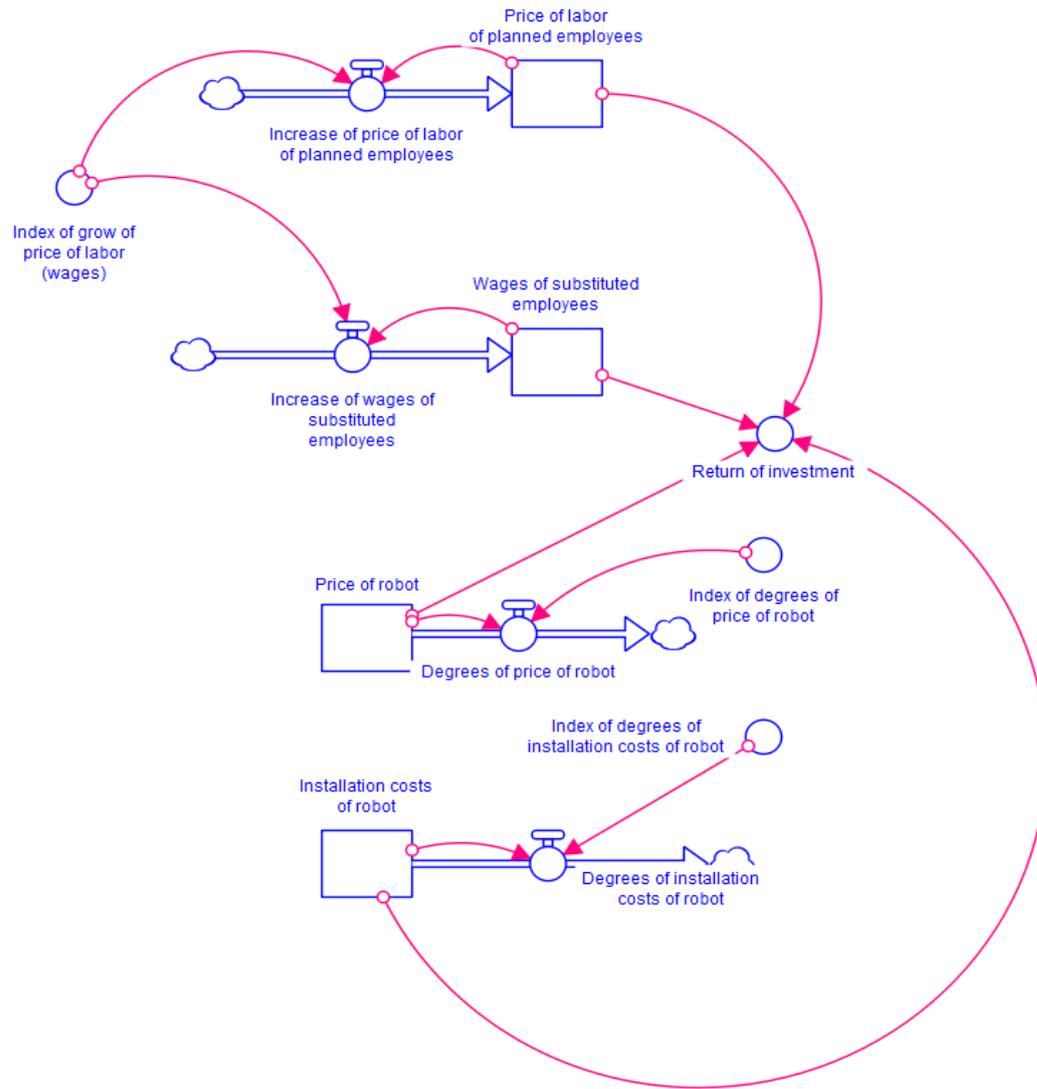
Figure 2. Labor-capital substitution model (own processing in Stella Proffesional)

	Wages of substituted employees	Price of robot	Installation costs of robot	Return of investment
1	782k	800k	1,5M	2,94
2	829k	800k	1,5M	2,77
3	877k	800k	1,5M	2,62
4	928k	800k	1,5M	2,48
5	981k	800k	1,5M	2,34
6	1,04M	800k	1,5M	2,22
7	1,1M	800k	1,5M	2,09
8	1,16M	800k	1,5M	1,98
9	1,23M	800k	1,5M	1,87
10	1,3M	800k	1,5M	1,77
11	1,38M	800k	1,5M	1,67
12	1,46M	800k	1,5M	1,58
13	1,54M	800k	1,5M	1,49
14	1,63M	800k	1,5M	1,41
Final	1,72M	800k	1,5M	1,33

Figure 3. Development of return on investment over fifteen years (own processing in Stella Professional)

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for each year. The return value varies depending on the values of the input variables in a given year and expresses the length of the return in years for the values of the modeled input variables valid in a given year. From the above table it is clear that the growth of labor costs combined with the stagnation of costs for new technologies means that the payback period of potential investment will shorten in the coming years.

The following Figures 2 and 3 show the return of investment. If the investment is made in the current year, the return of investment (difference between wage and robotic workplace expenses) will be less than 3 years. If the investment were made in 5 years, it's payback period would already be 2.34 years, due to rising labor costs and the persistence of costs for the robotic workplace. If the investment were realized in the fifteenth year, the payback period of the investment would be 1.33 years.

Figure 3 (right graph) also shows that the wages of the employees are rising over time, but the price of robots is falling over time. This decrease in the price of robots is caused by a significant increase in the number of robots sold and a reduction in the cost of production due to new technologies.
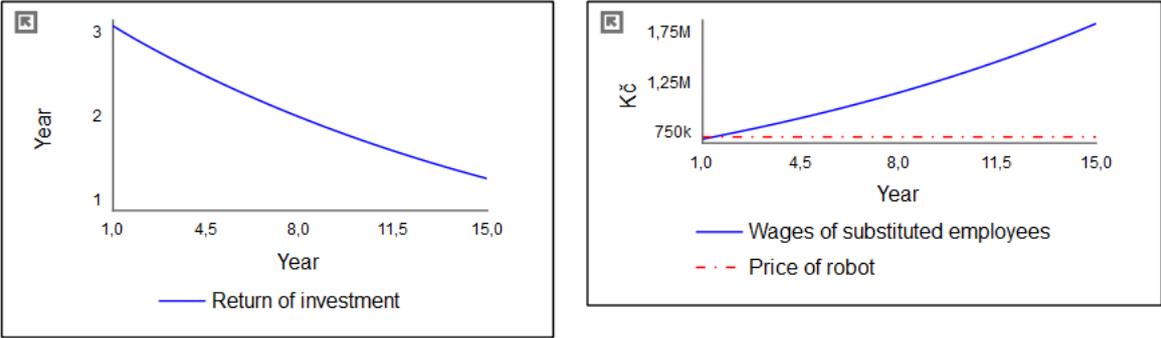
Figure 3. Development of labor costs (wages) and return on investment over fifteen years (own processing in Stella Professional)

4. Discussion

The paper "Capital-Labor Substitution and Economic Efficiency in Context Industry 4.0" is based on the current situation in the European market. The key questions are: To substitute a human labor with a robot or not? How effective and repayable is this compensation? Aren't these just marketing games? The paper provided a new perspective on the economic model of substituting labor with capital. In addition, a mathematical and economic view of substitution has been developed and a parameterizable tool has been created to enable companies to support them in deciding whether or not to invest in substitution. However, it should be noted that marketing and strategic considerations are also part of decision-making, and a pure mathematical calculation of return and net present value cannot be isolated in decision-making.

The model has been validated in several companies and modified to the requirements of company managers. In future research, it would be appropriate to verify the model on multiple types of companies and incorporate the acquired into other models.

5. Conclusions

In all phases of investment projects, from the first idea to the final implementation, it is therefore necessary to assess efficiency according to financial and non-financial criteria. The results of the research will help solve the problem of empirical evaluation of the importance of individual variables in determining future earnings, and will propose measures to improve the evaluation of investment performance using dynamic models and mathematical calculations with predictions of development for the next fifteen years (Žižlavský, 2014). The Czech Republic lacks such a user-friendly tool and would be very beneficial for companies to evaluate the return on investment.

Conflict of interest: none

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Bitcoin Data with Indicators in Years 2017-2021

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Abstract: Nowadays, new cryptocurrencies are constantly appearing, their popularity is growing and all this is influenced by the dominant cryptocurrency, which is Bitcoin. Bitcoin and cryptocurrencies generally have a strong impact on economic functioning around the world because people are willing to invest huge sums of money in those currencies. This article analyzes the development of Bitcoin over the last five years, i.e., the years 2017 to 2021. Although investments in cryptocurrencies and Bitcoin are very risky and growth of its value has a sinusoidal curve, in terms of several years Bitcoin value is still growing. The total increase over the last 5 years in price was from $ 998 to $ 46,198 and Bitcoin multiplied its value 46.29 times. In the last 5 years, Bitcoin has experienced several huge ups and downs. The aim of this work is to analyze the development of Bitcoin in terms of how the price in the market developed and thus affected the global economy. Likewise, how does the current price affect the business economics? This article shows the development of Bitcoin and lists several indicators that affect its price globally.

Keywords: bitcoin; data; indicators; overview

JEL Classification: F02; F63; M20

1. Introduction

This article describes the development of Bitcoin, what indicators and variables can affect the price and the associated impact on the corporate and global economy. Bitcoin is the most famous cryptocurrency, which originated in 2009. It is also the open-source Internet payment network of the same name, in which Bitcoin is used as a currency. The uniqueness of bitcoin is its full decentralization - there is no central server in the network through which all payments pass. At the same time, it is not subject to any regulatory authority or central bank, so there is no institution that can manipulate the value of Bitcoin (Chaim & Laurini, 2019).

All communication in the network takes place using a computer program that communicates with other participants. Participants are of two kinds - owners of BTC (wallets), and miners. Users send money, pay for products or services, and thus create supply and demand. The miners ensure the functioning of the network and its security, for which they are rewarded by the new Bitcoins. No one but users and miners are in the network (Koutmos, 2018; Wątorek et al., 2021).

A large number of transactions are constantly taking place in the network. These are grouped into blocks. Every 10 minutes, 1 block is created and the blocks put together a blockchain. Blockchain is a public database of all completed transactions, which is regularly updated. This database ensures anonymity and at the same time prevents unauthorized transactions.

Users have their Bitcoins stored in HW or SW wallets. They can create any number of bitcoin addresses in their wallets. The transactions then take place in such a way that the sender enters the required amount of bitcoins, fills in the recipient's bitcoin address and confirms the payment with his key.

Although cryptocurrencies are a relatively risky asset, investors should think carefully about developments over the last 10 years. Cryptocurrencies can serve as a very interesting enrichment of the portfolio with the potential for huge value for money (Jareño et al., 2020; Klein et al., 2018).

As Bitcoin's popularity grows, so does the number of low-quality cryptocurrencies that will never be profitable, so investors must do their own research. There are many cryptocurrencies that have multiplied a hundred or more times in a few years, but there are many more cryptocurrencies that have lost their value. The investment in Bitcoin is considered to be the most stable in the cryptocurrency world, but Bitcoin cannot be expected to be so highly profitable.

In recent years, Bitcoin has gained enormous media and investor attention, and the faster it grows or falls, the more attention grows (Urquhart, 2018; Vidal-Tomás & Ibañez, 2018). The main reason why cryptocurrencies have become so popular is that because they have enabled efficient payments through a decentralized system, there is no political or government control process (Amsyar et al., 2020; Corbet et al., 2020). But there is a critical issue with this aspect. This problem is hackers who are very creative and are constantly trying new methods to steal users' wallets with cryptocurrency. Hackers are targeting a whole range of cryptocurrency investors. More and more people are investing in cryptocurrencies, and so there are many who are unable to secure their funds and are not so familiar with fraudsters' methods (Corbet et al., 2020; Dyhrberg et al., 2018). There is a really large number of fraudsters in the cryptoworld, and even without them, investing in cryptocurrencies would be very risky (Chaim & Laurini, 2019; Fosso Wamba et al., 2020).

2. Methodology

Information on the current price of Bitcoin and a large number of other cryptocurrencies is constantly public information. The author draws on this information. A csv file has been created for statistical analysis and reporting. The data file is freely available on Kaggle (https://www.kaggle.com/datasets/raimondextervinluan/bitcoindatamovingaverages), which is a machine learning and data science database. The data file is published under the "CC0: Public Domain" license. WEKA software was used to display the reports. WEKA is a popular package of machine learning programs written in Java, developed at the University of Waikato, New Zealand. Weka is free software available under the GNU General Public License.

The data file has 1,827 rows, where each row shows one day. The data file then contains the Bitcoin value exactly at the beginning of the day, the daily maximum, the daily minimum, the value at the end of the day, the total amount traded that day, the current Bitcoin stock and also the average for the last 20, 50 and 200 days.

3. Results

Bitcoin has undergone significant development over the last five years. During this time, there have been three major price increases and three major price declines in price developments. The first huge increase to nearly twenty thousand dollars took place in December 2017. The second increase was almost sixty-four thousand dollars per bitcoin in April 2021. The third increase to the largest value to date of sixty-eight thousand dollars per bitcoin took place in November 2021. The work will then be described and shown how this development took place. The following chart, Figure 1, shows the development in 2017.
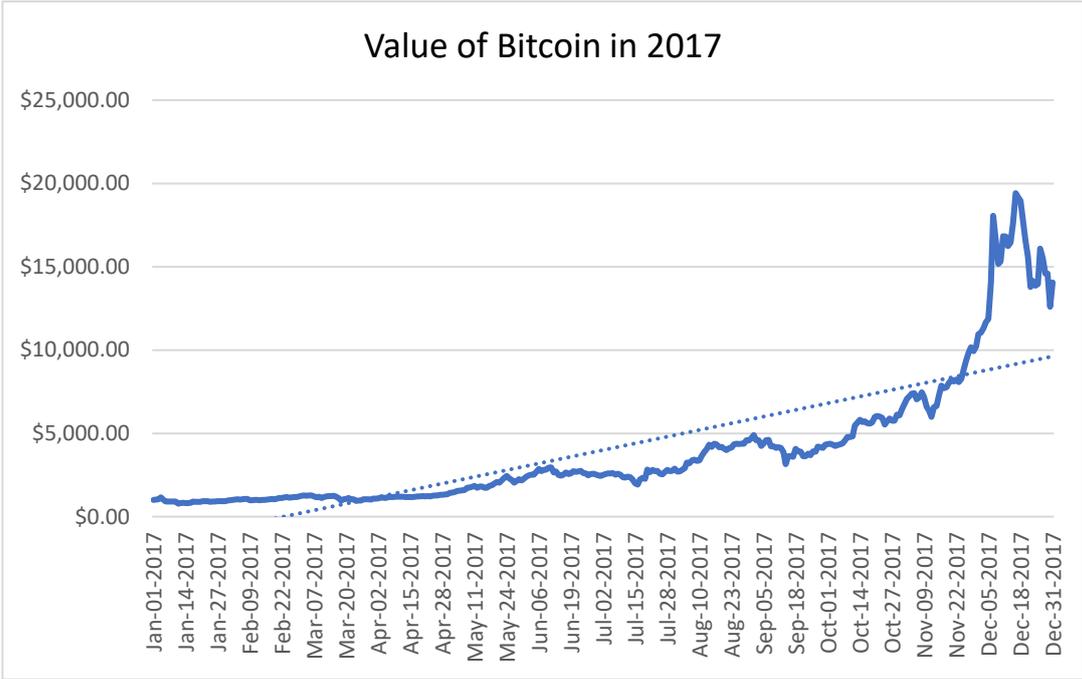
Figure 1. Value of Bitcoin in 2017

The price of Bitcoin as well as other cryptocurrencies is tied to how its price is perceived and what the demand is. If investors believe that the value of Bitcoin is worth a certain value, they will pay, especially if they believe that the value will increase. The value of Bitcoin had a relatively stable growth in 2017 until December, where after a rapid increase, the value began to decline. There is speculation that only a few individuals are responsible for the growth of Bitcoin in 2017, who purposefully and strategically gradually tried to increase the price as much as possible (Dyhrberg et al., 2018; Liu & Tsyvinski, 2021). The increase in 2017 was from $ 998 to $ 14,046. This is a 1,407% increase. The maximum in 2017 was $ 19,417. Figure 2 shows the development in 2018.

Another major factor influencing the price of Bitcoin is the legislative setting of cryptocurrencies in countries with large GDP. This year, several countries have speculated whether cryptocurrencies are beneficial for them, and even the very speculations and statements of, for example, the country's minister or president can have a very significant effect on the price. In 2018, value development had a declining trend, falling from $ 14,000 by $ 10,000 for one Bitcoin to $ 4,000. On January 26, 2018, the largest cryptocurrency site in Japan was hacked. $ 530 million was stolen and Bitcoin had a downward curve this year due
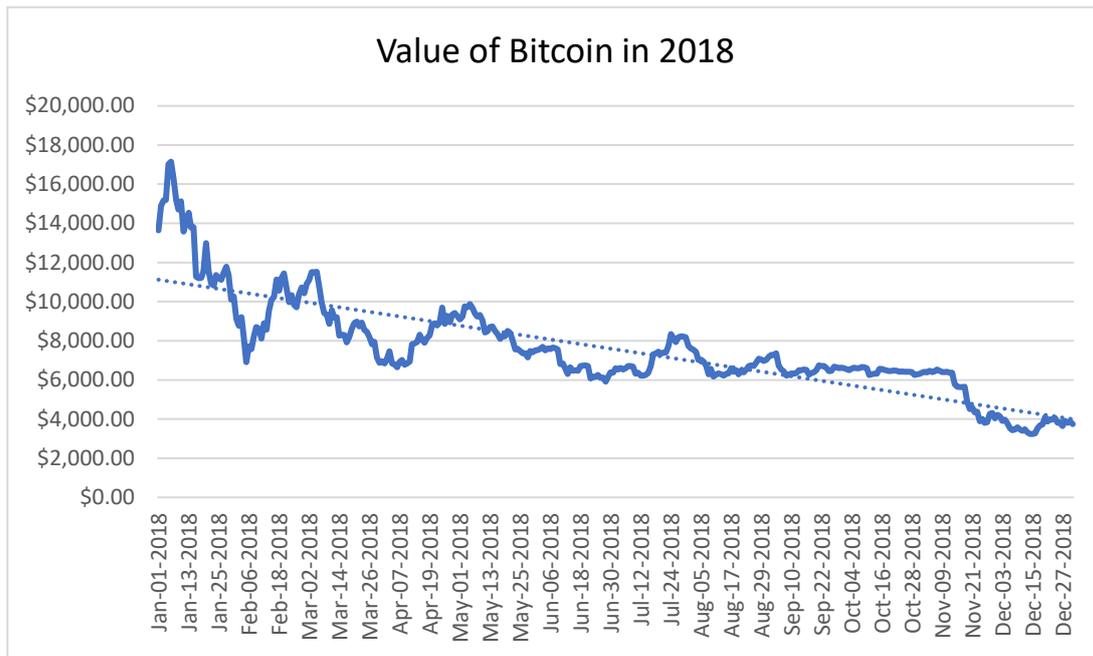
Figure 2. Value of Bitcoin in 2018
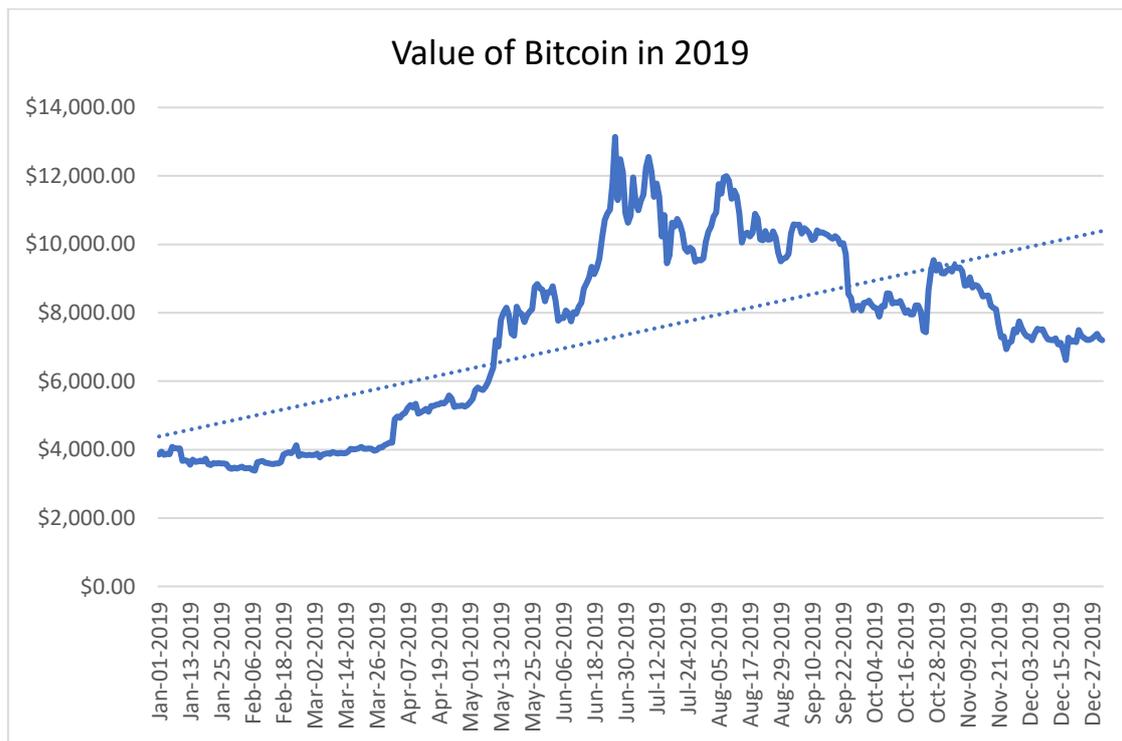
Figure 3. Value of Bitcoin in 2019

to further hacker attacks. This year-round decline has once again raised the doubts and fears of all investors. The decrease in 2018 was from $ 13,644 to $ 3,747. This is a loss of 72.54% of the total value in one year. Figure 3 shows the price development in 2019.

Looking at how Bitcoin was designed, there will be a maximum of 21 million Bitcoins. The closer Bitcoin gets to the limit, the more prices are expected to rise. In 2019, the price increased until the middle of the year, and since then the development has been declining, but the value has almost doubled that year from four thousand dollars to eight thousand

dollars. After a year of depreciation, investors began to regain faith and positive sentiment about the blockchain world, and the total daily traded value increased steadily, and so did the value of Bitcoin. This increase in confidence in Bitcoin could be due to less dramatic price fluctuations over several months and also the announcement by several large investors that Bitcoin could cost up to $ 1 million per Bitcoin in 10 to 20 years. Such huge fluctuations prove a great risk when investing in Bitcoin and an even greater risk when investing in other cryptocurrencies. For this reason, the vast majority of investors advise investing only the amount of money that an individual can afford to lose. The increase in 2019 was from $ 3,852 to $ 7,196. This is a 187% increase. The price development in 2020 is shown in Figure 4.
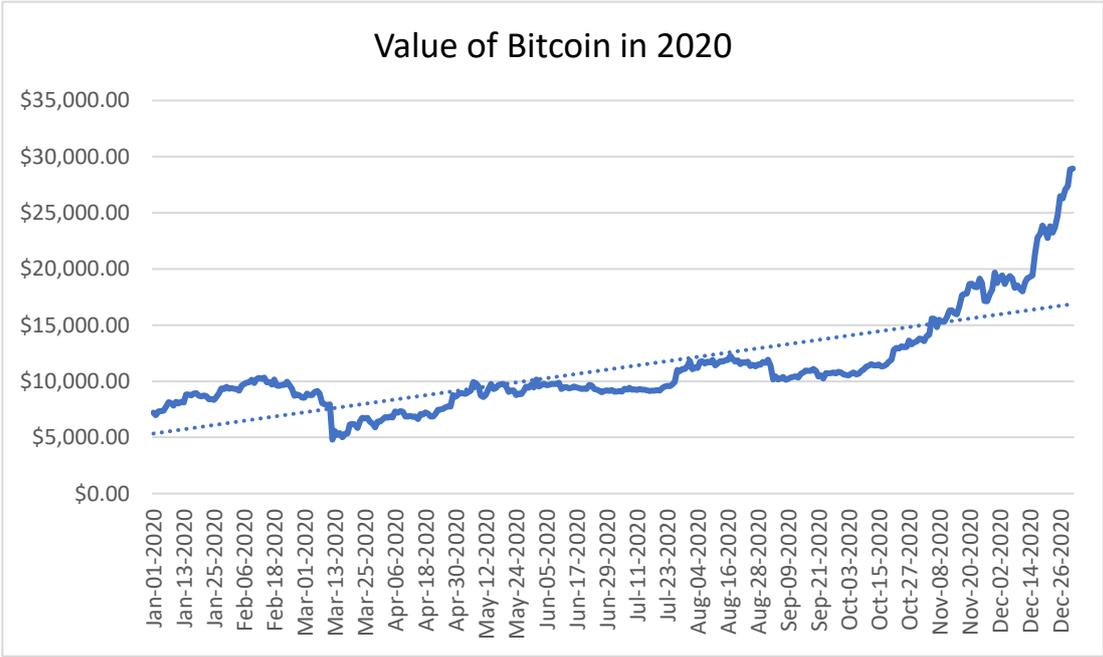
Figure 4. Value of Bitcoin in 2020

In 2020, the world was hit by a covid pandemic. Many funds have been invested to solve this crisis and so the price of cryptocurrencies has stagnated. The price of Bitcoin did not start to rise significantly until November 2020. In 2020, the price of Bitcoin remained stable and by the end of the year the price had risen to almost thirty thousand dollars for one Bitcoin. For this reason, the trend is growing in 2020. The dramatic rise in prices at the end of 2020 may be related to over-savings, as many people still had income during the pandemic, but did not have as many opportunities to buy products and use services, as well as travel restrictions.

The increase in 2020 was from $ 7,214 to $ 28,938. This is a 401% increase. The following is a graph of 2021 (see Figure 5).

The trend curve in this chart (Figure 5) is the most stable of all selected years. Even so, the price for one Bitcoin has a slightly rising curve. The increase in 2021 was from $ 29,329 to $ 46,198. This is a 158% increase. Overall, between 2017 and 2021, Bitcoin increased in price from $ 998 to $ 46,198 and multiplied its value 46.29 times, which is an increase by 4,629%.
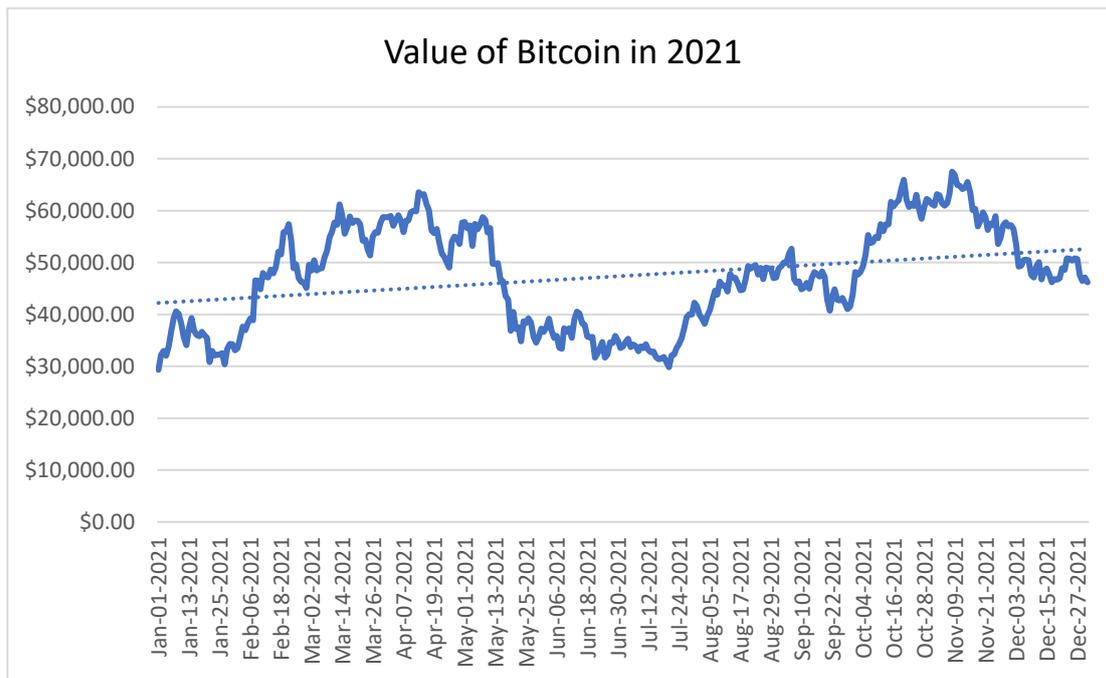
Figure 5. Value of Bitcoin in 2020

Table 1. The development of the Bitcoin price over the last five years by months

Month\Year	2017	2018	2019	2020	2021
January	$998.33	$13,644.69	$3,852.52	$7,214.71	$29,329.70
February	$989.02	$9,118.23	$3,471.27	$9,382.89	$33,536.48
March	$1,222.50	$10,920.66	$3,832.52	$8,549.34	$49,589.98
April	$1,080.50	$6,841.73	$4,200.88	$6,591.47	$58,727.65
May	$1,421.60	$9,084.64	$5,390.89	$8,822.56	$57,794.46
June	$2,407.88	$7,520.81	$8,598.79	$10,167.40	$36,679.41
July	$2,434.55	$6,363.38	$10,635.87	$9,228.08	$33,504.93
August	$2,718.26	$7,600.56	$10,369.53	$11,797.82	$39,918.96
September	$4,892.01	$7,189.71	$9,719.56	$11,924.49	$48,829.97
October	$4,362.54	$6,596.43	$8,299.65	$10,621.71	$48,147.57
November	$6,755.90	$6,368.62	$9,229.52	$13,760.89	$60,939.36
December	$10,957.09	$4,206.22	$7,405.66	$18,756.51	$57,190.98

Table 1 shows that the price for one Bitcoin can vary greatly each month, even by several thousand dollars. Another very commonly used variable in cryptocurrencies is volume and market cap. Volume shows the number of dollars that were traded in a given period. The market cap is then the total amount of money in a given cryptocurrency. For Bitcoin, the volume in 2017 was $ 2,141,854,403 per day and the market cap was $ 66,592,811,613. In 2021, the volume rose to $ 89,267,636,362 per day and the market cap to $ 889,147,945,205.

4. Discussion

For many years, several new cryptocurrencies have sprung up every month, trying to follow the glory of Bitcoin, but Bitcoin is still the main safest cryptocurrency. There are speculations that Bitcoin could be overcome in a few years by other cryptocurrencies such as

Ethereum, Internet Computer, Terra or Solana, but it is extremely difficult to estimate how prices will develop and it depends on a huge number of variables.

How a given cryptocurrency will increase or decrease depends on how currently investors believe or disbelieve the given cryptocurrency market, how big this market is, what the situation is in the world and also what the current momentum is (Li et al., 2021; Liu et al., 2022; Liu & Tsyvinski, 2021). Momentum is a very important variable. When the value goes up and it is a growing momentum, more people get involved and the price rises further and faster. If a large number of people sell their investments, then there is fear, panic and more people are determined to sell their tokens as well (Chaim & Laurini, 2019; Koutmos, 2018).

As a possible research into the future, further analysis of development prediction using time series or neural networks could be performed from this data. However, prediction of price is complex in this regard and depends on many factors, as has already been seen during the covid pandemic, war, crisis, the reaction of famous people on social networks, fluctuations in investor confidence or the level of panic and fear (Shen et al., 2019; Thies & Molnár, 2018).

Looking at the price development over the last 5 years, it is clear that the price can develop very quickly by several thousand dollars per bitcoin in both directions. Among the main factors influencing the price are the legislation of various countries, influencers, the amount of money invested from investors, the global crisis, wars, the confidence of current Bitcoin holders, the integration of cryptocurrency payments in companies and organizations, and even how celebrities comment on cryptocurrencies in public.

The longer Bitcoin operates in society, the more companies will use it for their day-to-day operations, and thus, whether the price of one Bitcoin rises or falls, it will increasingly affect other cryptocurrencies, other investments and thus the global economy.

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Research on the Efficiency Calculation and Influencing Factors of New Urbanization in China

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Abstract: Scientific and systematic evaluation of the efficiency of new urbanization is an important basis to realize the high-quality development of new urbanization. Starting from the connotation of new urbanization, this paper takes population, economic, spatial, social indicators and environmental pollution indicators as expected outputs or unexpected outputs to construct an input-output model and calculates the efficiency of new urbanization in 239 prefecture-level cities in China from 2014 to 2019 by directional distance function (DDF) and Global Malmquist-Luenberger (GML) index. And it examines the main factors influencing the efficiency of new urbanization under environmental constraints by using a two-way fixed effect model. The results show that: with full consideration of environmental constraints, the efficiency of China's new urbanization shows a v-shaped growth trend and regional heterogeneity from 2014 to 2019. Especially, the effect of the national new urbanization strategy is more significant after 2017, which significantly improves the overall efficiency level of cities and towns. Population, FDI and savings level are the most important factors affecting the efficiency of new urbanization.

Keywords: China's urbanization; urbanization efficiency; direction distance function

JEL Classification: R00; R15; R42

1. Introduction

In the past four decades, China's unprecedented rapid urbanization has become an important engine driving economic growth and eliminating rural poverty. However, the long-term rapid urbanization process has also brought with it the aggravation of environmental pollution and the deterioration of urban governance, the expansion of urban-rural inequality, and the lag of population urbanization. The root cause lies in the tendency of blindly pursuing rapid growth in quantity in the past urbanization. The vigorous "city-building movement" and have resulted in a great waste of land and other factor resources, thus dragging down the efficiency and quality of urbanization. Efficiency is the core issue to be solved in the process of Urbanization in China. In 2013, the China Urbanization Conference put forwards the new urbanization strategy of "promoting people's urbanization as the core and improving quality as the guidance", marking that China has entered the new urbanization stage. Compared with traditional urbanization, new urbanization emphasizes the core role of human, highlights the transformation of the development way with high pollution and high energy consumption, pursues green, low-carbon, intelligent and sustainable high-quality development. Therefore, this paper tries to include the core index of human urbanization into the calculation of the new urbanization efficiency, and analyzes the influencing factors of new urbanization efficiency

under the constraints of environmental protection, which represents the requirements of sustainability.

Most of the existing literatures used non-parametric methods to calculate China's urbanization efficiency, especially data Envelopment analysis (DEA) and Malmquist index model (ML). The general conclusion is that China's urbanization efficiency is chronically low and growth is slow (Huang, 2015). A few literatures use stochastic frontier function (SFA) to study regional urbanization efficiency and the influence of various factors under specific applicable conditions (Dai, 2012). The core of DEA model is to use linear programming to project the decision unit (DMU) onto the DEA frontier and judge its validity by comparing its deviation from the optimal frontier. Therefore, the selection of the direction distance function is the key to measure the scientific nature of measurement. To solve this problem, the traditional radial DEA model is widely used in existing literatures (Nie & Jia, 2011), but this model is difficult to solve the measurement error caused by ignoring relaxation variables (Wei, 2014). In a small number of literatures that choose non-radial DEA model, the selected distance function is not suitable for research purposes (Wan, 2015). In our paper, we use DDF and GML index models to measure the efficiency of new urbanization, which can effectively avoid the above problems.

The follows of the paper is: Section 2 introduces the research methods and data description; Section 3 calculates the efficiency of new urbanization; Section 4 analyzes the influencing factors; Section 5 gives the concluding comments and suggestions.

2. Methodology and Data

2.1. Calculation Model

We use DDF-GML model to Calculation of the efficiency of new urbanization. DDF-GML is an important method in the field of efficiency measurement. Among them, DDF is essentially a general expression of the radial DEA model (Chung, 1997). GML index is constructed by Oh (2010). Due to the limitation of the length of the article, the mathematical derivation of the model is shown in the appendix.

2.2. Data Description and Index Selection

Based on the above Calculation model, this paper calculates the new urbanization efficiency of 239 prefecture-level cities in China from four dimensions of population, economy, space and society. The original data of relevant indicators come from "China Urban Statistical Yearbook", "China Urban and Rural Construction Statistical Yearbook", provincial and municipal statistical yearbook, CEIC database and Wind database, and interpolation method is used to supplement some missing data. In Table 1 and Table 2 (see below), there is a detailed description of input-output variable selection and data adoption.

3. Efficiency Measurement Results of China's New Urbanization

According to the above measurement method of directional distance function and GML productivity index, we calculate the new urbanization efficiency of 239 prefecture-level cities

in China. In order to facilitate in-depth analysis of the changes of production frontier boundary of China's new urbanization efficiency and further explore its dynamic evolution trend, we decompose the total factor productivity of new urbanization into two parts: technical efficiency change (EC) and technological progress change (TC) by using the Global Malmquist-Luenberger (GML).

Table 1. Selection of input-output indicators of new urbanization efficiency

Intension	Variable means	Specific calculation method
Input index	Non-agricultural labor	Non-agricultural industrial employees/ten thousand
	Capital investment	Actual fixed assets investment / 100 million yuan
	Land input	Built-up area/km2
	Energy resources	The city's electricity consumption/ten thousand kWh
Expected output	Population Urbanization	(permanent urban population/total resident population)×100
	Economic Urbanization	Actual per capita GDP/ yuan
	Spatial Urbanization	(built-up area/land area of municipal district)×100
	Social Urbanization	(per capita disposable income of urban residents/rural income)
Unexpected output	Waste water pollution	Waste water discharge/ten thousand tons
	Exhaust pollution	Sulfur dioxide emissions/ton
	Smoke (powder) dust pollution	Powder (smoke) dust emissions/ton

Table 2. Descriptive statistics of input-output indicators of new urbanization efficiency

Input-output indicators		Maximum	Minimum	Mean	Standard Deviation
Input index	Non-agricultural labor	420.72	1.38	29.28	43.52
	Capital investment	7,739.60	21.65	1,225.72	1,129.48
	Land input	1,249.00	13.00	116.68	127.93
	Energy resources	8,235,701.43	9,754.00	810,254.20	1,060,220.00
Expected output	Population Urbanization	94.95	21.4	52.60	14.05
	Economic Urbanization	22.89	0.58	4.21	2.74
	Spatial Urbanization	94.85	0.30	9.20	10.46
	Social Urbanization	4.63	0	2.50	0.52
Unexpected output	Waste water pollution	86,804.00	7.00	7,089.42	7,886.88
	Exhaust pollution	496,377.00	2.00	52,933.62	46,797.19
	Smoke (powder) dust pollution	5,168,812.00	34.00	41,151.19	182,881.80

3.1. Efficiency Trend of China's New Urbanization at the National Level

Table 3 shows the dynamic change trend and decomposition results of new urbanization efficiency at the national level from 2014 to 2019. It is not difficult to see that, with full consideration of undesired output, the efficiency of new urbanization at the national level from 2014 to 2019 presents a v-shaped growth trend and significant stage characteristics. On the whole, the annual growth rate of new urbanization efficiency reached 2.88%. In terms of stages, it can be divided into two stages with completely different characteristics and obvious differences in situation.

Table 3. Efficiency and decomposition of China's new urbanization from 2014 to 2019

Year	GML	EC	TC
2014	1.0320	0.9927	1.0593
2015	0.9890	1.0782	0.9317
2016	1.0149	1.0573	0.9660
2017	1.0388	1.0150	1.0405
2018	1.0305	0.9730	1.0746
2019	1.0675	1.0402	1.0441
2014-2016	1.0120	1.0427	0.9857
2017-2019	1.0456	1.0093	1.0531
Overall Average	1.0288	1.0260	1.0194

3.2. Efficiency Differences of China's New Urbanization at City Levels

In order to further analysis due to the individual heterogeneity between different cities new urbanization efficiency difference, we divide cities into different type by population size.

Table 4 shows the efficiency and decomposition results of new urbanization of Different Cities in China from 2014 to 2019. On the whole, the four types of cities in China show a trend of improving the efficiency of new urbanization, with their annual growth rate (from large to small) reaching 1.81%, 3.26%, 4.37% and 1.23% respectively. On the other hand, the efficiency of new urbanization in large cities and medium-sized cities is 2.88%, which is higher than the average level of the whole city, and significantly higher than megacities and small cities. To be specific, the efficiency improvement of big cities mainly comes from technological progress, with an average annual growth rate of 3.94%. The high quality of urbanization in medium-sized cities benefits from the technical efficiency. This shows that the current effect of promoting the new urbanization process in large and medium-sized cities is good. On the other hand, the efficiency of new urbanization in megacities and small cities lags behind the national average. The low efficiency of small cities is mainly rooted in the weak foundation of their own economic development, which is difficult to rely on the improvement of economic level and promote spontaneously, thus resulting in the phenomenon of extensive expansion led by administration. However, megacities are basically regional central cities, and the level of public service facilities at the present stage cannot meet the needs of rapid urbanization development, which leads to a series of "urban diseases", resulting in low urbanization efficiency.

Table 4. New urbanization efficiency and its decomposition by city from 2014-2019

Year	Megalopolis			Big city			Medium city			Small city		
	GML	EC	TC	GML	EC	TC	GML	EC	TC	GML	EC	TC
2014	1.025	0.982	1.044	1.060	0.966	1.133	1.020	0.992	1.046	1.022	1.014	1.018
2015	1.016	1.019	0.999	0.998	1.065	0.951	1.016	1.140	0.909	0.953	1.034	0.932
2016	1.007	1.023	0.985	1.008	1.047	0.972	1.050	1.094	0.967	0.986	1.032	0.959
2017	1.047	0.998	1.050	1.025	0.967	1.080	1.043	1.023	1.044	1.044	1.044	1.006
2018	0.993	0.986	1.007	1.035	0.978	1.076	1.052	0.981	1.093	1.008	0.960	1.061
2019	1.019	1.002	1.017	1.067	1.076	1.023	1.080	1.046	1.047	1.060	1.011	1.059
2014-2016	1.016	1.008	1.009	1.022	1.026	1.019	1.029	1.075	0.974	0.987	1.027	0.970
2017-2019	1.020	0.995	1.025	1.043	1.006	1.060	1.058	1.017	1.061	1.038	1.005	1.042
Total	1.018	1.001	1.017	1.033	1.017	1.039	1.043	1.046	1.018	1.012	1.016	1.006

4. The Influencing Factors of China's New Urbanization Efficiency

4.1. Selection of Influencing Factors of New Urbanization Efficiency

Based on the above new urbanization GML index calculation results, we mainly select the following influencing factors to explore their impact on the efficiency of new urbanization:

(1) Government role. In the process of China's economic development, the government plays a crucial role (Lin, 2002). (2) Industrial structure. The industrial structure reflects the mode of urban economic growth and division of labor between cities. The jobs brought by urban industries are the fundamental driving force of urbanization (Lu, 2011). (3) Demographic factors. Population agglomeration is an important driving force for urban development and realization of scale economy. (4) Degree of opening-up. The ability of a city to attract foreign direct investment not only reflects the level of openness and internationalization of a city, but also represents the attraction of attracting all kinds of talents and capital. (5) Savings level. Urbanization process is an important factor affecting the savings rate of urban and rural residents. Urbanization can bring about the decline of the national savings rate through economic growth and economic structure. (6) Infrastructure level. Infrastructure modernization is an important symbol of urban development, and its allocation level directly affects the capacity of a city to attract foreign capital, population, technology and other factors. Table 5 below shows the specific forms of variables.

Based on the practices of Jin (2016), this paper constructs a two-way fixed effect model using panel data to test the effects of various influencing factors on the efficiency of new urbanization.

$$Y_{it} = \beta_0 + \beta_i X_{it} + \gamma_t + \mu_i + \varepsilon_{it} \tag{1}$$

Y_{it} is the explained variable, and the logarithm value of the cumulative GML index of new urbanization measured above is selected to measure the influence of all influencing factors on the efficiency of new urbanization. Subscripts I and T respectively represent the I city and t year, γ_t represents the time-fixed effect, μ_i represents the individual fixed effect of prefecture-level

cities, and X_{it} is the above influencing factors. Including the role of government, industrial structure, demographic factors, degree of openness, savings level and infrastructure level. In the above model, we focus on the estimated value of the coefficient β_i, which measures the net impact of each influencing factor on the efficiency of new urbanization.

Table 5. New urbanization efficiency and its decomposition by city from 2014-2019

Influence factor	Variables Represent	Specific calculation method
Role of government	Gov	(government expenditure/regional GDP) x 100
Industrial structure	Na-Industry	(Output value of regional secondary and tertiary industries/Regional GDP)×100
Demographic factors	POP	The population density of pop municipal districts is logarithmi
Degree of Openness	FDI	regional actual utilization of foreign direct investment/Regional GDP)×100
Savings level	Save	(total savings of urban and rural residents/Regional GDP)×100
Level of infrastructure	Infra	Per capita paved road area is logarithmic

Table 6. Estimated results of influencing factors of regional new urbanization efficiency by region

Variables	All region	Eastern region	Central region	Western region
	(1)	(2)	(3)	(4)
gov	0.0022	0.0072*	0.0040	-0.0009
	(0.9876)	(1.9609)	(0.4712)	(-0.3339)
Na-industry	-0.000042	0.000469	0.000930	-0.001159
	(-0.0636)	(0.6119)	(0.5471)	(-0.8715)
pop	0.1801***	0.1980***	0.1679***	0.2229***
	(8.4948)	(6.2995)	(5.0571)	(3.7845)
fdi	0.0201***	0.0332***	0.0263	-0.0213
	(2.6787)	(4.2043)	(1.4765)	(-1.1964)
save	-0.0022***	0.0004	-0.0041***	-0.0002
	(-2.9251)	(0.2941)	(-2.7530)	(-0.1810)
infra	0.0112	0.0020	0.0995***	-0.0359
	(0.6937)	(0.0952)	(2.6587)	(-1.2031)
Year FE	YES	YES	YES	YES
Region FE	YES	YES	YES	YES
Observations	1,422	583	413	426
R − squared	0.132	0.283	0.127	0.165

Note: The values in brackets are T-values; *, ** and ** are significant at the significance level of 10%, 5% and 1%, respectively.

4.2. Results of Influencing Factors of New Urbanization Efficiency

Table 6 shows the regression results of influencing factors of regional new urbanization efficiency. Column (1) shows the influence of various factors on the efficiency of new

urbanization in all cities. Columns (2) to (4) show results in the samples of three regions. By observing the characteristics of the influence of various factors on urbanization efficiency, the following conclusions can be drawn:

(1) From a comprehensive perspective, population factors, the level of opening and the level of savings are the most important factors affecting the efficiency of new urbanization. Among them, no matter in the analysis of the whole sample or by region, the population factor plays a huge role in promoting the efficiency of new towns, which is significantly positive at 1%. The degree of opening-up is also an important variable to improve the efficiency of new urbanization, especially in the eastern coastal cities where foreign capital is most widely utilized. Savings level has a negative effect on the city's urbanization efficiency.

(2) The government plays a positive role in the efficiency of new urbanization. The government-led urbanization promotion mode is the fundamental difference between Chinese urbanization and that of European and American countries (Wang & Zhang, 2014). Although the coefficient result of the empirical whole is not significant, it is obviously positive, and in the sample of the eastern region, its coefficient result is significant and higher than the overall coefficient. This shows that, the prefecture-level cities in the east have greater motivation to promote the new urbanization process more effectively by relying on their rich financial resources.

(3) The developed level of urban infrastructure promotes the improvement of urbanization efficiency, and its influence is very significant in the central region. Although industrial structure factors play a significant role in the efficiency of new urbanization in theory, the empirical results are not significant.

Table 7. Estimated results of influencing factors of regional new urbanization efficiency by city

Variables	Megalopolis	Big city	Medium city	Small city
	(1)	(2)	(3)	(4)
gov	0.0185	0.0042	0.0025	0.0028
	(1.0837)	(0.6144)	(0.3458)	(1.1775)
Na-industry	0.000803	-0.000399	0.000135	-0.000603
	(0.4965)	(-0.3937)	(0.1113)	(-0.5528)
pop	0.1279	0.4071***	0.2015***	-0.0649*
	(1.7021)	(14.7220)	(4.6294)	(-1.7124)
fdi	0.0104	0.0234**	0.0431***	0.0069
	(0.7677)	(2.0002)	(2.8035)	(0.5422)
save	-0.0018	-0.0007	-0.0022	-0.0017
	(-0.8894)	(-0.5230)	(-1.4370)	(-1.5318)
infra	0.0538	0.0034	-0.0158	0.0290
	(1.0525)	(0.1004)	(-0.4589)	(1.2251)
Year FE	YES	YES	YES	YES
Region FE	YES	YES	YES	YES
Observations	39	380	494	503
R-squared	0.547	0.463	0.205	0.079

Note: The values in brackets are T-values; *, ** and ** are significant at the significance level of 10%, 5% and 1%, respectively.

Table 7 implies the regression results of influencing factors of urban new urbanization efficiency. Columns (1) to (4) correspond to the effects of influencing factors on new urbanization efficiency under the different samples. The results show that the population factor and the degree of opening to the outside play a significant role in promoting cities of different sizes.

5. Conclusions

This paper estimates the efficiency of new urbanization in 236 China's cities, and analyzes its influencing factors. The results imply that the efficiency of China's new urbanization shows a v-shaped growth trend and significant spatial and regional differences when fully considering the undesired output. Although the efficiency growth rate in the eastern region is not as high as that in other regions, the eastern regional cities can promote the new urbanization process more stably by relying on their strong local financial resources and market resources advantages. And analysis of influencing factors tells us that Population, FDI and savings level are the most important factors affecting the efficiency of new urbanization.These research conclusions will provide a very important empirical evidence for China to better promote new urbanization.

Conflict of interest: none

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Appendix

The Introduction of Directional distance function (DDF) and Global Malmquist-Luenberger index (GML)

1. Directional distance function (DDF)

Directional distance function (DDF) is essentially a generalized expression of radial DEA model. Its advantage lies in that the direction of the projection of the evaluated DMU in the production front can be customized by the researcher, so that the desired industry and undesired output can be effectively treated differently. Therefore, DDF is introduced into the calculation of new urbanization efficiency. We defined $\vec{g} = (\vec{g}_x, \vec{g}_y, \vec{g}_b)$ as the directional vectors of various input and output variables, then the corresponding directional distance function of the t period is in the form of:

$$\vec{D}^t(x^t, y^t, b^t, \vec{g}) = max\{\beta | (x^t - \beta\vec{g}_x, y^t + \beta\vec{g}_y, b^t - \beta\vec{g}_b) \in P(x)\}$$

x^t, y^t, b^t respectively represent factor input vector, expected output vector and unexpected output vector of t period; Is the vector of the inefficient term, and represents the directional distance function value of the maximum expected output and minimum unexpected output in the t period. According to the directional vector $\vec{D}^t(x^t, y^t, b^t, \vec{g})$, we can clearly judge the effectiveness of input-output. $\vec{D}^t(x^t, y^t, b^t, \vec{g}) = 0$ Indicates that the input-output efficiency of DMU has reached the optimal under the given conditions of input factors. At that time, $\vec{D}^t(x^t, y^t, b^t, \vec{g}) > 0$ indicates that the input-output efficiency still has potential room for improvement, and the higher its value is, the lower the efficiency is and the greater the room for improvement is. Therefore, based on the specific direction distance function, we can build a new urbanization efficiency model based on non-expected output and expected output.

2. Global Malmquist- Luenberger index

GML index is constructed by Oh (2010) by combining the Global Malmquist productivity concept and malmquist-Luenberger index method. Its purpose is to solve the defects of DDF-ML index constructed by Chung (1997) in measuring productivity. This paper uses it as an effective method to measure the efficiency of new urbanization. According to the GML index constructed by Oh (2010), the GML productivity index between the t period and the $t + 1$ period is defined as:

$$GML^{t,t+1}(x^t, y^t, b^t, x^{t+1}, y^{t+1}, b^{t+1}) = \frac{1 + D^G(x^t, y^t, b^t)}{1 + D^G(x^{t+1}, y^{t+1}, b^{t+1})}$$

$D^G(x, y, b) = max\{\beta | (y + \beta y, b - \beta b) \in P^G(x)\}$ is the global directional distance function; $P^G(x)$ is the global production possibility set, which is the union of all current production possibility sets; $GML^{t,t+1}$ is the total factor productivity from period t to period $t + 1$, when $GML^{t,t+1} > 0$, it means that the total factor productivity increases; when $GML^{t,t+1} < 0$, it means that the total factor productivity decreases; when $GML^{t,t+1} = 0$, it means that the total factor productivity remains unchanged. Further, similar to ML index, the

index can be divided into two parts: change in technical efficiency (EC) and technological progress (BPC or TC):

$$GML^{t,t+1}(x^t, y^t, b^t, x^{t+1}, y^{t+1}, b^{t+1}) = \frac{1 + D^G(x^t, y^t, b^t)}{1 + D^G(x^{t+1}, y^{t+1}, b^{t+1})}$$

$$= \frac{1 + D^t(x^t, y^t, b^t)}{1 + D^{t+1}(x^{t+1}, y^{t+1}, b^{t+1})} \times \left[\frac{1 + D^G(x^t, y^t, b^t)}{1 + D^G(x^{t+1}, y^{t+1}, b^{t+1})} \times \frac{1 + D^{t+1}(x^{t+1}, y^{t+1}, b^{t+1})}{1 + D^G(x^t, y^t, b^t)} \right]$$

$$= \frac{TE^{t+1}}{TE^t} \times \frac{BPG_{t+1}^{t,t+1}}{BPG_t^{t,t+1}} = EC^{t,t+1} \times BPC^{t,t+1}$$

$EC^{t,t+1}$ represents the change of technical efficiency from the t period to the $t + 1$ period. Its plus and minus respectively represent the improvement and deterioration of technical efficiency. $BPC^{t,t+1}$ is the ratio of the closeness of the frontier in phase t to the global frontier and the closeness of the frontier in phase $t + 1$ to the global frontier, and represents the technological progress in two periods. Its plus and minus signs respectively represent technological progress and regression.

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Comparison of Selected Models for Ranking of Decision Making Units

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Abstract: Data envelopment analysis (DEA) techniques belong to the most often applied models for ranking of decision making units (DMU) or alternatives according to their input and output characteristics. Traditional DEA models assign to the DMUs efficiency scores that allow their ranking – higher scores higher position in the final ranking. The frequently discussed problem is ranking of efficient units because they reach maximum efficiency score. Their number can be quite high depending on the number of DMUs and the number of variables (inputs and outputs) of the model. The aim of the paper is to compare the most important methods for ranking of DMUs. Their application may lead to different rankings. In this case we offer a procedure for aggregation of several different rankings into one final result. The proposed methodology will be illustrated on a numerical example and the results discussed.

Keywords: data envelopment analysis; ranking; efficiency; super-efficiency; aggregation

JEL Classification: C44

1. Introduction

DEA models is a non-parametric method for estimation of the production possibility set (PPS) frontiers, and identification of the DMUs being on the frontier (efficient DMUs) on one hand, and the remaining units (inefficient DMUs) on the other hand. First DEA models were introduced by Charnes et al. (1978), and further developed by many authors in the next decades until the present time. Charnes' et al. (1978) is known in the literature as CCR model. DEA models evaluate the set of DMUs according to their variables (inputs and outputs). Let us consider the set of n DMUs characterized by m inputs and r outputs. The values of the inputs for the DMUs are x_{ij}, $i = 1, …, n$, $j = 1, …, m$. Analogously, y_{ik}, $i = 1, …, n$, $k = 1, …, r$, are the output values. The traditional formulation of the DEA model in its input orientation is as follows:

Minimize:

$$\theta_q^{CCR}$$

subject to:

$$\sum_{i=1}^{n} x_{ij}\lambda_i + s_j^- = \theta_q x_{qj}, j = 1,..., m, \tag{1}$$

$$\sum_{i=1}^{n} y_{ik}\lambda_i - s_k^+ = y_{qk}, \quad k = 1,..., r,$$

$$\lambda_i \geq 0, \ s_j^- \geq 0, \ s_k^+ \geq 0, \quad i = 1,\dots, n, \ j = 1,\dots, m, \ k = 1,\dots, r,$$

s_j^-, $j = 1,\dots, m$, s_k^+, $k = 1,\dots, r$, are slack variables, and DMU$_q$ is the unit under evaluation. Optimal objective function value of model (1) equals to 1 for the units belonging to the PPS frontier, and less than 1 for the inefficient units. Lower values indicate that the unit is further from the frontier. The inefficient units are easily ranked according to their efficiency scores. For the efficient ones a suitable procedure for their discrimination must be applied. There have been proposed many such procedures in the literature in the past. In our study, five procedures based on solving linear programs are considered.

Except the traditional radial DEA models – their typical representative is model (1) – have been proposed models based on measuring the efficiency using slack variables only. Tone's model (Tone, 2001) belongs to the most frequently applied in current research studies. This family of models is denoted as SBM (slacks-based measure) models. Its mathematical formulation follows:

Minimize:

$$\theta_q^{SBM} = \frac{1 - \dfrac{1}{m}\sum_{j=1}^{m}\left(s_j^- / x_{qj}\right)}{1 + \dfrac{1}{r}\sum_{k=1}^{r}\left(s_k^+ / y_{qk}\right)}.$$

subject to

$$\sum_{i=1}^{n} x_{ij}\lambda_i + s_j^- = x_{qj}, \quad j = 1,\dots, m, \tag{2}$$

$$\sum_{i=1}^{n} y_{ik}\lambda_i - s_k^+ = y_{qk}, \quad k = 1,\dots, r,$$

$$\lambda_i \geq 0, \ s_j^- \geq 0, \ s_k^+ \geq 0, \quad i = 1,\dots, n, \ j = 1,\dots, m, \ k = 1,\dots, r,$$

Model (2) returns objective function (efficiency score) equal to 1 for SBM efficient units and it is less than one for the inefficient ones. It is proved that the SBM efficiency score is always less or equal than the CCR efficiency score. Model (2) is not linear, but its linearization can easily be done using Charnes-Cooper transformation.

The paper is organized as follows. Section 2 contains formulation of all DEA models used further in numerical experiments. Section 3 presents the results of all methods on an example published in (Jablonský, 2016) that is often used for such comparisons. The final aggregated ranking is derived using an original optimization procedure. Aggregation of rankings is a frequently discussed problem in current research. One of the last papers in top OR journals about this topic is (Mohammadi & Rezaei, 2020). The paper concludes by discussion of results and future research possibilities.

2. Methodology

Standard DEA models as model (1) and (2) allow (CCR or SBM) ranking of inefficient units according to their efficiency scores. To rank efficient units, because to their maximum efficiency scores, many models based on various principles have been proposed in the past. For comparison purposes we will apply the following ones:

1. Andersen and Petersen's (1993) super-efficiency model – AP model. This model removes the unit under evaluation from the set of DMUs and measures the distance of this unit from the new PPS frontier. Higher distance means that higher increasing inputs or decreasing outputs does not affect the efficient status of the unit, i.e. the unit under evaluation has higher super-efficiency score. The input-oriented formulation of the AP model is the same as model (1). Only difference is in putting the weight of the unit under evaluation equal to zero. As the result, the super-efficiency score of the originally efficient unit is greater than 1.

2. Tone's (2002) super-efficiency model – SSBMT model. It is, as in the previous case, a model from the category of super-efficiency models. The objective function of this model equals to 1 if the unit under evaluation is SBM inefficient, i.e. has SBM efficiency score computed by model (2) less than 1. For SBM efficient units returns a super-efficiency score greater than 1 which allows complete ranking of all DMUs. The non-linear formulation of this model is below:

Minimize:

$$\phi_q^{SBM} = \frac{\dfrac{1}{m}\sum_{j=1}^{m} x_j^* / x_{qj}}{\dfrac{1}{r}\sum_{k=1}^{r} y_k^* / y_{qk}}$$

subject to:

$$\sum_{i=1,i\neq q}^{n} x_{ij}\lambda_i + s_j^- = x_j^*, \quad j = 1,..., m, \tag{3}$$

$$\sum_{i=1,i\neq q}^{n} y_{ik}\lambda_i - s_k^+ = y_k^*, \quad k = 1,..., r,$$

$$x_{qj} \leq x_j^*, \quad j = 1,..., m,$$

$$y_{qk} \leq y_k^*, \quad k = 1,..., r,$$

$$\lambda_i \geq 0, \ s_j^- \geq 0, \ s_k^+ \geq 0, \quad i = 1,…, n, j = 1,..., m, k = 1,..., r,$$

As the SBM model (2), model (3) can be transformed into a linear program easily. Moreover, its input- and output-orientation versions have been proposed in (Tone, 2002).

3. Jablonský (2012) formulated a super-efficiency goal programming model (SBMG model) that can be used for comparison purposes with other ranking models. Its mathematical formulation follows:

Minimize:

$$\varphi_q^G = 1 + tD + (1-t)\left(\sum_{j=1}^{m}\left[s_{j1}^+ / x_{qj}\right] + \sum_{k=1}^{r}\left[s_{k2}^- / y_{qk}\right]\right),$$

subject to:

$$\sum_{i=1,i\neq q}^{n} x_{ij}\lambda_i + s_{j1}^- - s_{j1}^+ = x_{qj}, \quad j = 1,\ldots, m, \tag{4}$$

$$\sum_{i=1,i\neq q}^{n} y_{ik}\lambda_i + s_{k2}^- - s_{k2}^+ = y_{qk}, \quad k = 1,\ldots, r,$$

$$s_{j1}^+ \leq Dx_{qj}, s_{k2}^- \leq Dy_{qk} \quad j = 1,\ldots, m, k = 1,\ldots, r,$$

$$s_{j1}^-, s_{j1}^+, s_{k2}^-, s_{k2}^+ \geq 0, \lambda_i \geq 0, j = 1,\ldots, m, k = 1,\ldots, r, í = 1,\ldots, n,$$

$$t \in \{0, 1\}.)$$

where $s_{j1}^-, s_{j1}^+, s_{k2}^-, s_{k2}^+$ are variables measuring the negative and positive deviations of the virtual unit and the unit under evaluation in input and output space. D is the maximum relative deviation, and t is the parameter that may be set to 0 or 1. The value $t = 0$ ensures minimization of the sum of relative deviations, and $t = 1$ minimizes the maximum deviation. The model is applied on CCR (or SBM) efficient units and returns super/efficiency score greater or equal than 1.

4. An interesting concept that allows complete ranking of the DMUs is measuring the distance of the units from the pessimistic frontier introduced by Wang et. al (2007). Pessimistic frontier is the opposite of the optimistic PPS frontier constructed by CCR model (1).

Maximize:

$$\theta_q^P$$

subject to:

$$\sum_{i=1}^{n} x_{ij}\lambda_i \geq \theta_q x_{qj}, \quad j = 1,\ldots, m, \tag{5}$$

$$\sum_{i=1}^{n} y_{ik}\lambda_i \leq y_{qk}, \quad k = 1,\ldots, r,$$

$$\lambda_i \geq 0, \ s_j^- \geq 0, \ s_k^+ \geq 0, \ i = 1,\ldots, n, j = 1,\ldots, m, k = 1,\ldots, r.$$

The optimal value θ_q^P is greater than 1. Higher values indicate that the unit under evaluation is further from the frontier. Hence higher values of the pessimistic model lead to higher ranking of the DMUs. It is possible to formulate a pessimistic super-efficiency model in a similar way as in the optimistic case. This model allows distinguishing among pessimistic efficient units.

Cross efficiency evaluation is an approach based on completely different principles than super-efficiency models. In this approach the unit under evaluation is evaluated using the optimal weights of the other unit of the set. Let E_{qj} be the efficiency score of the q-th unit using the optimal weights of the j-th unit derived using traditional CCR model. The final result of the evaluation for the q-th unit is the average cross-efficiency score computed as a simple average

$$\varphi_q = \frac{\sum_{j=1}^{n} E_{qj}}{n}, q = 1, \ldots, n. \tag{6}$$

The maximum value of φ_1 scores is 1. Higher values show higher level of efficiency and higher ranking.

3. Results

In this section, the results of all five algorithms are computed with the dataset that contains 19 DMUs and 5 variables (2 inputs and 3 outputs). This dataset originates from the paper (Jablonský, 2016) and due to the limited space is not displayed here. Because the results of all methods are different, the final ranking will be derived using an optimization procedure that minimizes the sum of deviations of the final ranking and all five rankings obtained by the methods mentioned in the previous section.

Table 1 contains efficiency and super-efficiency scores. In the first column, there are CCR efficiency scores (less than 1) computed by model (1), and for CCR efficient units (units 1, 11, and 18) the super-efficiency scores derived by Andersen and Petersen (1993) model (greater than 1). Second column of Table 2 contains the efficiency scores obtained by SBM model (2), and for the SBM (and CCR efficient also) efficient units their super/efficiency scores derived by model (3). The SBMG model (4) is just the model that may be used for CCR efficient units to distinguish among them. That is why, the results in the third column of Table 3 are chosen as a geometric average of CCR and SBM efficiency scores, except for the CCR efficient units. The fourth column presents the scores given by the pessimistic model (5) and by its super-efficiency modification. Higher values in this column indicate that the unit is further from the pessimistic frontier, and it is better evaluated in the final ranking. The last column contains cross-efficiency scores computed by (6).

Table 1. Efficiency and super-efficiency scores

DMUs	CCR/AP	SBM/SSBM	SBMG	PESSIM	CROSS
1	1.389	1.103	1.305	1.031	0.698
2	0.618	0.464	0.535	0.807	0.520
3	0.985	0.850	0.915	1.588	0.858
4	0.977	0.828	0.899	1.293	0.766
5	0.837	0.688	0.759	1.395	0.761
6	0.875	0.620	0.737	1.401	0.754
7	0.657	0.415	0.522	0.979	0.531
8	0.773	0.688	0.729	1.278	0.708
9	0.972	0.777	0.869	1.583	0.857
10	0.853	0.672	0.757	1.254	0.727
11	1.407	1.225	1.521	1.580	0.984
12	0.788	0.642	0.711	1.216	0.701
13	0.674	0.390	0.513	0.882	0.533
14	0.693	0.524	0.603	1.103	0.619
15	0.850	0.721	0.783	1.119	0.685
16	0.932	0.828	0.878	1.393	0.804
17	0.948	0.689	0.808	1.370	0.795
18	1.319	1.168	1.386	1.289	0.926
19	0.833	0.723	0.776	1.190	0.711

Table 2 contains ranking of all units according to the scores in Table 1. Their analysis shows quite high differences in the positions of the DMUs. That is why a simple optimization procedure for aggregation of rankings is proposed. The model that results in final ranking of n units that minimizes the sum of all positive and negative deviations from m particular rankings is formulated as follows:

Minimize:

$$\sum_{i=1}^{m}\sum_{j=1}^{n}(d_{ij}^{-} + d_{ij}^{+})$$

subject to:

$$x_{ij} + d_{ij}^{-} - d_{ij}^{+} = y_{i}, \qquad i=1,...,m, j=1,...,n,$$

$$\sum_{j=1}^{n} z_{ij} = 1, \qquad i=1,...,m,$$

$$\sum_{i=1}^{m} z_{ij} = 1, \qquad j=1,...,n, \qquad (7)$$

$$y_{i} = \sum_{j=1}^{n} j.z_{ij}, \qquad i=1,...,m,$$

$$z_{ij} - binary,$$

where x_{ij}, $i=1,…, n, j=1,…, m$, is the position of the i-th unit in the j-th ranking, y_i, i = 1,…, m, is the final position of the i-th unit, and d_{ij}^{-}, d_{ij}^{+} are deviational variables to be minimized. z_{ij}, $i=1,…, n, j=1,…, m$, are artificial binary variables that allows to ensure the uniqueness of the final ranking. Model (7) can be easily modified to find the solution that minimizes the absolute value of the maximum deviation. Both aggregated rankings (SUM and MAXMIN) are presented in the last two columns of Table 2.

Table 2. Ranking of the DMUs

DMUs	CCR/AP	SBM/SSBM	SBMG	PESSIM	CROSS	SUM	MINMAX
1	2	3	3	16	14	3	9
2	19	17	17	19	19	19	19
3	4	4	4	1	3	4	3
4	5	6	5	8	7	7	6
5	12	11	11	5	8	10	11
6	9	15	13	4	9	9	8
7	18	18	18	17	18	18	18
8	15	12	14	10	12	14	14
9	6	7	7	2	4	5	4
10	10	13	12	11	10	12	10
11	1	1	1	3	1	1	1
12	14	14	15	12	13	15	15
13	17	19	19	18	17	17	17
14	16	16	16	15	16	16	16
15	11	9	9	14	15	13	12
16	8	5	6	6	5	6	5
17	7	10	8	7	6	8	7
18	3	2	2	9	2	2	2
19	13	8	10	13	11	11	13

4. Discussion and Conclusions

The results presented in Table 2 show the expected outcome – the similarity in rankings among the ones obtained by the family of super-efficiency models is very high. On the contrary, cross-efficiency approach produces in some cases significant differences. It is not so surprising because this model is based on completely different principles than the super-efficiency models. Moreover, the results given by this model need not be always unique because of not rarely occurring alternative solutions the differences. Pessimistic frontier model is closer to the CCR results but there is an exception. In our case, it is the first unit of the set. This unit is efficient in the optimistic (CCR) model and pessimistic model as well. It means that this unit is the member of both (optimistic and pessimistic) frontiers. This is the reason why this unit is ranked much worse in the pessimistic model than in the optimistic one.

The model for the aggregation of several different rankings is a tool that can allow to get one final ranking, e.g. if several decision makers express their opinions and try to find a compromise solution. In the case of our example, both aggregated rankings are similar each other except for the first unit where the difference is six positions. It is caused by worse positions of this unit in pessimistic and cross-evaluation models.

The models for aggregation of rankings are both easy to solve even they are discrete optimization models. The numerical experiments confirm that they produce the final ranking for the problems with up to 200 units and up to 10 single rankings in few second using simple discrete solvers. Ranking of the DMUs in DEA models is still a frequently discussed problem. The future research may be concentrated on the ranking of the units in network production systems.

Conflict of interest: none

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COVID-19 and its Influence on Knowledge Conversion within an Organization

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Abstract: This paper focuses on the impact of the COVID-19 pandemic on the knowledge conversion process. To observe the impact, we decided to use a model called SECI, created by Ikujiro Nonaka and Hirotaka Takeuchi. The model is widely recognized and has been used in many pieces of research. The question we ask is whether and how is the knowledge conversion process influenced by the pandemic. Further investigation revealed that the socialisation process (the first phase of the SECI model, where tacit knowledge is being converted and shared to create another tacit knowledge) is the most influenced process of the four processes. The methods used for the research are especially literature review and analysis and synthesis of papers. The results showed that the pandemics do influence the knowledge conversion, especially in terms of shifting the communication and cooperation toward virtual methods. This has a major impact especially on the socialisation process, as it is based on sharing experiences, usually in physical proximity.

Keywords: knowledge conversion; SECI model; tacit knowledge; COVID-19 pandemic

JEL Classification: M150

1. Introduction

Knowledge has been lately considered one of the most important assets for any organization. It is widely recognized as a source of competitive advantage (Zack, 1999; Macey et al., 2011; Cook, 2008). As Nonaka et al. mention, *"knowledge creation is a continuous, self-transcending process through which one transcends the boundary of the old self into a new self by acquiring a new context, a new view of the world, and new knowledge"* (2000, p. 8). The knowledge creation and sharing process enables an organization to manage the ongoing change in its environment. The importance of knowledge management can be observed especially in the area of productivity and work efficiency, but incorrect management of knowledge processes in the organization can have far more serious effects than lower productivity. These effects can manifest themselves in organizations, that deal with human health and lives. Examples might be airlines, medical, military, or fire brigade organizations, where a loss of employee knowledge can result in the loss of human lives (Oliver et al., 2017; Weick & Sutcliffe, 2015).

The subject of KM is very broad. It relates to different domains of research such as organizational theory (Weick, 2006; Nonaka et al., 2014), leadership theory (Manz & Sims, 1991; Rojhe & Syal, 2014), the theory of employee inclusion (Lawler, 1986; Rana, 2015; Konrad, 2006), etc. On the other hand, knowledge can be also seen as "commons" (Hess & Ostrom, 2007), which represents a common shared resource that serves a given group or system and promotes the "common good". In the present paper, we focus on the role of knowledge in

organizational theory. There are several models depicting knowledge managing processes in an organization, such as SECI (Nonaka et al., 2014; Nonaka & Takeuchi, 1995), LIR (Born, 2002), or Information security knowledge sharing integrated model (Safa & Von Solms, 2016).

Previous research has shown, that the SECI model will be the most appropriate for our research. The main reason is that its applicability and usefulness have been verified by various research. Its role is to depict the process of creating and managing knowledge within an organization. The model has been implemented in several studies concerning knowledge creation and management. It was used in small organizations, universities, multiorganizational projects, etc. (Arias Velásquez & Mejía Lara, 2021; Saide & Sheng, 2021). Also, it is both complex in terms of application and simple in terms of understanding the process. If we look a little closer, the model explains a process of creating and managing knowledge within an organization, concretely the process of transforming and sharing explicit and tacit knowledge, utilizing four processes: socialisation, externalisation, combination, and internalisation (Figure 1). Each process represents the transition from one type of knowledge to another or the same, ex. socialisation (tacit-tacit), externalisation (tacit-explicit) etc.
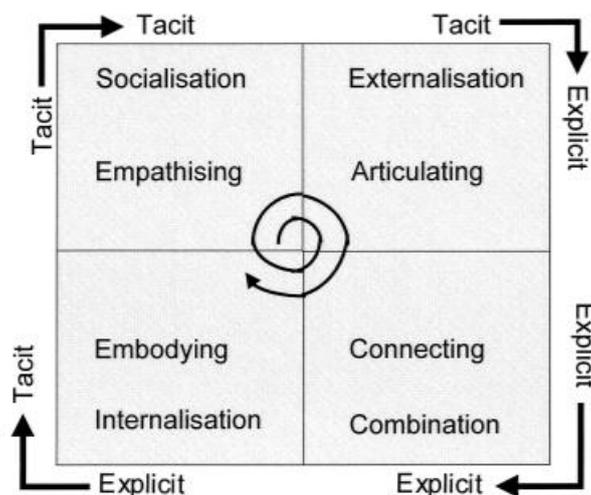
Figure 1. The SECI process (Nonaka et al., 2000)

The whole process of generating and managing knowledge is influenced by many factors, such as technological development, culture (national and organizational), a situation in the society, etc. At present, the situation linked with the COVID-19 virus represents a great challenge for knowledge management as such (Ammirato et al., 2021; Arias Velásquez & Mejía Lara, 2021; Saide & Sheng, 2021). Does it also influence the knowledge conversion process?

Hence the research question is:

Q: *Does the pandemic COVID-19 influence the process of creating and managing knowledge in an organization?*

To address this question, we will use the IMRAD scheme. After this brief introduction of the subject, the methodology of the research will be outlined, subsequently, we will present the research results. In the end, the discussion of the findings, the limits of this approach, and recommendations for future research will be presented.

2. Methodology

The method used for the present research is mainly a literature review approach. The processes used especially study selection, analysis, and synthesis of papers and reporting of the results. The nature of the research is rather exploratory, as we are exploring links between two concepts (knowledge conversion and COVID-19), of which one has emerged recently (Saunders et al., 2015). Therefore, there is quite little known about the nature of the link between them. It might result in finding new relations between concepts, but it might result in reaching the deadlock as well.

The main source of literature was the Web of Science Core Collection database. The algorithms used in the search were:

1. TS=(knowledge AND management AND COVID-19)
2. TS=(SECI model)

In the course of the research two other algorithms were added, due to further investigation:

3. TS=(SECI model AND socialisation)
4. TS=(SECI model AND pandemics)

For the publications concerning COVID-19, the year of publication was automatically 2020 or later (as the influence of the virus became grave and known worldwide in the second half of 2019). For the first algorithm, there were 2,005 relevant publications. Afterward, we restricted the research area to management, business, multidisciplinary sciences, and social sciences interdisciplinary, excluding medical publications in particular. This process resulted in 270 publications. The search with the second algorithm resulted in 152 publications, with restrictions to the field of management only. Entering the third algorithm, the result was 16 publications and the fourth algorithm resulted in only one publication, as the area of research is still new and much narrower than the first subject. The publications found in this process were then manually sorted according to their relevance to the topic. For complementary research, we also used the EBSCO database.

3. Results

In this section, we will outline the base for answering the research question. Previous research has confirmed that the pandemic COVID-19 has a significant effect on knowledge management and vice versa (Ammirato et al., 2021; Kirchner et al., 2021; Arias Velásquez & Mejía Lara, 2021), which means, it could have some impact on knowledge conversion process as well. A concrete example of such an influence can be an improvement of virtual instructions and the digital transformation of the educational process in the research made

by Arias Velásquez and Mejía Lara (2021). Another research, that focused on the educational sector, identified five areas linked with knowledge management, which need to be addressed to maintain knowledge sharing effective, especially under the influence of pandemics (Saide & Sheng, 2021). Deliu (2020) suggests the importance of corporate governance supporting knowledge management governance, especially during a socio-economic crisis such as the COVID-19 pandemic. As we could see, the COVID-19 pandemic has had an impact on knowledge management. The question that follows is, whether specifically the process of knowledge conversion is influenced.

3.1. Knowledge Conversion and the Influence of COVID-19

To enable the analysis of the process of **knowledge conversion**, **the SECI model** will be used. As we mentioned above, the model depicts the process of creating and sharing explicit and tacit knowledge. The term *knowledge conversion* describes an interaction between two types of knowledge. There are four conversion processes: socialisation, externalisation, combination, and internalisation (see Figure 1). (The first letters of their names form the acronym "*SECI*".) The model has been implemented in several studies concerning knowledge creation and management. It was used in small organisations, universities, multiorganisational projects etc. (Arias Velásquez & Mejía Lara, 2021; Saide & Sheng, 2021).

In the process of **socialisation,** tacit knowledge is converted through sharing experiences. As tacit knowledge is not possible to express by data or words, the best tool for its conversion is learning while working together (Dávideková & Hvorecký, 2017; Nonaka et al., 2000). In this process, people empathize with co-workers and others around them, which creates an environment more open to sharing knowledge. In the **externalisation** process, tacit knowledge is converted (articulated) into explicit. It is said that after this process, knowledge is crystalized and becomes the basis for new knowledge. The third conversion process is **combination**, where the explicit knowledge is connected and combined into a more complex system of explicit knowledge. It can be done through computer networks, for example creating databases. In the last process called **internalisation**, the explicit knowledge is embodied into tacit knowledge by individuals. It is often done through action (Nonaka et al., 2000). After the internalisation, the process starts over at another level, continuing in the same scheme.

As mentioned above, the **pandemics of COVID-19** have had several impacts on organizations and their management. As we can observe, some of the most significant influences of COVID-19 are the increasing development and implementation of a virtual version of communication, cooperation, etc. (Arias Velásquez & Mejía Lara, 2021; Saide & Sheng, 2021). As a result of restricting personal contact among employees, there has been an increasing shift towards working from home (Crane & Matten, 2021). This tendency is quite important for our research, as it might have an impact on the way of sharing knowledge. Among other impacts of COVID-19 pandemics the main influence was, according to Crane & Matten (2021), reassessment of the stakeholder view in terms of what groups of stakeholders are essential for the economy to keep going. They mention that the focus on employees may be stronger, as they are the essential group of stakeholders, that keeps on

organization going. If we consider knowledge-based organizations (or knowledge workers), changes in focus on employees may result in development in the knowledge conversion process, as it is one of the most important processes for such organizations. It may also relate to another research made by Rhodes and Fleming (2020) concerning Corporate social responsibility. They explain that besides the company's interest (which is rarely exceeded by an organization), other interests have become important, such as health quality of the stakeholders (employees for example). It is becoming more important to perceive an organization as a part of a system of social governance where political and social responsibility is based on the interests of the whole society.

As we may have observed the knowledge conversion processes concern many activities in an organization. And some of them have been influenced by the pandemic quite significantly. We can remark that the most influenced is the process of socialisation. In the second part of the results section, we will explore the process and how it may be influenced.

3.2. Process of Socialisation and the Influence of COVID-19

As Nonaka et al. mention, *"tacit knowledge is deeply rooted in action, procedures, routines, commitment, ideas, values and emotions"* (2000, p. 7). As this type of knowledge is quite difficult to communicate, it requires a special way of sharing. That is why the **socialisation process** takes place while sharing and developing tacit knowledge. It might even require a kind of "simultaneous processing" (Nonaka et al., 2000).

Another specificity of the socialisation process is that it requires more personal contact than the other processes. As Nonaka et al. highlight, *"Since tacit knowledge is difficult to formalize and often time- and space-specific, **tacit knowledge can be acquired only through shared experience**, such as **spending time together or living in the same environment**. Socialisation typically occurs in a traditional apprenticeship, where apprentices learn the tacit knowledge needed in their craft through **hands-on experience**, rather than from written manuals or textbooks."* (2000, p. 9).

If we look at sharing data between computers, it has to be explicit data, as they are codifiable. On the other hand, as Dávideková and Hvorecký (2017) suggests, *"tacit knowledge is primarily transferred by non-ICT methods"* (2017, p. 105). Although some ICT methods, that can transmit human-oriented features, might still play a role in the socialisation process. Especially video and phone meetings or records that can transmit intonation and facial expressions and e-mails that transmit the writing style.

4. Discussion

We explored the influence of the COVID-19 pandemic on the knowledge conversion process in organizations using the SECI model. As we could see in the result section, the SECI model is comprised of four knowledge conversion processes. These processes are used in most organizations, like sharing, and developing knowledge is basic for evolving and proceeding in business activities. They comprise both personal and virtual communication. Given the COVID-19 situation, the proportion of virtual communication has grown at the expense of personal contact (Arias Velásquez & Mejía Lara, 2021; Crane & Matten, 2021). The answer to the research question is therefore positive. The process of knowledge conversion

described by the SECI model is influenced by COVID-19 and has moved more into the virtual sphere. It also seems that the effect might be different for the four conversion processes. To deepen the understanding of the problem, we explored the process of socialisation and the influence of the pandemics on it. It is because the results have shown, that the socialisation process mostly requires personal contact as its main tool is sharing experience (Dávideková & Hvorecký, 2017; Nonaka et al., 2000). Based on this information, it seems it is influenced the most – out of all four processes.

The pandemic influences the socialisation process, as the process is based on sharing experiences in person. The best way to share tacit knowledge is by sharing the same environment and spending time together (Nonaka et al., 2000). And the effect of the pandemic has been rather a reduction in "spending time together and sharing the same environment". The number of people working from home has been gradually increasing. But as Dávideková and Hvorecký (2017) mention the primary method of sharing tacit knowledge is by non-ICT methods. The socialisation process might be strongly influenced by the COVID-19 pandemic, as in many organizations, employees spend much more time in-home office, therefore they spend less time together and have fewer opportunities to share experiences in person. This supports the claim, that knowledge conversion can be influenced by pandemics.

Some may ask whether personal contact is really necessary for the socialisation process. For example, Dávideková and Hvorecký (2017) mention, that e-mails and video calls, and conferences can transfer some human-oriented features. Which may to some extent replace personal contact. The problem is, that only some aspects are transferable – like facial expressions, voice intonation, etc. But it definitely cannot be fully replaced. Besides personal communication, Nonaka et al. (2000) also mention sharing the same environment or living together, which virtual communication and video conferences cannot substitute.

Another question we may ask is whether the influence of pandemics in terms of working from home is so important. It seems to be almost over and even though some employers are keeping their employees in the home office, the situation does not require it anymore. So, do we have to worry about it, when the situation is slowly getting back on the old track? The truth is, that even if it might get partially back, there may be other similar problems, which would restrict personal contact. It might be the same, another pandemic, or something completely different such as weather conditions. Either way, it's always better to be prepared. We need to understand the causes and consequences and be ready to handle them. Another argument for dealing with this question is that we were not prepared for such a situation and it had quite a strong impact on the whole society. Also, working from home has many benefits for both employers and employees, so even after the pandemic will be over, some of the "home office" effects will remain.

We found out that while using virtual communication methods, there are some restrictions to personal contact and sharing an environment. So, the question arises, what we can do about it, and to what extent does it mean a problem. As we mentioned above, working from home is more and more common. Therefore, some reduction of hours spent together will happen anyway. But the number of hours spent together does not mean good quality

sharing knowledge. This means that maybe less time but more effectively spent may be valid for the socialisation process. If an organization creates an effective infrastructure for sharing tacit knowledge, it can work even better than before. The question is, what kind of infrastructure would it be and how would it function. This might be a subject of another research.

The limits of this paper are given partly by its theoretical nature and partly by time options and conditions for articles. For example, it has been time-bound for a few months, therefore the complexity of the study and the possibility of more profound empirical research was limited.

On the other hand, it could help us to understand the problem better if we made empirical research in an organization that had a significant increase of home office workers and a shift towards virtual communication. There we could observe changes in the process of knowledge conversion. Another **recommendation for future research** would be to study the knowledge spiral functioning under the influence of pandemics. Knowledge spiral is another concept created by Nonaka et al. (2000) that is comprised of the SECI model and two other knowledge creation models. Such research could bring us a more complex picture of the influence of pandemic and other incidents of this sort.

5. Conclusions

This paper aimed to find out, whether and how the COVID-19 pandemic influences the process of knowledge conversion in an organization. With the help of the SECI model (which describes the knowledge conversion between explicit and tacit knowledge), we found out, that the pandemic does influence the process described by the SECI model. The process, that is influenced the most, is the conversion between tacit and tacit knowledge (socialisation). The main influence comes from the shift towards virtual communication and working from home. As the socialisation process requires personal communication and sharing activities and the environment, the pandemic might reduce the quality of the process, which might disrupt the whole process of knowledge conversion. On the other hand, if the amount of time spent together decreases, but is not removed completely, it is possible, that the quality of the socialization process is maintained. In this process, it is not the quantity of time that matters, but the quality and manner of time spent. A proposal for a topic for further research may be just how to maintain the quality of the socialization process when the opportunity of meeting and sharing the same environment decreases.

Conflict of interest: none

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Environmental and Business Measurement for Sustainable Development: Emissions and Enterprises' Sales Linkages among Slovak Industrial Enterprises

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Abstract: Like in many post-communist countries, the economic activity of Slovak industrial enterprises causes harmful environmental effects. One of the ecological commitments for Slovakia under the EU Effort Sharing Regulations is to avoid increasing emissions. This engagement requires new, innovative technological processes and the consideration of sustainable principles. No more is enough to look "green" on the outside, but above all important to act. The main idea of our article is to offer an appropriate indicator for enterprise's management that enables them to implement relevant environmental measures. The article reveals the nexuses between the values of sulphur dioxide emissions of 75 industrial enterprises in different regions of Slovakia and their obtained revenues during 2014-2019. The conducted study and its results will be valuable managers guidance on recording and assessing the degree of sustainable development. Furthermore, based on the economic-environmental ratio indicator created by us, we can derive a myriad of similar indicators characteristic of individual industrial enterprises. Therefore, it enables management to make relevant decisions and act sustainably, as post-communist countries as members of the EU declared in their environmental policies.

1. Introduction

The unlimited human needs are a severe problem according to the limited resources. This fact represents a particular economic paradigm and is, at the same time, a driving force in progress towards the efficient use of factors of production. Despite the development of science and technology, which generate new innovative processes, various negative externalities arise. The consequences of these activities are accompanied on the one hand by economic production and the satisfaction of predominantly material needs, on the other hand by massive pollution (air, water, soil, etc.) with unavoidable consequences that threaten meeting the needs of future generations. It is evident that the cultural distinction significantly affects the enterprise's management and is closely related to the history and customs in the region. The rapid expansion of industrial production in the second half and at the end of the 20th century significantly affected the Slovak and other post-communist countries' national and business results. Subsequently, the environmental damage forced these countries as new EU' members

to deal with it and, through environmental policy, create a direction toward sustainable production. For 2030, according to the current legislation, EU Effort Sharing Decision Slovakia's national target will be to reduce emissions by 12% compared to 2005 levels determined by Regulation (EU) 2018/842.

The article has three main parts. First, the literature review explains Slovakia´s road to sustainability and the related direction of its environmental policy. Then we are following with the methodological and analytical part. Then, with the implementation of the usage of statistical analyses, we describe our findings of the relationship between produced emissions of sulphur dioxide and revenues from related industrial enterprises in Slovakia. Finally, our results are completed by creating our new suggested economic-environmental ratio indicator.

1.1. Literature Review – Sustainable Development and Its Historical Background

The initial impetus that led to sustainable development activities was the publication of Silent Spring by American biologist Rachel Carson (Moldan, 2003). This publication has been critical of the threat of toxic chemicals, which negatively impact human health and constitute a significant threat to the environment. Subsequently, the United Nations (UN), as the leading player in the effort to avert the ecological crisis, began to address the issue of the environment. In 1972, ten years after the book Silent Spring, the first official conference, called the Stockholm Coup, launched a global effort to combat environmental pollution. The United Nations Environment Program (UNEP) was established as part of the Stockholm Conference and followed by initiatives of UNEP, the International Union for Conservation of Nature (IUCN) and the World Wide Fund for Nature (WWF), the World Conservation Strategy (WCS) in 1980. This strategy refers to "development that can be considered sustainable", especially when we consider improving people's quality of life and protecting the world's environment". UNEP (1980) recognizes that in this context, it is necessary to maintain "the management of the use of the biosphere by man so that it can provide its potential for the satisfaction of future generations." (UNEP, 1980). A few years later, in 1987, the UN Commission established the World Commission on Environment and Development (WCED). This WCED in the Brundtland Report ("Our Common Future") characterized the term "sustainable development", which thus gained general acceptance among states. The definition of sustainable development was as follows: "as development that meets people's needs without restricting future generations in meeting their needs." (WCED, 1987) Reconciling economic development while maintaining social and environmental balance has become a general priority. In 1992, at the United Nations Conference on Environment and Development - UNCED in Rio de Janeiro, 4 key documents were adopted, which were the starting point for developing sustainable development strategies. These documents included the Rio Declaration (containing 27 principles), the Convention on Biological Diversity, the Framework Convention on Climate Change and AGENDA 21.

The need to address these current global challenges associated with economic activity poses a significant threat to the economy's future and threatens life on Earth, with more and more countries in the world realizing it (Pham et al., 2021; Wilhite et al., 2014). Therefore, the UN issued recommendations to all Member States to develop national strategies based on these

documents. For this reason, the UN General Assembly created the Commission for Sustainable Development - CSD, which included 53 member states of the world. The commission's main task was to support the implementation of UNCED documents and its subsequent monitoring at the regional, national and global levels. In 2002, the World Summit on Sustainable Development in Johannesburg evaluated the ten-year development of the implementation of AGENDA 21. (Ministry of the Environment of the Slovak Republic, 2001). To this day, the UN has been predetermining initiatives and standards into EU policy and being part of national legislation, being the primary concern of consumers, and reflected in various voluntary activities (Krause, 2019).

The priority of incentives and standards is to focus on the rational and efficient use of resources, the protection of climate change and the safeguarding of the diversity of nature. These activities significantly impact the current state of the environment, man's existence, and biodiversity. The professional public and organizations respond to this by creating a set of standards, tools, measures, or strategies to eliminate the problems that have arisen and prevent further growth into the future. Achieving sustainable development is a crucial priority in addressing social and environmental issues. (Linnenluecke et al., 2017). Today, sustainable development is an important area of development for world society. Integration groups are also aware of this fact, which introduce elements of sustainable development into practical life. One of the significant integration groups that deal with sustainable development is the European Union. It represents an increased initiative in addressing sustainability issues, particularly since the Council of Europe Summit in Cardiff in 1998. The main reason for the summit was climate change, the expansion of limited resources, dynamic population growth, environmental pollution, and others. The dominant areas for addressing these issues include industry, transport, energy and agriculture. In 2015, UN member states approved the AGENDA 2030 program for sustainable development at the United Nations Sustainable Development Summit.

1.2. Forming Environmental Policy

The general goal of every enterprise on the market existence, also in post-communist countries, has always been and still is - to maximize its profits. Every enterprise wants to be better than its competitor, get long-term development and business growth (Malichova & Durisova, 2015; Potkany et al., 2009), and it is a natural force in the market and an effort to control it. So, in recent years external, and internal influences have forced the enterprise's management to pay attention to the environmental impacts of economic activity. As a result, there is pressure on enterprises that must implement sustainable principles in the production process. However, the involvement and implementation of sustainability elements vary between countries on Earth. It is evident that transforming post-communist countries need to make good use of their market potential following the principles of sustainable development (Scrieciu & Stringer, 2008). However, realizing the appropriate use of the possibility of the enterprise in the former post-communist country was not easy. Once centrally planned economic systems fell under the responsibility and ownership of the government, with regulated trade flows and factor prices being strictly controlled and monitored (Demekas &

Khan, 1991). However, state control over the market varied in communist countries. In Czechoslovakia, Poland and Hungary, progressive, alternative, and organized structures to communism emerged (Sowards, 1996). During this period, there was a high decline in the quality of the environment. The reason was the rapid growth of industrial enterprises. The number of industrial enterprises has increased in engineering, metalworking, and the chemical industry. However, a stronger emphasis on industrial development in post-communist states has also brought shadowy effects in environmental pollution, which has not received much attention (Haggard & Kaufman, 2008). The reason was the adoption of the Marxist ideology on natural resources, which stated that the environment has no intrinsic value but should primarily serve humanity and human needs (Mazurski, 1991). Despite this fact, the industry's boom took on incredible proportions. Today, it is challenging and strenuous for post-communist countries to get out of the shadow of the communist past. In most countries, democratic regimes consolidated. Several years of efforts by these countries to transform and get economic, social, and cultural power are in process (Butek & Klieštik, 2017).

The changes made in post-communist countries focused primarily on the elementary parts and reorganization (Vilinovič, 2011). We encounter the challenges of transforming global requirements into local measures related to the change processes in enterprises (Sákal & Fidlerová, 2012). In this case, we are talking about industry and production, which significantly impact the biosphere due to the emissions produced. Examining the impacts of an enterprise's activity is, therefore, one of the fundamental pillars for achieving sustainable development in interactions with the environment, as confirmed by international studies by the authors (Epstein & Roy, 2001; Schaltegger & Burrit, 2010; Johnson & Schaltegger, 2015; Govindan et al., 2016). According to Mirchi et al. (2012) and Turner et al. (2016), creating a holistic framework for better grasping and managing uncertainty is necessary, especially in the enterprise's environment. The creation of such a complex apparatus brings with it many complications. From a methodological point of view, the economic, social, and environmental aspects need to be considered when developing and implementing sustainable policies (Tsai et al., 2020). The production process and managerial decision process about investments are influenced by appropriate economic policy, in the case of environmental innovation by environmental policy. (Malichova et al., 2016, Durisova et al., 2020)

1.3. Environmental Policy of the Slovak Republic from 1993

As social and environmental balance became a priority in 1992 and the Slovak Republic was established in 1993, the new government approved the Strategy – principles and priorities of the State Environmental Policy, which has not been updated since 2020. Upon acceding to the EU in 2004, Slovakia made a considerable investment in aligning its environmental regulatory framework with its new obligations as an EU member. There has been a significant evolution in the mix of environmental policy instruments, including regulatory, economic and information-based measures (OECD, 2011). Even though efforts based on international benchmarking indicators lag the comparable industrialized countries in air quality and waste management, a document entitled Strategy of Environmental Policy of the Slovak Republic until 2030 (referred to as Envirostrategy 2030) was prepared. The predecessors of this document

were several vital strategies based on UN AGENDA 2030, such as the National Strategy for Sustainable Development of the Slovak Republic, National Reform Program 2016, Stability program of the Slovak Republic for the years 2016-2019 and the like. In total, more than 42 concepts, national and operational programs have been created with a focus on national SDG priorities, which include SDGs 3, 6, 7, 8, 9, 10, 11, 12, 13 and 15 with an environmental dimension. The main goal of Envirostrategy 2030 is to determine the strategic direction of what public decisions are expected to be made, which would significantly contribute to the sustainable approach of the country.

2. Methodology

Enterprises in post-communist countries are gradually moving towards changes towards sustainable production. Relation between the economic and environmental impacts that result from the production of enterprises are essential. Therefore, a description of the continuity of environmental-economic quantities and examine which quantities are suitable for this analysis. Following the studies about the damaging effects of air pollution and its impacts on human health, ecosystems, and biodiversity (Schraufnagel et al., 2019; WB, 2019; WB & IEP, 2021), we focused our research on the impact of the emission of sulphur dioxide (SO_2), because it is a significant contributor to air pollution. The negative externality of SO_2, health impact derives mainly from direct exposure to SO_2. The most significant source of SO_2 in the atmosphere as burning fossil fuels in power plants and other industrial facilities. Other sources of SO_2 emissions include industrial processes such as extracting metal from natural sources such as volcanoes, locomotives, ships and other vehicles and heavy equipment that burn fuel with high sulphur content. In Slovakia, the SO_2 emissions were shown in 2000-2010 a downward trend, mainly due to a change in fuel use.

In the practical part of this article, we analysed the relationship between the produced emissions of Sulphur dioxide (SO_2) and revenues from the sale of goods and services of related industrial enterprises in Slovakia. Not all industrial enterprises in Slovakia are obliged to record and report produced emissions. However, sulphur dioxide emissions are among the five primary pollutants from enterprises that the Slovak Hydrometeorological Institute recorded. Currently, 77 enterprises in Slovakia are obliged to record the produced emissions of sulphur dioxide. In this analysis, we deal with data from 75 enterprises due to the incomplete data from two enterprises. Therefore, the number of industrial enterprises in this study is 75, and the appropriate data were collected from 2014-2019.

We used a parametric statistical method of analysis of variance, ANOVA. In the ANOVA, we focused on regression, which examines the relationship of dependence between two or more variables.

3. Results

Our research started with setting the following hypotheses, which were statistically verified, and we provide the results in this section.

- *H1: The values of sulphur dioxide emissions in selected industrial enterprises are constant in recorded years so there is a reported change in the revenues of selected industrial enterprises.*
- *H2: Sulphur dioxide emission values do not change in the regions of Slovakia.*
- *H3: Acquired revenues values of selected industrial enterprises in Slovakia statistically report a nexus on the production of sulphur dioxide emissions.*
- *Hypothesis H4: The statistical model is not statistically significant.*

The paper deals with data on SO2 emissions produced in individual years and regions. Table 1 shows the population and area of each region of the Slovak Republic.

The established hypotheses were verified based on one-way analysis of variance (ANOVA). The significance level was set at 0.05 in both cases.

Based on the significance, which has a value greater than the specified level of significance, we accept hypothesis H1, which means that sulphur dioxide emissions are constant in each recorded year (Table 2). This fact is quite serious.

In the case of H2 hypothesis verification, the significance value was lower than the significance level (Table 3), which means we reject the hypothesis, and its alternative form applies. The conclusion is that the values of sulphur dioxide emissions are different in the regions of Slovakia.

Table 1. Characteristics of the regions of the Slovak Republic (Statistical Office of the European Communities, 2019)

Region	Population	Area (km²)
Banskobystrický	647,874	9,454
Bratislavský	659,598	2,053
Košický	800,414	6,753
Nitriansky	676,672	870.7
Prešovský	825,022	8,993
Trenčiansky	585,882	4,502
Trnavský	563,591	4,145
Žilinský	697,502	6,808.8

Table 2. ANOVA Data analysis of sulphur dioxide during recorded years

SUMMARY				
Groups	Count	Sum	Average	Variance
2019	8	3,811,990.7	476,498.8	3.33518E+11
2018	8	3,401,028.3	425,128.5	2.66188E+11
2017	8	2,999,612.1	374,951.5	2.01193E+11
2016	8	2,749,018.9	343,627.4	2.40369E+11
2015	8	1,287,811.1	160,976.4	12787772523
2014	8	1,194,479.4	149,309.9	18508069974

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	7.48217E+11	5	1.49643E+11	0.84	0.53	2.44
Within Groups	7.50794E+12	42	1.78761E+11			
Total	8.25616E+12	47				

Table 3. ANOVA Data analysis of sulphur dioxide in the regions of the Slovak Republic during the recorded years

SUMMARY				
Regions	Count	Sum	Average	Variance
Banskobystrický	6	123,962.4	206,615.4	1,965,019,749
Bratislavský	6	6,874,653.2	1,145,775.5	4.84241E+11
Košický	6	2,594,276.8	432,379.5	6,909,661,990
Nitriansky	6	609,007.0	101,501.2	309,677,246.4
Prešovský	6	1,427,493.6	237,915.6	33,539,799,239
Trenčiansky	6	395,158.2	65,859.7	601,645,070.1
Trnavský	6	239,167.2	39,861.2	231,928,113.7
Žilinský	6	2,064,492.0	344,082.0	36,843,999,326

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	5.43294E+12	7	7.76135E+11	11	1.18442E-07	2.25
Within Groups	2.82322E+12	40	70580387247			
Total	8.25616E+12	47				

This alternative hypothesis points out that the production of sulphur dioxide emissions varies between regions, so in Slovakia, we have different environmental qualities in different regions in terms of sulphur dioxide emission. In regions with high production values of these emissions, there can be a significant negative impact on human health. High levels of oxide emissions in the air cause people diseases, especially the respiratory tract, cardiovascular diseases, headaches, and depression (Mináriková, 2001).

In the next part of the analysis, we determined the dependence of selected variables using regression and correlation analysis. First, a regression model is determined, the statistical significance of which will be determined at the level of 0.05 using an F-test.
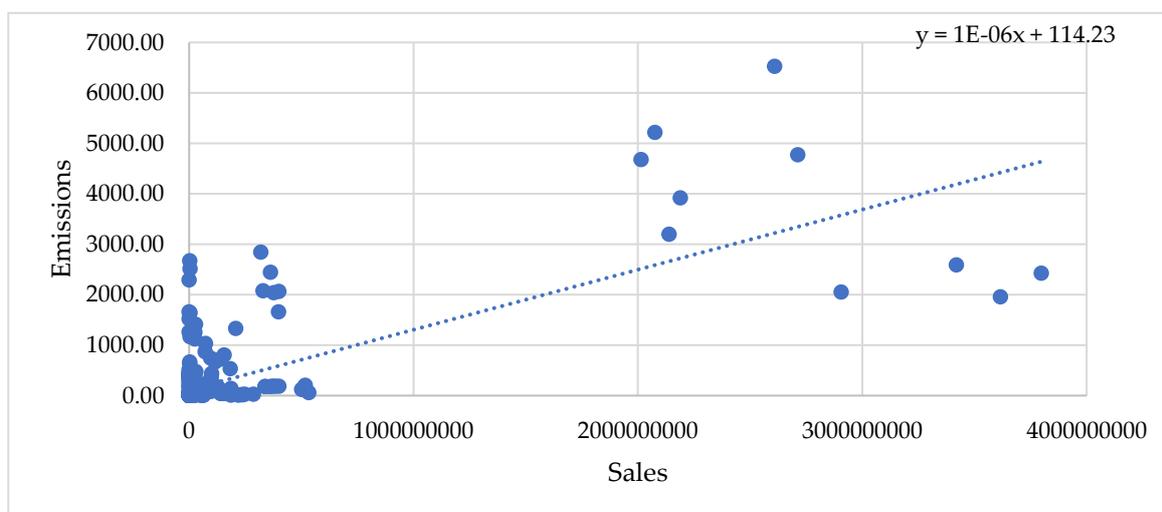
Figure 1. Dependence of sales and emissions of sulphur dioxide

The graph of the dependence of sales and emissions of sulphur dioxide shows a direct linear dependence. In Figure 1, we can notice that two primary areas are being created. The

first area, the cluster is enterprises in the regions, which together generate low sales of up to 1,000,000,000 euros and produce low emissions of sulphur dioxide up to 3,000 tons. The second cluster is enterprises, which together generate high sales of 200 billion euros. A gap is emerging between these two significant clusters, which arises because in Slovakia, we have a minimum number of large industrial enterprises and many small industrial enterprises that report produced sulphur dioxide emissions.

Table 4. Output of the regression between the produced emissions and revenues of enterprises

SUMMARY OUTPUT					
Regression Statistics					
Multiple R	0.72				
R Square	0.52				
Adjusted R Square	0.52				
Standard Error	290,276,297.7				
Observations	449				
ANOVA					
	df	*SS*	*MS*	*F*	*Sig. F*
Regression	1	4.156E+19	4.156E+19	493.23	3.48E-74
Residual	447	3.76644E+19	8.42603E+16		
Total	448	7.92244E+19			
	Coefficients	*Standard Error*	*t Stat*	*P-value*	
Intercept	-6510803.4	14,401,032	-0.45	0.65	
Emission	440,457.9	19,832.5	22.2	3.478E-74	

The resulting dependence has a value of 72.43%, which means a strong dependence between variables. The correlation coefficient acquires a value of 52.46%, which means high tightness, resp. high probability that phenomenon B is caused by phenomenon A. Based on this analysis, we can state the truth of the established hypothesis H3, confirming the hypothesis. The acquired values of revenues of industrial enterprises in Slovakia are highly dependent on sulphur dioxide emissions.

The regression function has the form: (f): y = 440,457.88x -6,510,803.38.

3.1. Creation of the Indicator ERIsox, - a Tool for Better Managerial Decision Making

A high dependence was found in analysing the relationship between the values of produced sulphur dioxide and obtained sales of industrial enterprises. For this reason, we move on to the second part of the article, which is the creation of the ERIsox (Environmental Ratio Indicator of sulfur dioxide), which has the form:

$$ERI_{SOX} = \frac{turnover\ of\ the\ enterprise\ during\ the\ period\ (per\ year)}{missions\ of\ sulfur\ oxides\ (in\ tonnes\ per\ year)} * 1\ 000\ 000 \quad (1)$$

and presupposes practical use by managers in enterprise.

We used this ratio indicator to analyse the production of sulphur dioxides and the obtained revenues of enterprises in the Slovak Republic. The following Table 5 shows the values of the ERIsox ratio indicator in the period 2014-2019 in individual regions of the country.

Region	2014	2015	2016	2017	2018	2019
Banskobystrický	1.85	2.41	1.37	1.87	2.42	2.47
Bratislavský	2.34	2.98	14.95	14.06	16.20	18.22
Košický	4.32	3.37	4.15	3.78	4.51	5.80
Nitriansky	1.34	0.91	0.89	0.89	0.99	1.09
Prešovský	0.62	0.79	0.71	4.10	3.98	4.07
Trenčiansky	0.50	0.86	0.66	0.45	0.45	1.04
Trnavský	0.10	0.45	0.50	0.38	0.46	0.50
Žilinský	0.87	1.11	4.27	4.47	5.00	4.93
Average	1.49	1.61	3.44	3.75	4.25	4.76

The only region that shows significant differences is Bratislava, whose indicator's value has an annual upward trend. The values of the ratio indicator in other regions of Slovakia have a long-term constant character. After excluding the Bratislava region from the sample, the average achieved value of the ratio indicator in Slovakia is 2.04.

Table 6. The average values of the ERIsox in the whole of Slovakia (2014-2019)

Period	2014	2015	2016	2017	2018	2019
AVERAGE ERIsox	1.49	1.61	3.44	3.75	4.25	4.77

The situation that has arisen (Figure 2) shows that the trend showing real data is growing, which is beneficial for the country and beneficial for sustainable direction.
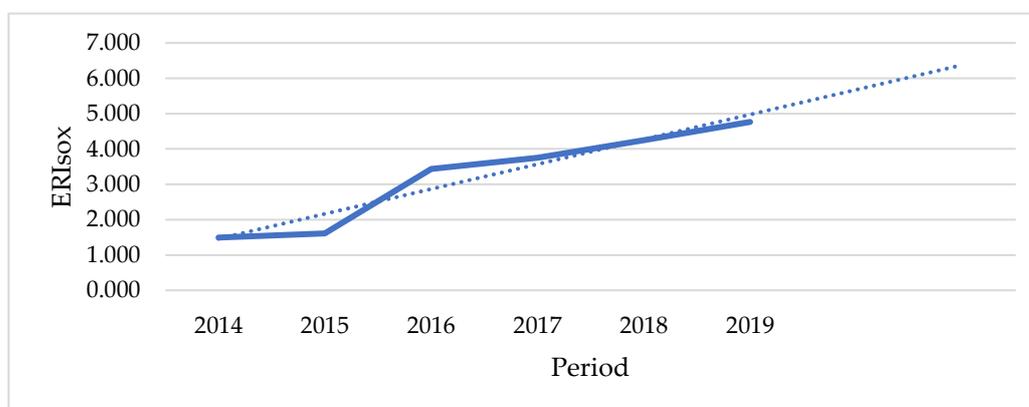
Figure 2. Mean values and forecast of the ERIsox

It is necessary to draw attention to the fact that the positive trend and the forecast of the values of the ratio indicator are significantly influenced by the positive values acquired by the Bratislava Region for a long time.

4. Discussion

From our perspective, economic growth without pollution achieved by clean production requires good management and strategic decisions based on appropriate data. Our intention in this article is to discuss what specific sustainability data or indicators should managers monitor and control due to their particular conditions according to the enterprise's business

and production orientation. Yes, we know that only monitoring sulphur dioxide emissions are not enough, and in some enterprises, even it is not needed or helpful. We chose this substance due to our analysis in the Slovak republic. It indicated that sulphur dioxide emission is one of the main negative externalities produced by industrial enterprises oriented to metal production and metallurgy, chemistry, plastics, energy, and mining. The primary source of sulphur dioxide is burning fossil fuels, such as coal, oil, and natural gas. In recent years, across Europe, much progress has been made to decrease this type of emissions. All this evidence guided us to create the ERIsox indicator. It is effective for mentioned enterprises and could be meaningful information for managers of other industrial enterprises. The primary goal of creating the ERIsox indicator is its ability to record data continuously. Due to the disclosure of Profit and Loss Statements from Slovak enterprises, which have been publicly available for six years, we have narrowed the data recording period for 2014-2019. A broader range of years allows offering more accurate results. Nevertheless, the sample size allowed us better to calculate the correlation and regression between the variables. Therefore, it is not authoritative on how large a sample the survey is conducted if the dependence is sufficiently demonstrable. It is substantial that managers be convinced of the importance of implementing this indicator in the enterprise. The ERIsox indicator can be modified to various financial and environmental indicators if a strong dependence between the given variables is demonstrated. Certainly, indicators should be tailormade according to the given industrial enterprise that burdens the environment. Our viewpoint is to show a possibility, how to parse the relations between environmental and economic indicators. Our findings offer the first contribution for managers to identify appropriate data importance of their monitoring step by step to promote future managerial decisions.

5. Conclusions

Production processes in the industrial sectors of the post-communist countries are changing and, with innovation, becoming more sophisticated. Even though this production focused on producing "use-value" directly rather than generating profit, private ownerships and competitive markets had no chance to produce effectively. This production has many adverse effects, resulting in environmental damages. Air and water pollution abounded. By one estimate, in the late 1980s, particulate air pollution was 13 times higher per unit of GDP in Central and Eastern Europe than in Western Europe. Increasing competitiveness among enterprises but also motivation factors of the employees (Hitka et al., 2019) are a driving force in adopting practices and activities that improve development. They expect that enterprises' production process will have the least possible negative impact on the environment and people healthy quality of life. However, this fact brings with it several underdeveloped factors. These include an insufficiently developed concept of the principles of sustainable development intended for management. Yes, many environmental principles and indicators exist. However, there is a lack of practical instructions on the enterprise's use. Nevertheless, each industrial enterprise is specific, focuses on producing several goods, and requires a unique approach. The ERIsox ratio, which is described in the practical part of this article, is a suitable metric for continuously recording and comparing the development of sustainable

development in the enterprise. Therefore, managers need to respond appropriately to increase the value of the ERIsox indicator. In two cases, it will be caused if the enterprise's revenues increase or emission values decrease. If the values of emissions decrease, and at the same time, the enterprise's revenues increase. In this case, managers will be able to deduce the activity of their enterprise, which produces the given emissions as sustainable. Each post communistic industrial enterprise management can inspire practices in sustainable enterprises. Moreover, they can consider how quickly they want to get out of the shadow of communist production.

Conflict of interest: none

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Optimal Control of Technology Development Level on Primary Energy Consumption

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Abstract: Energy is a driving force of economic growth. However, the use of energy causes lots of pollution. Technology development is strongly encouraged to promote the economic growth as well as energy conservation. In this paper, we formulate an optimal control model to minimize the total primary energy conservation in a time period. The optimal technology development level path and the primary energy consumption path is studied. Our main finding is that, to achieve an efficient economic growth path, the elasticity coefficient of GDP with respect to the primary energy consumption should be small, and the technology development investment should be high enough. In other words, high-technology industries other than heavy industries should be invested with more money to achieve a high-quality economic growth. A big elasticity coefficient of GDP with respect to the primary energy consumption will result in an inefficient development because the primary energy consumption can go higher with time.

Keywords: primary energy consumption; technology development level; optimal control theory

JEL Classification: O13; P28; Q43

1. Introduction

Energy is an important supporting material for the economic and social development of all countries in the world, and is the main driving force of economic growth (Stern, 2000). In the 40 years of reform and opening up, China's economy has developed rapidly and the demand for energy is also increasing. Now all countries in the world are promoting low-carbon economy, energy conservation and emission reduction. In China, according to the Outline of the People's Republic of China 14th Five-Year Plan (2021-2025) for National Economic and Social Development and Long-Range Objectives for 2035, the allocation and utilization of energy resources should be more efficient. The energy consumption and carbon dioxide emission per unit of GDP should be reduced by 13.5% and 18% respectively.

Previous studies have extensively examined the impact factors of energy consumption. Rahman et al. (2020) as well as Tang et al. (2016) showed that there is a unidirectional correlation from energy demand to GDP growth. Ahmad et al. (2016) showed there is a correlation from GDP growth to energy use. Tugcu and Topcu (2018) suggested that there is a bidirectional relationship between these two. Technological innovation is another factor that affects energy consumption. Wang and Wang (2020) discovered that technological

innovation has a positive impact on energy efficiency. Cao et al. (2020) found that technological improvement and use of resources are the main methods to encourage economic growth. Li and Solaymani (2021) argued that technological innovation that enhances energy efficiency is only effective in reducing energy consumption in the industrial sector.

Although many studies have already showed the relationships of energy consumption, GDP and technology development, little attention is paid to forming a theoretical framework. Many of the existing works are empirical research. In this paper, we want to study the relations of the optimal primary energy consumption path and the optimal technology development level path in a theoretical approach. We form an optimal control model to minimize the total primary energy consumption in a time period. Then we study the optimal solution paths to the problem.

This paper shows that, to achieve an efficient development path, the elasticity coefficient of GDP with respect to the primary energy consumption should be small, and the technology development investment should be high enough. A big elasticity coefficient of GDP with respect to the primary energy consumption will result in an inefficient development because the primary energy consumption can go higher with time.

This paper also shows that, we should invest on high-technology industries as much as we can to achieve higher GDP and lower primary energy consumption. For heavy industries, the investment should keep low to avoid the energy consumption.

The remaining sections are organized as follows. In Section 2 we formulate the optimal control model. In Section 3 we calculate the model to achieve the optimal paths of technology development level, GDP and primary energy consumption. Some further analyses are also implemented. Section 4 concludes the paper and suggests directions for future research.

2. The Model

In this section, we consider a dynamic optimization problem in a given time interval to minimize the primary energy consumption. We use an optimal control model to find the optimal path of technology development level.

The IPAT model (Ehrlich & Holdren, 1971) has been widely used to study the impact of population (P), affluence (A) and technology (T) on the environment, for example, CO_2 emissions (see, e.g., Soulé & DeHart, 1998; Chontanawat, 2018). In the field of this method, affluence is often replaced with per capita GDP. Extensive studies showed that energy consumption has a positive and significant effect on CO_2 emissions (see, e.g., Boutabba, 2014; Heidari et al., 2015). Thus, we use the primary energy consumption to replace the environmental impact and taking economic growth, technology development and population size into consideration, we can form the IPAT model as below.

$$E(t) = aA(t)^{-1}G(t)^{\alpha}L(t)^{\beta}, \tag{1}$$

where $E(t)$, $A(t)$, $G(t)$ and $L(t)$ represent the primary energy consumption, technology development level, GDP and population respectively in time t. Here α and β are elasticity coefficients of GDP and population respect to the primary energy consumption, and a is a positive constant.

The production function is assumed to have a Cobb-Douglas form:

$$G(t) = bA(t)K(t)^{\mu}L(t)^{\eta}, \tag{2}$$

where $K(t)$ stands for the capital amount. Here μ and η are elasticity coefficients of capital amount and population respect to GDP, and b is a positive constant.

Replacing $G(t)$ in Equation (1) by its Cobb-Douglas form in Equation (2), we have:

$$E(t) = ab^{\alpha}A(t)^{\alpha-1}K(t)^{\alpha\mu}L(t)^{\alpha\eta+\beta}. \tag{3}$$

Technology development level $A(t)$ is the cumulative level of long-run technological changes. Denote $I(t)$ as the capital amount in technology development. We assume that $A(t)$ linearly changes with $I(t)$:

$$A(t) = gI(t) + g_0, \tag{4}$$

where $g > 0$ represents the contribution parameter of the capital amount in technology development to the technology development level, and g_0 is a positive constant. We further assume that $I(t)$ satisfies:

$$\dot{I}(t) = u(t) - \delta I(t), \tag{5}$$

where $u(t)$ stands for the technology development investment rate. We assume that the technology development investment rate has a boundary, i.e., $u(t) \in [\underline{u}, \overline{u}]$. Suppose that both $\underline{u}$ and $\overline{u}$ are positive. And δ is the depreciation rate of the capital amount in technology development.

The objective is to minimize the total primary energy consumption in a given time interval [0, T]. The technology development level $A(t)$ is the state variable. Whereas the technology development investment rate $u(t)$ is the control variable. Without loss of generality, we further assume that the technology development level in time 0 is positive and is known as $A(0) = A_0$, but $A(T)$ can be free. The optimal control problem is then formulated as:

$$
\begin{aligned}
min \qquad & V[A(t)] = \int_0^T E(t)dt = \int_0^T ab^{\alpha}A(t)^{\alpha-1}K(t)^{\alpha\mu}L(t)^{\alpha\eta+\beta}\, dt \\
subject\ to \qquad & A(t) = gI(t) + g_0, \\
& \dot{I}(t) = u(t) - \delta I(t), \\
& A(0) = A_0, \qquad A(T) free, \\
and \qquad & u(t) \in [\underline{u}, \overline{u}].
\end{aligned}
\tag{6}
$$

3. Results

In this section we find the optimal path of the technology development level $A(t)$ and the technology development investment rate $u(t)$. Then we calculate the optimal paths of technology development level, GDP and primary energy consumption. Condition for an efficient economic development is given at the end.

3.1. Maximizing the Hamiltonian

Let us first change the objective into a maximize form:

$$\max \quad -V[A(t)] = -\int_0^T E(t)dt, \tag{7}$$

then the Hamiltonian is:

$$H = -E(t) + \lambda(t)\big(u(t) - \delta I(t)\big), \tag{8}$$

where $\lambda(t)$ is the costate variable. We replace the state variable $A(t)$ with Equation (4), then the Hamiltonian becomes:

$$H = -ab^\alpha (gI(t) + g_0)^{\alpha-1} K(t)^{\alpha\mu} L(t)^{\alpha\eta+\beta} + \lambda(t)\big(u(t) - \delta I(t)\big). \tag{9}$$

Noticing that H is linear in the control variable $u(t)$ with slope $\frac{\partial H}{\partial u(t)} = \lambda(t)$, and $u(t)$ has a boundary $[\underline{u}, \overline{u}]$, to maximize H with respect to $u(t)$, we have to choose $u^*(t) = \overline{u}$ if $\lambda(t) > 0$, and $u^*(t) = \underline{u}$, if $\lambda(t) < 0$. In short,

$$u^*(t) = \begin{cases} \overline{u} & if \ \lambda(t) > 0, \\ \underline{u} & if \ \lambda(t) < 0. \end{cases} \tag{10}$$

3.2. The Optimal Costate Path, Control Path and State Path

The search for the costate path begins with the equation of motion

$$\dot{\lambda}(t) = -\frac{\partial H}{\partial I(t)} = ab^\alpha g(\alpha - 1)(gI(t) + g_0)^{\alpha-2} K(t)^{\alpha\mu} L(t)^{\alpha\eta+\beta} + \delta\lambda(t). \tag{11}$$

The equation is a first-order linear differential equation with a constant coefficient but a variable term.

The right-hand side of Equation (11) has an unknown variable $I(t)$. Since we only care if $\lambda(t)$ is positive or negative, we now split the problem into two cases, namely $\lambda(t) > 0$ and $\lambda(t) < 0$.

Case 1. If $\lambda(t) > 0$, by using Equation (10), we have $u^*(t) = \overline{u}$. Substituting $u^*(t) = \overline{u}$ into Equation (5) yields

$$\dot{I}(t) = \overline{u} - \delta I(t). \tag{12}$$

It follows that the general solution for $I(t)$ in this first-order differential equation is

$$I(t) = c_1 e^{-\delta t} + \frac{\overline{u}}{\delta}, \tag{13}$$

where c_1 is an arbitrary constant to be definitized. Substituting Equation (13) into (4), by using the initial condition $A(0) = A_0$, we have

$$A^*(t) = \left(A_0 - g_0 - \frac{g\overline{u}}{\delta}\right) e^{-\delta t} + \left(\frac{g\overline{u}}{\delta} + g_0\right). \tag{14}$$

By using Equation (4) again we have $c_1 = \frac{A_0 - g_0}{g} - \frac{\overline{u}}{\delta}$, and

$$I^*(t) = \left(\frac{A_0 - g_0}{g} - \frac{\overline{u}}{\delta}\right) e^{-\delta t} + \frac{\overline{u}}{\delta}. \tag{15}$$

Substituting Equation (15) into (11), we have

$$\dot{\lambda}(t) = ab^{\alpha}g(\alpha-1)\left(\left(A_0 - g_0 - \frac{g\overline{u}}{\delta}\right)e^{-\delta t} + \left(\frac{g\overline{u}}{\delta} + g_0\right)\right)^{\alpha-2} K(t)^{\alpha\mu}L(t)^{\alpha\eta+\beta} \tag{16}$$
$$+ \delta\lambda(t).$$

The general solution for $\lambda(t)$ can then be derived as

$$\lambda(t) = e^{\delta t}\left[\int Q(t)\,e^{-\delta t}dt + c_2\right], \tag{17}$$

where $Q(t) = ab^{\alpha}g(\alpha-1)\left(\left(A_0 - g_0 - \frac{g\overline{u}}{\delta}\right)e^{-\delta t} + \left(\frac{g\overline{u}}{\delta} + g_0\right)\right)^{\alpha-2} K(t)^{\alpha\mu}L(t)^{\alpha\eta+\beta}$, and c_2 is an arbitrary constant to be definitized.

To definitize c_2, we can make use of the transversality condition for the vertical-terminal-line optimal control problem, $\lambda(T) = 0$. Letting $t = T$ in Equation (17), applying the transversality condition, we find that $c_2 = \left[-\int Q(t)\,e^{-\delta t}dt\right]_{t=T}$.

Case 2. If $\lambda(t) < 0$, by using Equation (10), we have $u^*(t) = \underline{u}$. Similar to the approach we used in Case 1, we can derive the following results. The general solution for $I(t)$ is

$$I(t) = c_1 e^{-\delta t} + \frac{\underline{u}}{\delta}. \tag{18}$$

The optimal state path for $A(t)$ is

$$A^*(t) = \left(A_0 - g_0 - \frac{g\underline{u}}{\delta}\right)e^{-\delta t} + \left(\frac{g\underline{u}}{\delta} + g_0\right). \tag{19}$$

And the optimal path for $I(t)$ is

$$I^*(t) = \left(\frac{A_0 - g_0}{g} - \frac{\underline{u}}{\delta}\right)e^{-\delta t} + \frac{\underline{u}}{\delta}. \tag{20}$$

The optimal path for $\lambda(t)$ becomes

$$\lambda(t) = e^{\delta t}\left[\int Q(t)\,e^{-\delta t}dt - \left[\int Q(t)\,e^{-\delta t}dt\right]_{t=T}\right], \tag{21}$$

where $Q(t) = ab^{\alpha}g(\alpha-1)\left(\left(A_0 - g_0 - \frac{g\underline{u}}{\delta}\right)e^{-\delta t} + \left(\frac{g\underline{u}}{\delta} + g_0\right)\right)^{\alpha-2} K(t)^{\alpha\mu}L(t)^{\alpha\eta+\beta}$.

In the end of this section, we give a sufficient condition under which $\lambda(t)$ can be positive and negative.

Lemma 1. If the elasticity coefficient of GDP with respect to the primary energy consumption $\alpha < 1$, then $\lambda(t) > 0$ for all $t \in [0, T)$. If the elasticity coefficient of GDP with respect to the primary energy consumption $\alpha > 1$, then $\lambda(t) < 0$ for all $t \in [0, T)$.

Proof. From Equations (17) and (21), we know $\lambda(t) = e^{\delta t}\left[\int Q(t)\,e^{-\delta t}dt - \left[\int Q(t)\,e^{-\delta t}dt\right]_{t=T}\right]$,

where $Q(t) = ab^{\alpha}g(\alpha-1)\left(\left(A_0 - g_0 - \frac{gu^*}{\delta}\right)e^{-\delta t} + \left(\frac{gu^*}{\delta} + g_0\right)\right)^{\alpha-2} K(t)^{\alpha\mu}L(t)^{\alpha\eta+\beta}$. Here u^* is either $\overline{u}$ if $\lambda(t) > 0$ or $\underline{u}$ if $\lambda(t) < 0$. For both $u^* = \overline{u}$ and $u^* = \underline{u}$, we can derive that $\left(A_0 - g_0 - \frac{gu^*}{\delta}\right)e^{-\delta t} + \left(\frac{gu^*}{\delta} + g_0\right) = A_0 e^{-\delta t} + \left(1 - e^{-\delta t}\right)\left(\frac{gu^*}{\delta} + g_0\right) > 0$ holds for all $t \in [0, T]$. Thus $ab^{\alpha}g\left(\left(A_0 - g_0 - \frac{gu^*}{\delta}\right)e^{-\delta t} + \left(\frac{gu^*}{\delta} + g_0\right)\right)^{\alpha-2} K(t)^{\alpha\mu}L(t)^{\alpha\eta+\beta} > 0$ holds.

If $\alpha < 1$, then we have $Q(t) < 0$ as well as $Q(t)e^{-\delta t} < 0$ for all $t \in [0,T]$. Noticing that $Q(t)e^{-\delta t}$ is the derivative of $\int Q(t)\,e^{-\delta t}dt$, we know that $\int Q(t)\,e^{-\delta t}dt$ is a decreasing function in t. Thus $\int Q(t)\,e^{-\delta t}dt - \left[\int Q(t)\,e^{-\delta t}dt\right]_{t=T} > 0$ holds for all $t \in [0,T)$, which give us the result that $\lambda(t) > 0$ for all $t \in [0,T)$.

Similarly, if $\alpha > 1$, we have $Q(t) > 0$ as well as $Q(t)e^{-\delta t} > 0$ for all $t \in [0,T]$. Thus $\int Q(t)\,e^{-\delta t}dt$ is an increasing function in t. Thus $\int Q(t)\,e^{-\delta t}dt - \left[\int Q(t)\,e^{-\delta t}dt\right]_{t=T} < 0$ holds for all $t \in [0,T)$, which give us the result that $\lambda(t) < 0$ for all $t \in [0,T)$. This ends the proof of Lemma 1.

3.3. Analysis of the Optimal Paths of Technology Development Level, Economic Growth and Primary Energy Consumption

From the results showed in Section 3.2, we analyze the optimal paths of technology development level $A^*(t)$, economic growth level $G^*(t)$ and the primary energy consumption $E^*(t)$ in two cases, namely $\alpha < 1$ and $\alpha > 1$.

Case 1. The elasticity coefficient of GDP with respect to the primary energy consumption $\alpha < 1$.

From Lemma 1, we know that $\lambda(t) > 0$ for all $t \in [0,T]$. Taking Equation (10) into consideration, the optimal technology development investment rate $u(t)$ should always keep its maximum value $\bar{u}$. According to Equation (14), the optimal path of technology development level is $A^*(t) = \left(A_0 - g_0 - \frac{g\bar{u}}{\delta}\right)e^{-\delta t} + \left(\frac{g\bar{u}}{\delta} + g_0\right)$. As discussed in Section 3.2, $A^*(t)$ is always positive. However, if the technology development investment rate $\bar{u}$ is high enough, i.e., $A_0 - g_0 - \frac{g\bar{u}}{\delta} < 0$, then the optimal technology development level $A^*(t)$ will be an exponentially increasing function with time t. Substituting $A^*(t)$ into Equations (2) and (3), it turns out that the corresponding economic growth path $G^*(t)$ will increase in time, whereas the corresponding primary energy consumption $E^*(t)$ will decrease in time. This is an efficient development case. We put these results in Theorem 1 given below.

Theorem 1. (**Efficient development case**) When the elasticity coefficient of GDP with respect to the primary energy consumption $\alpha < 1$, the optimal technology development investment rate is $u^*(t) = \bar{u}$. If $\bar{u}$ satisfies that $\bar{u} > \frac{\delta}{g}(A_0 - g_0)$, then the optimal technology development level $A^*(t)$ and the optimal economic growth $G^*(t)$ will increase in time. The optimal primary energy consumption $E^*(t)$ is decrease in time.

By the similar approach, we have results if $\bar{u}$ is not high enough, i.e., $\bar{u} < \frac{\delta}{g}(A_0 - g_0)$. We list it in Theorem 2.

Theorem 2. (**Inefficient development case**) When the elasticity coefficient of GDP with respect to the primary energy consumption $\alpha < 1$, the optimal technology development investment rate is $u^*(t) = \bar{u}$. If $\bar{u}$ satisfies that $\bar{u} < \frac{\delta}{g}(A_0 - g_0)$, then the optimal technology development level $A^*(t)$ and the optimal economic growth $G^*(t)$ will decrease in time. The optimal primary energy consumption $E^*(t)$ is increase in time.

Case 2. The elasticity coefficient of GDP with respect to the primary energy consumption $\alpha > 1$.

From Lemma 1, we know that $\lambda(t) < 0$ for all $t \in [0, T)$. Taking Equation (10) into consideration, the optimal technology development investment rate $u(t)$ should always keep its minimum value $\underline{u}$. In this case, similar to Case 1, we can derive that $A^*(t)$ is always positive. Furthermore, if $A_0 - g_0 - \frac{g\underline{u}}{\delta} < 0$, we can derive that $A^*(t)$, $G^*(t)$, and $E^*(t)$ are all increase in time. If $A_0 - g_0 - \frac{g\underline{u}}{\delta} > 0$, we have $A^*(t)$, $G^*(t)$, and $E^*(t)$ are all decrease in time. We conclude it formally in Theorems 3 and 4.

Theorem 3. (**Inefficient development case**) When the elasticity coefficient of GDP with respect to the primary energy consumption $\alpha > 1$, the optimal technology development investment rate is $u^*(t) = \underline{u}$. If $\underline{u}$ satisfies that $\underline{u} > \frac{\delta}{g}(A_0 - g_0)$, then the optimal technology development level $A^*(t)$, the optimal economic growth $G^*(t)$ and the optimal primary energy consumption $E^*(t)$ will all increase in time.

Theorem 4. (**Inefficient development case**) When the elasticity coefficient of GDP with respect to the primary energy consumption $\alpha > 1$, the optimal technology development investment rate is $u^*(t) = \underline{u}$. If $\underline{u}$ satisfies that $\underline{u} < \frac{\delta}{g}(A_0 - g_0)$, then the optimal technology development level $A^*(t)$, the optimal economic growth $G^*(t)$ and the optimal primary energy consumption $E^*(t)$ will all decrease in time.

Here we label Theorems 2-4 all with inefficient cases because either $G^*(t)$ is decrease in time or $E^*(t)$ is increase in time. An increase of $E^*(t)$ shows the primary consumption is going up, and a decrease of $G^*(t)$ shows that the economic growth is slowing down.

In the end of this section, we put all the results into Table 1 below.

Table 1. The monotonicity of the optimal paths of $(A^*(t), G^*(t), E^*(t))$

	$u^* > \frac{\delta}{g}(A_0 - g_0)$	$u^* < \frac{\delta}{g}(A_0 - g_0)$
$\alpha < 1$ ($u^* = \overline{u}$)	(+,+,-) Efficient	(-,-,+) Inefficient
$\alpha > 1$ ($u^* = \underline{u}$)	(+,+,+) Inefficient	(-,-,-) Inefficient

Note: The symbol "+" means the optimal path is increasing in time, and "-" means the optimal path is decreasing in time. We say the case is efficient if $G^*(t)$ is increasing in time and $E^*(t)$ is decreasing in time. Either a decreasing $G^*(t)$ or an increasing $E^*(t)$ is considered as inefficient.

As shown in Table 1, to achieve an efficient development path, the elasticity coefficient of GDP with respect to the primary energy consumption α should be small, and the technology development investment should be high enough. What we should notice is that, even if the technology development investment is high enough, a big elasticity coefficient of GDP with respect to the primary energy consumption α still results an inefficient development because the primary energy consumption can go higher with time.

In the meanwhile, let's take a deeper look at the elasticity coefficient α. If α is small, it means that the increasing rate of primary energy consumption is less related to the increasing rate of GDP. High-technology industries with less energy consumption would be the main contribution to GDP. In this case, our results show that the technology development investment should be its upper bound. The more investment they have, the more rapid GDP goes higher and less energy consumption is needed. In the contrary, a large α means that

the increasing rate of primary energy consumption is closely related to the increasing rate of GDP. Heavy industries would be the main contribution to GDP. In this case, our results show that the technology development investment should be its lower bound. Even the GDP still goes up with more technology development investment, it would cause a huge energy consumption.

4. Discussion

This paper builds an optimal control model to minimize the total primary energy consumption in a time period. The relations of the optimal primary energy consumption path and the optimal technology development level are revealed in a theoretical approach.

Our main findings are listed below. First, to achieve an efficient development path, the elasticity coefficient of GDP with respect to the primary energy consumption should be small, and the technology development investment should be high enough. Second, A big elasticity coefficient of GDP with respect to the primary energy consumption will results an inefficient development because the primary energy consumption can go higher with time. Third, high-technology industries other than heavy industries should be invested with more money to promote economic growth as well as energy conservation.

This paper can be extended in several ways. First, in this paper, we only take into one state variable $A(t)$. However, the capital amount $K(t)$ is also a driving factor for both economic growth and energy conservation. An analysis with both $A(t)$ and $K(t)$ might give more fruitful results. Second, empirical research with data in China can also be added. These extensions are left to be future research.

Conflict of interest: none

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Development of Organic Production as a Condition for Sustainability of Russian Agriculture

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Abstract: The paper is devoted to the prospects for the development of organic agriculture in the Russian Federation and its impact on the sustainability of the agricultural sector, the characteristics of which are also defined in the work. The aim of the study is to substantiate the necessity and accessibility of the development of organic production as a condition for the sustainability of agriculture in Russia. Based on the data of the official international and Russian statistical observation in the form of time series and cross-sectional data using statistical methods of grouping, correlation, modeling of the trend of the time series, analysis of time series, it has been established that at the present stage the agricultural sector of Russia in the direction of its development corresponds to the general global trends in the expansion of production and consumption of organic products and has the main prerequisites for the development of organic agriculture, varying by region. The paper substantiates the positive influence of organic production on the formation of sustainable agriculture through strengthening the position of it in the economy, meeting the effective demand of the population for high quality food products, preserving different types of producers and wise use of resources.

Keywords: organic agriculture; sustainability; international trade, resources; conditions for organic agriculture

JEL Classification: C10; C22; O13

1. Introduction

The sustainability of Russian agriculture is a prerequisite for the country's economic development. Agriculture provides food to the population, raw materials for the food and processing industries, services, shapes the environment, influences social and cultural systems and contributes to economic growth (Huylenbroeck et al., 2007). In addition, according to the input-output tables of most European countries and the United States, agriculture has the highest level of total input ratios compared to other industries (Linchpin, 2021), for example, in Russia in 2018 it was 489.4 rub per 1,000 rub. of agricultural output. So, it has the potential to become a driving force for the development of the country's economy as a whole (Romantseva, 2020; Benesova et al., 2017). The Ministry of Agriculture of Russia understands sustainable agriculture as the basis for the formation of agricultural policy in accordance with the definition of the Food and Agricultural Organization of the United Nations as a

production that has five main attributes: it saves resources, does not cause environmental degradation, is technically accessible, economically viable and socially acceptable (FAO, 1989).

This became especially evident during the crisis caused by the COVID 19 pandemic. Agriculture is often exposed to various natural and human-induced shocks and stresses, such as floods, droughts, temperature fluctuations, water shortages, resource scarcity, including those due to the economic crisis. Moreover, governmental decision in the field of supporting agriculture play significant role. Changing of quotes dairy industry can affect to firm competitiveness (Naglova et al., 2017). Therefore, agriculture has the ability to adapt to them in order to be viable in the future. This ability is referred to as agricultural sustainability and is defined by USAID as "the ability of people, households, communities, countries, and systems to mitigate, adapt to, and recover from shocks and stresses in a manner that reduces chronic vulnerability and facilitates inclusive growth" (USAID, 2012). The pandemic crisis in the Russian Federation was expressed in the reduction of production of small and medium-sized enterprises in various types of economic activities. This happened due to the imposed restrictions on shopping, visiting restaurants and movement, migration between cities and regions. The decline in the number of jobs has led to an increase in unemployment and a decrease in the incomes of some groups of the population. The created conditions disrupted the formation of gross value added in most types of economic activity. The research conducted by the author (Kagirova, 2021) using methods of econometric modeling, in particular the method of piecewise linear functions, confirmed the stability of the agricultural sector during periods of economic crises, expressed in the preservation of the level and trend of growth in gross value added in agriculture with a decrease in the volume of gross domestic product.

Factors that ensure the sustainability of agriculture are: effective demand for products; multi-structure in agriculture; the location of enterprises of the agricultural sector on a large territory with different conditions and specialization of production (the possibility of locating production in farms of different categories, redistribution of resources); the implementation of measures of state support for agriculture (Lampridi et al., 2019). A special role in providing income to producers of the agricultural sector of Russia belongs to the export of agricultural products, which was also confirmed by the results of studying the consequences of the 2020-2021 crisis caused by the pandemic. The results of 2020 showed an increase in exports of food products and agricultural raw materials in general by 19.2% and grain by 27.7%, compared to the previous period. At the same time in the UK the grain export decreased by 27.2%, in China by 14.4% (According to the International Trade Statistics Database - TrendEconomy.com). Current trends in consumer preferences in advanced economies are based on the principles of healthy food, involving the consumption of organic products (Rizzo et al., 2020; Glibowski, 2020). To ensure the positive influence of the export factor on the sustainability of agriculture, it is necessary to orient production towards meeting consumer demand in the world market, including following the global trends in the use of organic products (Hou et al., 2022). Organic products are understood in accordance with the FAO definition as products produced following specific socio-economic and ecological rules, such as: types and quantity of external inputs used (often referred as chemical fertilizers and

pesticides), natural resources conservation (biodiversity, soil and water), smallholders and family farmers' empowerment, and animal welfare (FAO, 2021). In Russian standards, organic products are recognized as products, produced in accordance with the rules of organic production, without the use of pesticides and other plant protection products, chemical fertilizers, growth and fattening stimulants, antibiotics, hormonal and veterinary drugs, genetically modified organisms, not processed using ionizing radiation and not containing residues of prohibited and harmful substances, as well as products of their processing (Interstate Standard, 2018).

Many works of scientists of different areas and from different countries are devoted to the study of the factors of development of organic production and the consequences for the economy. Thus, it has been established that an important condition for the development of organic agriculture is the interaction of producers in the implementation of the idea of a clean, resource-saving production from chemical influences (Sapbamrer & Thammachai, 2021), which forms the condition for the transition to new more profitable forms of interaction between participants in economic processes. Type of management plays a big role (Gogaev, et.el, 2019). Consumer interest in organic products is formed on the basis of the development in society of the idea of environmental protection (Prado & Moraes, 2020), as well as a sufficient level of income of the population, since production is mainly focused on the domestic market (Hanmann et al., 2020; Aertsens et al., 2009). The current level of development of society in Russia and the level of income, the existing natural conditions for the implementation of organic agriculture can form the basis for strengthening the position of the agrarian sector in the country's economy, as well as ensure the sustainability of agriculture.

Thus, the object of the presented study is the production of organic products in the Russian Federation.

The purpose of the study is to substantiate the necessity and availability of the development of organic production as a factor in the sustainability of agriculture in Russia. This involves solving the following tasks:

- to define the special characteristics of sustainable agriculture in Russia;

- to study the global trends in organic agriculture;

- to substantiate the necessity and possibilities for the development of organic agriculture in the Russian Federation.

Previous studies by the author have shown that the sustainability of agriculture in the Russian Federation is expressed in:

- uninterrupted supply of the population and industries with food products and raw materials, respectively;
- ensuring a high share of the gross value added of a type of economic activity in the formation of gross domestic product, subject to its sustainable growth
- ensuring the level of employment and income of the population of rural areas;
- preservation of natural resources and biodiversity, territorial integrity of the country;
- ensuring a high position of the country in the world food market.

Hypothesis: the development of organic production using the innovative technologies contributes to the formation of all these characteristics.

2. Methodology

To study the trends in organic agriculture, countries were selected with a duration of organic production in the agricultural sector for more than 10 years. Such indicators are considered as organic area (farmland); number of organic producers; sales of organic food; organic retail sales as the characteristic of consumer demand for organic products in the country.

To identify structural shifts in the production of organic products by countries, the Spearman rank correlation coefficient was applied:

$$r_s = 1 - \frac{6(\sum d^2)}{n(n^2 - 1)} \tag{1}$$

where d is the difference between two ranks (according to the share of the country in the total organic farmland) in 2019 and 2007 for each observation; n is number of observations (countries).

To analyze changes in the structure, data for 2007 (in most countries the production of organic products has already been formed) and 2019 (information on the production of products in most countries is available) were used.

To identify trends in the development of organic production in Russia and other countries, modeling of the trend of the time series was applied based on the Ordinary Least Squares (OLS) method, as well as the calculation of indicators of the time series – absolute growth and growth rate.

To identify the regional characteristics of agricultural production, the method of statistical grouping was used based on the interval series of distribution by the indicator of the area of fallow lands in the region. Three groups of regions were identified: the 1st group – regions with an area of fallow lands over 100 thousand hectares; the 2nd group – regions with an area of fallow lands from 10 to 100 thousand hectares; the 3rd group – regions with an area of fallow lands less than 10 thousand hectares per region (from the total number of constituent entities of the Russian Federation, regions in which there are no fallow lands, as well as the Tyumen region and Krasnoyarsk Territory, in which there is a high degree of air pollution, were excluded). For each group, indicators of factors for the development of organic production were calculated in the form of relative indicators and average values.

The initial data are presented in the form of time series, categorical data, and cross-sectional data. Sources of information: statistical office of the European Union Eurostat; International Trade Statistics Database - TrendEconomy.com; Research Institute of Organic Agriculture FiBL; The Food and Agriculture Organization of the United Nations (FAO); Federal State Statistical Services (Rosstat), National Organic Union of the Russian Federation.

3. Results

Analyzing the period from 1999 to 2019 it can be noted that sales of organic products in the world increased from 15.2 billion dollars in 1999 to 106 billion dollars in 2019, with an average annual growth of 4.6 billion dollars (significance F < 0.000, P-value for Intercept and Regression Coefficient < 0.000) (Figure 1).

$$y = 4.6114x + 4.76$$
$$R^2 = 0.9885$$
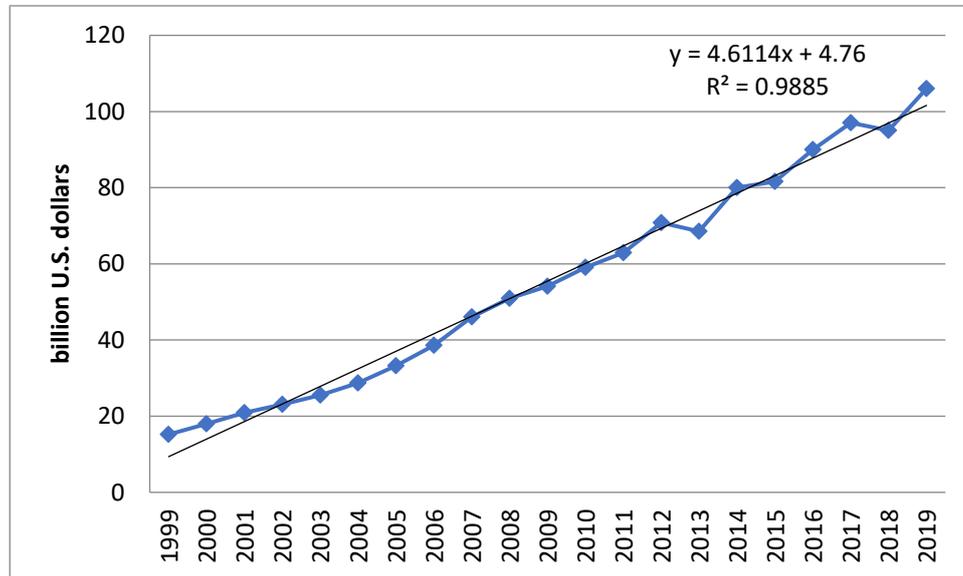
Figure 1. Worldwide sales of organic food from 1999 to 2019 (in billion U.S. dollars)

Thus, extrapolating the current trend, we can assume with a probability of 0.95 that the capacity of the organic food market will grow to $ 152 billion by 2030, provided other conditions remain unchanged. According to forecasts of the Institute for Research of Organic Agriculture (FiBL), by 2024 the market capacity will amount to more than $ 200 billion. Russian consumers are also forming a trend of growing interest in organic products, which is confirmed by Organic retail sales in Russia increased from € 30 million in 2007 to € 160 million in 2019 (i.e. €10.8 million average annual growth), similarly in Australia - an increase of 4.5 times, in Canada – 3.1 times, in China – 18.9 times. However, not all of these products are provided by domestic production. So, in Russia in the early 2000s, 100% of organic products sold on the market were imported, but currently more than 20% of the market is represented by domestic products. At the same time, Russia has significant opportunities for the development of organic production (natural conditions, low level of environmental pollution, development of transport infrastructure, availability of pastures).

Imports of organic products in the world (across all exporting countries) in 2018 amounted to 3,230,675 metric tons. In 2019, imports increased by 0.36% to 3,242,382 metric tons. According to the Federal Center for the Development of Agricultural Products Exports of the Ministry of Agriculture of Russia, the world imports of organic matter in 2019 amounted to only 13% of the total consumption, nevertheless, this is a significant segment of $ 15 billion. The growth of the world market for organic products forms a new niche for the export of products produced in Russia. Exports play a significant role in the formation of the gross value added of agriculture in Russia (in 2019 – 12.3% of output). Growth in the export of organic products with a higher price in comparison with traditional products in Russia

will provide sufficient profitability for producers for sustainable development of the agricultural sector and rural areas.

To get the significant estimation of trade potential of organic products, it is necessary to evaluate current agricultural trade of Russia. European Union and EACU countries are the main trade partners of Russia in agricultural products. Figure 2 shows the number of agricultural products imported from Russia by countries over the past 20 years (based on the data form Un Comtrade database. The inflation effect was reduced using agricultural indexes from FaoStat for each year).
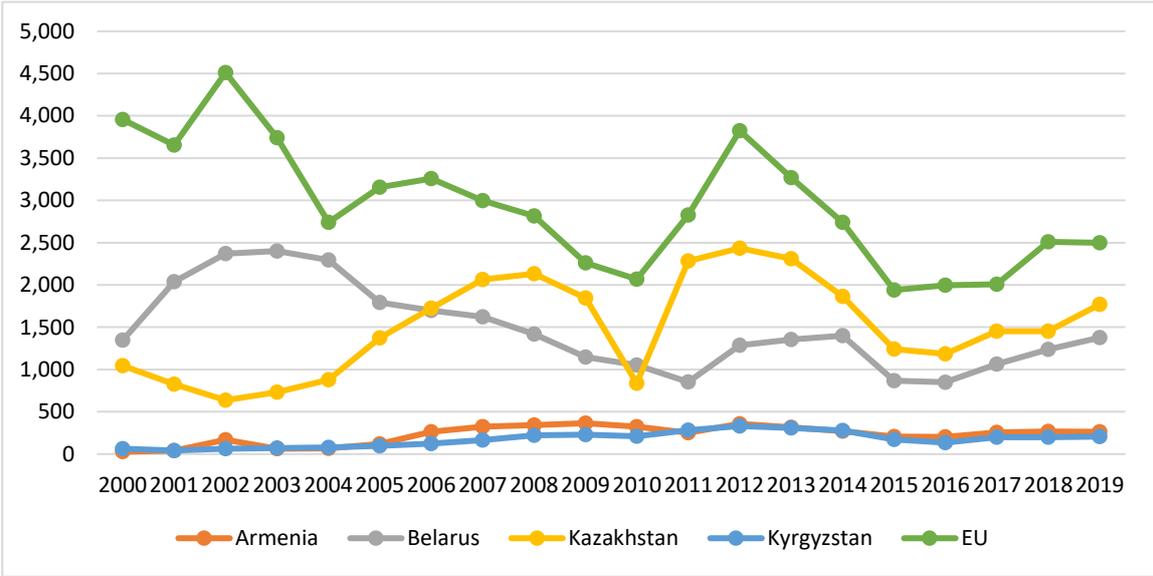
Figure 2. Import from Russia to EU and EACU from 2000 to 2019(in billion U.S. dollars)

The graph represents fluctuations with some shocks in international trade. The last leap is due to the introduction of an import ban in 2014. It affected all countries imports and exports, even which did not involve into ban. However, after decreasing, the amount of trade started to grow up. Thus, despite the several fluctuations, the import of agricultural products from Russia to EU and EACU is stable. Thereby import flow trade is quite permanent and these countries are potential consumers of organic production due to strong trade relationship and mutual agreement between firms. Last five years the main European trade partners for import from Russia were Germany, United Kingdom, Poland and Netherlands. Three types of agricultural products are mainly imported from Russia to European Union with covered 80% of all imports, they are fish, cereals, fats. The range of imported to EACU products is quite big.

The overview of organic production current state is based on the comparison of EAUE countries, Russia and selected European countries which are the main trade partners.

The European countries which are main trade partners have high level of organic land and for this reason could be high organic product competition during entering to organic market (Table 1).

The growing market for organic products, especially in developed European countries, requires the involvement in the production process of lands where mineral fertilizers and

chemical plant protection products have not been used for a long time. There is a limited number of such agricultural land in Europe.

Table 1. Organic production in 2019 (own calculation; World organic Agriculture report)

Country	Organic area [ha]	Organic share [%]	Organic producers [no.]
Armenia	594	0.04	29
Belarus	1,375	0.02	31
Kazakhstan	294,289	0.1	41
Kyrgyzstan	19,054	0.2	1,051
Russia	674,370	0.3	92
France	2,240,797	7.7	47,196
Germany	1,613,785	9.7	34,136
United Kingdom	459,275	2,6	3,584
Poland	507,637	3.5	18,655
Netherlands	68,068	3.7	1,867

Currently 72.3 million hectares of organic farming area is used worldwide. Analysis of the structure of the organic farming area by country in 2019 compared to 2007 did not reveal significant changes (Table 2).

Table 2. Calculation of Spearman's rank correlation coefficient based on the indicator of the structure of the organic farming area in 2007 and 2019

Country	2019 Share of the country in total organic farmland, %	Rank	2007 Share of the country in total organic farmland, %	Rank	d	d²
Australia	49.431	1	38.082	1	0	0
Argentina	5.087	2	8.825	2	0	0
Spain	3.262	3	2.557	10	7	49
United States of America	3.222	4	5.515	3	1	1
India	3.185	5	3.273	6	1	1
France	3.104	6	1.770	12	6	36
China	3.069	7	4.933	4	3	9
Uruguay	2.969	8	2.957	8	0	0
Italy	2.761	9	3.654	5	4	16
Germany	2.235	10	2.749	9	1	1
Canada	1.830	11	1.767	13	2	4
Brazil	1.777	12	2.961	7	5	25
Russian Federation	0.934	13	0.107	50	37	1,369
Austria	0.928	14	1.652	14	0	0
Sweden	0.850	15	0.979	17	2	4
….	….	….	….	….	….	….
Zimbabwe	0.001	122	0.001	122	0	0
Total	**100**	x	**100**	x	x	**47,566**

Spearman's coefficient (0.86) indicates insignificant structural changes. The composition of the group of countries, the largest in terms of land occupied by organic production, has not changed practically, the leading positions in this indicator are occupied by Australia (38.1%), Argentina (8.8%) and the USA (5.5%). The role of China (4.93%) and Brazil (2.96%) increased in 2019. At the same time, the Russian Federation was in 50th place in 2007, and moved to 13th place with a share of 0.3% of the total area. That is, there has been a significant increase in the share of countries with large-scale agricultural land. In the Russian Federation, organic farmland increased from 9,861 hectares in 2000 to 674,370 hectares in 2019, with the most stable growth observed since 2011 (on average by 68.4 thousand hectares or 24.9 % annually). According to the National Organic Union of the Russian Federation (National Organic Union, 2021), the number of certified according to the interstate standard organic producers, represented by farms and large agricultural holdings, is also increasing annually, from 12 in 2004 to 92 in 2019. In 2020, a Federal Law on organic products was passed, regulating its production. By December 2021, the 105th organic certificate was registered in the unified state register of the Ministry of Agriculture of Russia. In 2020, 44 registered companies were directly engaged in production, mainly crop products. About 70% of them work for the domestic market and are small farms. Large crop companies mainly work for export. Sales of organic products in the Russian Federation, including imports, exceeded €190 million. Russian producers accounted for 20-25% of this volume (€ 35-45 million). Products worth € 20-30 million were exported. Trends in the increase in the number of producers of organic products and areas of agricultural land occupied by organic production coincide with global trends: in general, for all countries, the average annual increase in organic farmland in the period from 2000 to 2019 was 8.3%, the number of producers – 14.2%. In addition, for small forms of management, which at this stage of development of the agricultural sector cannot fully compete with large agricultural complexes, the production of organic products can be a point of growth of opportunities, allowing them not only to survive, but to fully compete with large companies due to the high quality of products. For the majority of rural areas of the Russian Federation, organic farming may be the only possible development model.

Further expansion of organic production in agriculture in Russia is possible due to the existing unused agricultural land for a long period of time. With a total area of farmland at the end of 2019 of 221,955 thousand hectares, the area of fallow lands amounted to 4,926.6 thousand hectares. The distribution of fallow lands varies across the territory of Russia (Table 3).

The analysis of the results of grouping shows that fallow lands are concentrated mainly in regions with a fairly developed agricultural production, while the use of mineral fertilizers in these regions is on average lower than in the regions of the 2nd group by 17.3% and by 48.9% than in the regions of the 3rd group. The analysis of atmospheric pollution requires special attention in substantiating the possibility of producing organic products. So, in the first group of regions, the level of pollution is the lowest (on average 92.3 thousand tons in 2019). It is also worth noting that in the regions of groups I and II and as a whole in the sample, there is a tendency towards a reduction in emissions of harmful substances into the

atmosphere from 2005 to 2019 on average annually by 1.6 thousand tons, 4.2 thousand tons and 0.7 thousand tons, respectively. That is, the development of organic agriculture in these regions is possible. And the fulfillment of the condition of minimizing pollution for the production of organic products will contribute to the conservation of natural resources and biodiversity, and therefore, fulfill one of the tasks of sustainable agriculture.

Table 3. Characteristics of groups of regions of Russia by area of fallow lands according to 2019

Indicator	groups of regions by area of fallow lands, thousand hectares			Average
	I over 100	II from 10 to 100	III less than 10	
Number of regions	13	24	27	64
The area of fallow lands, thousand hectares:				
total	3,793.7	1,043.1	89.8	4,926.6
per 1 region	291.8	43.5	3.3	77.0
Share of Gross Value Added of agriculture in Gross Regional Product, %	8.2	7.1	9.4	8.3
Application of mineral fertilizers per 1 sown area, kg	38.2	46.2	74.7	55.8
Emissions of pollutants into the air, thousand tons	92.3	156.6	189.1	157.7
The share of peasant farms and subsidiary farms in the value of gross agricultural output, %	47.9	46.6	51.8	49.0

The regions of the first group are located on the territory of the Far Eastern Federal District and the Siberian Federal District. The inclusion of fallow lands in these districts in the production use will eliminate the violation of the country's territorial integrity due to purchases and leases by representatives of other countries (in particular, China), solving one of the specified tasks of sustainable agriculture.

Another important factor that determines the segment's predisposition to the transition to organic production is the share of competitive farms and small organizations that have sufficient flexibility in changing the production process. The agricultural sector of Russia is a system of complex structure, the elements of which are large and medium-sized agricultural organizations, including agricultural holdings, peasant farms and subsidiary farms; each of the elements has its own characteristics of the organization of the production process and the objectives of the activity. At the same time, peasant farms and subsidiary farms represent a small business that aims to provide the domestic market, organizes the production process on small areas of farmland, with a low volume of use of genetically modified products, chemicals. Subsidiary farms mainly have non-commercial production aimed at meeting the needs of a particular household, based on the principles of healthy nutrition. It is these categories of producers that are promising for the development of organic production. The preservation of various forms of organization of production and the development of small businesses makes it possible to ensure the sustainability of agriculture in times of crisis, which are difficult for large agricultural organizations bound by the terms of long-term contracts, including logistics. As can be seen from Table 3, in the Russian regions there is a

high proportion of small businesses in the total volume of agricultural production. The introduction of land into the production process by peasant farms will allow preserving multistructural agriculture and ensuring the stability of the agricultural sector during periods of crisis through effective redistribution of resources, their conservation, and increased employment in the agricultural sector.

In the world market, the most competitive are organic wheat, green peas, soybeans and buckwheat; also they are in great demand. High growth potential due to the large share of peasant farms in production has organic vegetable growing in open ground for the domestic market. In animal husbandry, the most promising direction for the production of organic products is dairy farming. Farms in this sector of the agro-industrial complex are the most competitive and mobile enough to meet the growing demand for organic products. High investment activity in the milk processing segment may also lead to an increase in demand for organic milk. At the same time, the growth of competition among processors will increase the profitability of producers of organic raw materials, and ensure the stable development of the agricultural sector. An increase in the production of organic milk will naturally lead to an increase in the demand for organic green feed.

The study (Sapbamrer & Thammachai, 2021) noted that one of the factors for the development of organic agriculture is the availability of neighboring farms for the producer, also with organic production, to ensure that production is clean from the effects of chemicals. This approach will contribute to the development of cooperation of peasant farms, including with large agricultural organizations. This will ensure the expansion of the use of expensive digital technologies in the production process, preserving land fertility, increasing productivity and labor productivity, which is consistent with the objectives of sustainable agriculture (Arkhipova et al., 2021).

Studies (Hanmann et al., 2020; Aertsens et al., 2009) have shown that Income is positively related to organic purchases. Therefore, the possibility of developing organic agriculture in Russia for consumption on the domestic market is largely determined by trends in household income. On average, the price difference for organic dairy products compared to conventional products is: milk – 220%, cottage cheese and butter – 380%, fermented baked milk – 550%, sour cream – 745%. Meat products are represented mainly by beef and lamb. The cost of lamb meat is 80-100% higher than the usual one, beef is 200-600%. Real disposable money incomes of the population have been showing a steady upward trend since 2000. So, from 2000 to 2020, the income of the population increased 2.44 times while maintaining the share of spending on food in the range of 29.6-31.2%, ensuring the effective demand of the population for organic products. Research conducted by the National Organic Union of the Russian Federation (National Organic Union of the Russian Federation, 2021) showed that "a huge advantage of the organic market is the loyalty of consumers to products, despite any crises. Despite all the problems, a person who adheres to proper nutrition tries not to return to ordinary foods. According to the specialists of the Union, during the crisis period of 2013-2015, the main part of clients remained, despite the problems, both legal and economic, and since 2016, with the growth of household incomes, the number of clients began to grow again." Thus, the production and sale of organic

products is a sustainable source of income for farmers. Higher selling prices of organic products provide a higher level of income for producers and a basis for modernization of production at their own expense and for obtaining credit funds.

One of the tasks of the current stage of development of the agrarian complex of Russia is to ensure the biological safety of production, preservation of soil fertility, purity of water resources, which is indicated in the State Program for the Development of Agriculture and Regulation of Markets for Agricultural Products, Raw Materials and Food (State Program). Conservation agriculture is one of the manifestations of organic production. The availability of information for the population about the content of resource-saving production and the characteristics of organic products ensures an increase in demand for these products in the domestic and world markets (Prado & Moraes, 2020). There is no massive advertising of organic products in Russia. The main source of information is the data presented on the packaging of the product itself and in the certificate, which complicates the formation of mass interest among the population in this type of product. However, according to a social survey, 58% of Russians are ready to overpay for ecological products. Producers can receive information about organic farming, as well as timely expert advice through the National Organic Union (Korshunov, 2019).

4. Discussion

The hypothesis put forward about the positive impact of the development of organic production on the sustainability of agriculture in Russia was confirmed. The study found that:

- growth in the size of organic farmland and the number of producers, and consequently the production volumes in Russia coincides with global trends, corresponds to the growth in demand in the world market for this type of agricultural products from the population and processors, i.e. increases the export potential of the country's agricultural sector and strengthens the country's position in the world market;
- organic agriculture ensures the inclusion of previously unused agricultural land in the production process, which ensures the integrity and sustainability of the country's rural areas, the inclusion of farms and small agricultural organizations in the production process, the development of producers' cooperation, thereby forming sustainable domestic production;
- the production of more expensive products, secured by effective demand, increases the profitability of the activities of produces of different categories, the possibility of their technical modernization and the stability of the agricultural sector.

The study found that the Russian Federation has conditions for the development of organic production: the presence of fallow areas; active participation in the formation of agricultural output of peasant farms and other forms of small business, capable of switching over to new production technologies in a short time; growth of incomes of the population, development of processing industries, which form effective demand; government regulation and support of organic production; the presence of our own powerful research and

production base for the development of organic agriculture and the biologization of agriculture (specialized research institutes, domestic production of biological products based on a bacterial bank, the Center for agricultural consulting and retraining of agro-industrial complex personnel) (Korshunov, 2019).

At the same time, there are a number of restrictions in the development of organic production: insufficient information support for consumers and producers; unlimited overpricing of organic products in retail chains; insufficient level of actual profitability of manufacturers for the use of innovative technologies without additional public and private investments.

One of the conditions limiting the scope of research and forecasting the development of organic production in Russia is the lack of data from official statistical observation in the context of the constituent entities of the Russian Federation on the amount of produced and consumed organic products, production costs by type of product. The direction of further research can be the identification of clusters of regions according to the level and potential of development of organic agriculture in order to formulate agricultural policy for sustainable agriculture.

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Relationship between Income Inequality, Poverty and Economic Growth, Comparative Analysis in Eastern and Western Europe with Panel Data

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Abstract: The relationship between income inequality, economic growth and poverty has a very complex structure. Eastern European countries had planned economy and socialist (communist) economy management in the past. The socialist (communist) form of state administration has not been experienced in Western European countries (except for Germany). According to real gross domestic product (real GDP) per capita data, Eastern Europe is poorer than Western Europe. In addition, income inequality is higher in Eastern Europe than in Western Europe. The study aims to show comparatively the relationship between income inequality, poverty and economic growth in Eastern and Western Europe in the period 1995-2016. The study results show that economic growth reduces absolute poverty ($3.2 poverty line – 2011 PPP) in Eastern and Western Europe. However, while economic growth increases income inequality in Eastern Europe, there is no relationship between these two macroeconomic indicators in Western Europe.

Keywords: economic growth; income inequality; poverty; panel data analysis

JEL Classification: I30; O10; O15

1. Introduction

Income inequality is one of the most interesting issues in the political arena. For the majority, it is important to understand the social cost of income inequality and its impact on the poor, as the quality of their standard of living is related to the income they earn. Increasing income inequality can negatively affect concepts such as health, education and government representation (Baden et al., 2015) Income inequality is one of the indicators that show how the resources in the economy are distributed in the society. In addition, income inequality measures are needed to measure poverty. Poverty is often discussed together with the poverty line. The situation in which individuals do not have the necessary income to survive is defined as absolute poverty. The most important parameter used to measure absolute poverty is the US dollar per day (Keeley, 2015). $1.90 per day is defined by the World Bank as the extreme poverty line. In 2018, the World Bank established additional poverty lines to explain the changing concept of global poverty. The $3.20 and $5.50 per day limits reflect the poverty lines in lower-middle-income and upper-middle-income economies, respectively. The 2020 World Bank Poverty and Shared Prosperity report shows that for the years 1990-2017, the poverty rate, which is the ratio of those living under $3.20 per day to the

total population, decreased in Europe and the Central Asia region. While the poverty rate ($3.20 poverty line) in this region was 10.3% in 1990, it decreased to 4.3% in 2018. The poverty rate, which takes into account those who are below $5.50, decreased from 25.8% in 1990 to 11.9% in 2018 (World Bank, 2020).

The world economy has been growing despite the financial crisis in East Asia in the 1990s. The issue of how much the poor benefit from this growth is a controversial issue. While some of the views point out that the poor do not benefit from the potential benefits of economic growth, according to the opposing views, liberal policies such as monetary and financial stability and free markets increase the income of both the poor and the rest of the society (Dollar & Kraay, 2002). Based on the trickle-down theory of development, neoliberals argue that economic growth will benefit society as a whole. According to those who support this view, government interventions to reduce poverty and ensure income distribution will negatively affect the market, as they will lead to a decrease in economic incentives, increase in inflation and unemployment. In 1980s, neoliberal policies were imposed on the underdeveloped economies, which had slow growth and problems in the balance of payments, in order to benefit from the World Bank and IMF (International Monetary Fund) loans. Grants and low-interest loans of the World Bank and IMF were used as tools in the implementation of neoliberal policies. If trade barriers are removed in developing countries, the demand for low-skilled labor will increase and, as a result, earnings will increase. Neoliberals are of the opinion that trade liberalization will bring the growth rates of countries closer to each other. By the end of the 1970s, some countries began to implement neoliberal policies, but the results on economic growth are rather mixed. Although neoliberals attribute the low growth rates to the lack of reforms, the impact of neoliberalism on the poor is of considerable concern (Johnston, 2005).

Eastern European countries consist of the former Soviet Union and Eastern Bloc countries. In 1989, the Eastern bloc collapsed, and in 1991 the Soviet Union disintegrated and new independent countries were born. Until 1991, Eastern European economies were included in a planned economy in which the state owned the means of production, the state controlled the market instead of a free market economy, and the state decided on production and distribution throughout the country. With the collapse of the Eastern Bloc and the collapse of the Soviet Union, the political propositions of neoliberalism spread all over the world. In this process, the planned economies left their place to the free market economy in the countries that became independent from the Eastern bloc countries and the Soviet Union. At the same time, these countries have experienced a painful transition period in the process of opening up to the outside and the formation of the private sector. While the wages of individuals are closer to each other in planned economies, wages differ according to education and skills in countries that have passed to free market economy. The deterioration of income distribution in Eastern European countries is shown as this process. In addition, with the transition to a free market economy, the state lost its influence on market control. In this case, the power of the state in the redistribution of income weakened.

Western European countries, on the other hand, are countries governed by a free market economy. The socialist (communist) form of state administration has not been experienced in

Western European countries (except for East Germany). GDP per capita and living standards are higher in all Western European countries than in Eastern European countries.

According to Penn World Table 9.1 (Feenstra et al., 2015), in Eastern and Western Europe, real GDP per capita (2011 US$) increased from 1995 to 2016. It is observed that the growth rates of Eastern Europe are higher than the growth rates of Western Europe. When we examine the poverty data for the same period, it is seen that the ratio of individuals with a daily income below US$ 3.2 – according to the 2011 PPP (Purchasing power parity) – to the total population has decreased in both regions since 1995 (The World Bank, 2021). Global income inequality has risen sharply since 1980 despite strong growth in China. Income inequality has increased in almost all regions of the world in recent years, but the rate of increase has been different from region to region. In countries with similar levels of development, the level of income inequality differs. The increase in the share of the people with the highest income level of the society in the total income is an indicator of the increase in inequality. From 1980 to the present, the share of 10% of the highest income of societies in total income has increased (Alvaredo et al., 2018). We see that the income-share of the 1% and 10% of the society with the highest income increased in this period. The share of 10% and 1% of the population with the highest income in total income has increased in both Eastern and Western European countries. While this increase was more moderate in Western Europe, a very serious increase was experienced in Eastern Europe. All these indicators reveal the existence of an injustice in the distribution of income in Eastern and Western Europe (WID, 2021).

The reason why Eastern European and Western European countries were chosen in the study is that Eastern and Western Europe not only represents a geographical separation, but also represents economic development and less development. Both regions have different economic management system infrastructures. In addition, it is seen that they are different in terms of income distribution and wealth distribution. The aim of our study is to analyze comparatively how there is a relationship between economic growth, income inequality and poverty in these economies, which had different economic management styles in the past, close to each other in terms of geographical borders but different from each other in terms of per capita income.

1.1. Literature Review

Although economic growth is a powerful mechanism in reducing poverty, there is no rule that economic growth will completely reduce income inequality. While economic growth increases the wealth of the rich, the poor may not gain from this growth in any way (Baden et al., 2015). Regardless of the level of income inequality, economic growth reduces poverty. Although the poverty-reducing effect of economic growth is undeniable, the fact that the effect of economic growth on poverty varies by region, supports the view that growth is not sufficient to reduce poverty. The rate and form of growth and the method by which poverty is measured determine the effect of growth in reducing poverty (Škare & Družeta, 2016).

Dollar and Kraay (2002) defined the 20% of the society with the lowest income as poor. They examined the relationship between the incomes of this group and economic growth in developed and developing countries. The study includes 137 countries and 953 observations

for the time period 1960-2009. According to the results of the study, if the average incomes increase, the incomes of the lowest 20% increase at the same rate. The same is true for vice versa. The incomes of the 20% of the poor with the average income are valid not only in normal economic times, but also in times of crisis. Other results of the study are that policies such as financial discipline, openness in international trade, the rule of law, private property, and low inflation increase the average incomes by improving the income distribution. The study findings show that the poor also benefit from economic growth. Although there is no clarity in the literature about which combination of growth-oriented policies will benefit the poorest of society, the findings of this study show that growth and the policies that support it benefit both the poor and the rest of society (Dollar & Kraay 2002).

Adams (2003) analyzed the effect of economic growth on income inequality and poverty for the time period 1980-1999. The model included 50 low- and middle-income countries with at least two representative household surveys. The study findings show that economic growth is important in reducing poverty in developing countries. Adams (2003) attributes that economic growth reduces poverty and this is because economic growth has no effect on income inequality. These findings show that economic growth does not have a significant effect on income inequality. According to the study, income inequality may increase, decrease or remain constant throughout economic growth (Adams, 2003).

Bourguignon (2004) introduced the concept of the Bourguignon Triangle, which is named after him. This model highlights the relationship between economic growth and distribution in relation to poverty reduction. In this model, importance is given to the interaction between growth, poverty and distribution. According to Bourguignon (2004), a change in poverty is a function of growth, distribution, and change in distribution. The change in income distribution can have a growth and distribution effect. The growth effect is a proportional change or growth in all incomes without changing the relative income distribution. The distribution effect, on the other hand, expresses the change in the relative income distribution, different from the average. Economic growth can change the distribution of income and wealth through many channels. In the development process, economic growth can affect income distribution by changing the allocation of resources by sector, relative prices and factor rewards. If growth policies ignore income distribution, they will not be effective enough to reduce poverty.

Fosu (2010) examined the impact of income inequality on poverty reduction for the East Asia and Pacific region, Europe and Central Asia region, Latin America and Caribbean region, Middle East and North Africa, South Asia region and sub-Saharan Africa region. In the study covering the time period 1980-2004, unbalanced panel data analysis was performed. In the equation where the dependent variable is the poverty rate (the ratio of the number of people living on $1 per day or $32.78 per month – according to the 1993 PPP – to the total population), the independent variables are the Gini coefficient (as a percentage) and the average monthly income (1993 PPP). In the study, in which fixed effects and random effects models were used, it was concluded that income distribution plays an important role in poverty reduction, contrary to traditional ideas. According to the results obtained, while an increase in income reduces poverty, an increase in inequality increases poverty. Income

inequality affects poverty in two ways. A high level of income inequality reduces the poverty reduction limit as a result of an increase in income. Another way of influencing is that if income inequality increases, it increases poverty at an increasing rate with the average income level.

Fosu (2011) examined growth, income inequality, and poverty reduction for 123 countries with data in 7 regions around the world, from 1981 to 1990 and from 1990 to 2005. It also included a global sample of 80 countries in the analysis. The results show that at both poverty levels ($1.25 and $2.5), an increase in incomes reduces poverty, while a decrease in income increases poverty. Although growth is the main factor in poverty reduction in most countries, it should be noted that income inequality is influential in the behavior of poverty.

Michálek and Výbošťok (2019), as a result of their study on 28 EU members for the years 2005-2015, found that economic growth encourages poverty reduction and that the increase in income inequality encourage poverty increase. The results show that economic growth and distribution affect the poverty level in EU countries. It has also been stated that countries with strong economies are better able to cope with poverty and income inequality in times of crisis (Michálek & Výbošťok, 2019).

Lechheb et al. (2019) examined the effect of economic growth on poverty and income inequality for the years 1970-2018 for 51 low-income countries. According to the results obtained in this study, in which unbalanced panel analysis was performed, the increase in income inequality causes a decrease in GDP per capita. In the study, it was stated that a 1% increase in the Gini coefficient would cause a 3.8% decrease in GDP per capita. In addition, in the study, it was concluded that there is a negative relationship between the poverty gap and economic development. A 1% increase in real GDP causes a 6.4% decrease in the proportion of people living below the poverty line. The results of the study show that economic growth is effective in reducing poverty in developing countries (Lechheb et al., 2019).

According to the World Bank's (2020) Poverty and Shared Welfare report, job losses have increased significantly due to the pandemic caused by the coronavirus (COVID-19). Thus, on a global scale, the situation of the poor has worsened, while new poor have emerged. According to forecasts for 2020, the pandemic is expected to push 100 million people into extreme poverty. In addition, the poverty-increasing effect of armed conflicts in some regions should be taken into account. The extreme poverty rate has doubled in the Middle East and North Africa from 2015 to 2018, due to the conflicts in Syria and Yemen. The report also examines the impact of climate change on poverty. According to the results, 132 million people may remain poor due to climate change. It is inevitable that pandemics, economic recessions, wars and climate change will have human and economic costs in the future. Global poverty estimates show that the poverty reduction process continues to slow down due to the impact of COVID-19 and it is difficult to reach the target of 3% in extreme poverty for 2030. In addition, conflicts and climate change are also factors that reverse poverty reduction (World Bank, 2020).

2. Methodology

Panel data analysis is the name given to the estimation methods with panel data models, which consist of combining the data collected from different units at a certain time (horizontal

section) and the data (time series) containing the change of variables according to the time unit (Baltagi, 2005).

The general regression equation used in panel data estimations is shown as equation

$$y_{it} = \alpha + \beta X_{it} + u_{it} \qquad (1)$$

Depending on the u_{it} error term assumptions, modeling can be done as a one-way and two-way panel data model. Depending on the assumptions on the error term components, estimation can be made in the form of Fixed Effects and Random Effects models (Baltagi, 2005).

The relationship between income inequality, economic growth and poverty was examined for a time period covering the years 1995–2016 by panel data analysis, by establishing two equations for the dependent variable, namely income inequality and poverty. The independent variables in the model are respectively stated as real GDP per capita, unemployment rate, openness rate, years of education and investment rate.

The explanations of the variables used in the model are shown in Table 1.

Table 1. Explanations of variables used in models testing the relationship between income inequality, economic growth and poverty

Variable	Description	Source
GİNİ$_{it}$	Gini coefficient before tax and government transfers at i unit and t time	SWIID (The Standardized World Income Inequality Database) (Solt, 2019)
lnRGDPPCP$_{it}$	Real GDP per capita in i units and t times (2011 USD \$)	Penn World Table 9.1 (Feenstra et al., 2015)
POVERTY$_{it}$	Ratio of population in households living below the poverty line (3.2 \$ (adjusted for purchasing power parity (2011 PPP)) to total population - Headcount ratio (%)	PovcalNet (The World Bank, 2021)
OPENNES$_{it}$	Openness rate calculated, by dividing the sum of exports and imports by GDP (calculated at constant national 2011 prices).	Penn World Table 9.1 (Feenstra et al., 2015)
UNEMPLOYMENT$_{it}$	Ratio of the total number of unemployed to the total labor force in i units and t times (modeled (ILO) estimation)	World Bank (2021)
INVESTMENT$_{it}$	Ratio of total investment to GDP in i units and t time	World Bank (2021)
EDUCATİON$_{it}$	Average years of education received by persons aged 25 and over at i unit and t time	UNDP (2021)
α_{it}	Constant coefficient	
$\beta 1_{it}$, $\beta 2_{it}$, $\beta 3_{it}$, $\beta 4_{it}$, $\beta 5_{it}$, $\beta 6_{it}$	Slope coefficients in i unit and t time	
u$_{it}$	Error term in i units and t time	

The relationship between income inequality, economic growth and poverty in Eastern and Western Europe for the years 1995–2016 was examined through panel data analysis using the STATA statistical program.

The income inequality regression equation is equation 2.

$$GİNİ_{it} = α + β1_{it} * lnRGDPpc_{it} + β2_{it} * POVERTY_{it} + β3_{it} * OPENNES_{it} + β4_{it} * \\ EDUCATION_{it} + β5_{it} * UNEMPLOYMENT_{it} + β6_{it} * İNVESTMENT_{it} + u_{it}$$ (2)

The poverty regression equation is equation 3.

$$POVERTY_{it} = α + β1_{it} * lnRGDPpc_{it} + β2_{it} * GİNİ_{it} + β3_{it} * OPENNES_{it} + β4_{it} * \\ EDUCATION_{it} + β5_{it} * UNEMPLOYMENT_{it} + β6_{it} * İNVESTMENT_{it} + u_{it}$$ (3)

Panel data analysis was performed separately for Eastern and Western European countries. Panel data of Eastern and Western European countries are arranged as Panel East and Panel West, respectively. The country groups in which the validity of the regression equations 2 and 3 will be tested are classified as follows.

Panel East: Eastern European countries – Belarus, Bulgaria, Czech Republic, Hungary, Moldova, Poland, Romania, Russia, Slovakia, Ukraine.

Panel West: Western European countries – Austria, Belgium, France, Germany, Luxembourg, Netherlands and Switzerland.

Panel East is designated as Panel East 1 and Panel East 2 where in Panel East 1 income inequality is the dependent variable, in Panel East 2 the poverty rate is the dependent variable. Also, Panel West is designated as Panel West 1 and Panel West 2 where in Panel West 1 income inequality is the dependent variable, in Panel West 2 the poverty rate is the dependent variable. Although all variables are the same in all panels, the dependent variables are different. Two regression equations for each of East and West Europe countries were tested in order to examine the effect of economic growth on income inequality and poverty.

3. Results

The cross-sectional dependence of the variables in the East and West panels was tested with Pesaran CD test. According to the results obtained, there is a cross-sectional dependence in the variables in both panels. For this reason, the second-generation Pesaran CADF unit root test was applied. If a unit root is found in the variables as a result of the Pesaran CADF unit root test, the first difference of the series is taken and the non-stationarity problem is eliminated. Panel East and panel West have variables that contain a unit root. The unit root test was applied again by taking the first-degree differences of these variable series. It was concluded that all series were stationary, except for the education variable in the western panel. While interpreting the education variable in the western panel, the interpretation should be made considering that this variable is non-stationary.

After completing the unit root tests for Panel East and Panel West, unit and time effects on the data in the East and West panels were tested using the F test. According to the results of the F test, the H_0 hypothesis, which states that the unit effects are equal to zero in the East 1 and East 2 panels, is rejected. Therefore, the East 1 and East 2 panels have a unit effect. According to the results of the F test, in which the H_0 hypothesis, which states that the time effects are equal to zero, is tested, the H_0 hypothesis cannot be rejected in the East 1 and East 2 panels. There is no time effect in Panel East 1 and East 2. In the East 1 panel, estimation was made using the fixed effects model and the random effects model. Hausman test was applied

to choose between fixed effects and random effects model. According to the results obtained, the random effects model was found to be more effective, since H_0, which states that the change in the coefficients is not systematic, cannot be rejected (Prob>chi2=0.0949). Since the slope coefficients of both models are very close to each other and the time dimension is larger than the unit dimension, the study was continued with the fixed effects model. In addition, the number of Prob>chi2=0.0949 obtained as a result of the Hausman test supports the fixed effects model at 10% significance level. In the East 2 panel, Hausman test were applied to decide between estimators. In the results obtained, the H_0 hypothesis is rejected at the 5% statistical significance level, so it is seen that the use of the fixed effects model is more appropriate. In panel East 1 and East 2, where we applied the fixed effects model, the basic assumption tests of heteroscedasticity, autocorrelation test and cross-section dependency test were applied. In the fixed effects model, the heteroscedasticity is answered with the Modified Wald test. According to the results obtained, the H_0 hypothesis, which states that there is no variance according to the units, is rejected in both panel East 1 and East 2. Therefore, it is concluded that there is a heteroscedasticity in both panels. The autocorrelation problem in the fixed effects model was tested with Durbin-Watson Test and Baltagi--Wu's LBI Test. The values obtained as a result of the test are less than 2. Therefore, it is concluded that there is an autocorrelation problem for the fixed effects model we applied. Cross-section dependence in the fixed effects model was tested with the Pesaran test, Friedman test, Breusch-Pagan Lagrange Multiplier LM test and Frees test. All test results indicate the presence of cross-section dependence. According to the results of the assumption tests, there is a heteroscedasticity, autocorrelation and cross-section dependence in Panel East 1 and East 2. The Driscoll – Kraay estimator was used to obtain the resistant standard errors in the case of the three problems in the panels (Tatoğlu, 2018; Ün, 2018).

According to the results, there is a unit effect in panel West 1 and West 2. In the West 1 panel, it was determined that there is a time effect. Due to the existence of both unit and time effects, two-way panel data model was used instead of one-way panel data model in panel West 1. According to the Hausman test result, it is more effective to use the two-way fixed effects model in Panel West 1. In the West 2 panel, which has a unit effect but no time effect, a one-way panel data model is used. One-way Hausman test was applied to test which of the fixed effects and random effects model was more suitable. The results show that using the fixed effects model is more effective. Two-way fixed-effects model was used in panel West 1, one-way fixed-effects model was used in panel West 2, heteroscedasticity, autocorrelation and cross-section dependence tests were performed from the basic assumption tests. As a result of the assumption tests, it was found that there was heteroscedasticity, autocorrelation and cross-section dependence in panel West 1 and West 2. In this case, the Driscoll – Kraay estimation method was used for both panels to obtain the resistant standard errors.

The results of the Driscoll Kraay estimator for all panels are given in Table 2.

Table 2. Driscoll-Kraay estimator results for panel East 1, East 2, West 1 and West 2

	East 1	West 1	East 2	West 2
gini	**Dependent variable**	**Dependent variable**	2.337162 (0,000 ***)	0.1293377 (0.000 ***)
lnrgdppcp	1.819327 (0.000 ***)	0.4361491 (0.874)	-21.11178 (0.000 ***)	-2.861163 (0.000 ***)
poverty	0.0441662 (0.000 ***)	1.291522 (0.001 ***)	**Dependent variable**	**Dependent variable**
opennes	0.0165873 (0.000 ***)	0.0190652 (0.000 ***)	0.0455699 (0.060*)	0.0010827 (0.252)
education	-0.2810328 (0.088 ***)	0.7297898 (0.000 ***)	-3.083401 (0.049**)	0.0023645 (0.949)
unemployment	0.2391554 (0.000 ***)	-0.0820361 (0.055*)	-0.9995604 (0.002 ***)	-0.0100771 (0.456)
investment	0.1405229 (0.000 ***)	-0.2126339 (0.000 ***)	-0.6715547 (0.001 ***)	0.0282703 (0.098*)
Constant	20.58167 (0.000 ***)	36.173293 (0.215)	162.7289 (0.000 ***)	23.95307 (0.000 ***)
Number of obs	220	153	220	153
Number of groups	10	7	10	7
within R-squared	0.3367	0.8948	0.48	0.4556

Notes: ***, ** and * indicate 1%, 5% and 10% statistical significance.

According to the results of panel data analysis covering Eastern European countries, as GDP per capita increases, income inequality increases, but poverty decreases. There is a positive and significant relationship between poverty and income inequality in Eastern Europe. An increase in the openness ratio increases both income inequality and the poverty rate. The education variable has a negative relationship with both the Gini coefficient and poverty. Income inequality and poverty are decreasing in Eastern Europe as the average years of schooling for people over 25 years of age increase. It is among the findings that the poverty-reducing effect of the education variable is greater than the income inequality-reducing effect. The result is that the increase in unemployment rate increases the Gini coefficient and reduces poverty. While the increase in investment increases inequality, it reduces the poverty rate.

The results of panel data analysis covering Western European countries show that GDP per capita does not have a statistically significant effect on income inequality. It is seen that there is a negative relationship between economic growth and poverty rate. As real GDP per capita increases, poverty decreases in Western Europe. It was concluded that there is a positive and statistically significant relationship between poverty and income inequality in Western Europe. The openness ratio has a positive and statistically significant relationship with the Gini coefficient. There is a positive relationship between the education variable, which we found to be non-stationary for Western Europe, and the Gini coefficient. According to the results, an increase in unemployment reduces income inequality. It is seen that there is no statistically significant relationship between poverty and independent variables: openness, education and unemployment rate. Finally, according to the results obtained from the Western Europe panel, an increase in the ratio of investments to GDP has the effect of reducing income inequality and increasing poverty.

4. Discussion

Measuring and analyzing income inequality is a very complex issue. Likewise, its relationship with economic growth has led to different results in different studies. Results may vary according to the variables used to measure income inequality, the variables representing economic growth, the methods applied, the time interval and the country structures.

A positive and statistically significant relationship was found between GDP per capita and income inequality coefficient in Eastern Europe. As per capita income increases, income inequality increases. The results support the results of Baden et al. (2015), Forbes (2000), Rubin and Segal (2015), Abdioğlu (2019), Kiatrungwilaikun and Suriya (2015), Jovanovic (2018). No significant relationship was found between income inequality and economic growth in Western European countries. The results support the results of Adams (2003), Deiningier and Squire (1998), Kuştepeli (2006) Makreshanska–Mladenovska and Petrevski (2019), Erkisi and Ceyhan (2020).

Economic growth reduces absolute poverty ($3.2 poverty line – 2011 PPP) in both Eastern and Western Europe. The poverty-reducing effect of economic growth is much higher in Eastern Europe than in Western Europe. For the Eastern and Western Europe region, the results support the results of Dollar and Kraay (2002), Bourguignon (2004), Adams (2003), Fosu (2010), Fosu (2011), Lechheb et al. (2019), Michálek and Výbošťok (2019).

As the ratio of the population to the total population rises in households living below the poverty line (US$ 3.2 – 2011 PPP), it is seen that income inequality increases in both Eastern European and Western European countries. In addition, the increase in income inequality is a factor that increases poverty in Eastern and Western European countries. The positive relationship between income inequality and poverty parallels the studies of Bourguignon (2004), Fosu (2010), Fosu (2011), Balcı İzgi and Alyu (2018) and Michálek and Výbošťok (2019).

Policies implemented in favor of the rich, changing income structure against labor income, extraordinarily high wages of senior executives, insufficient taxation of capital, shrinking of states, tax cuts and incentives applied to the highest income group, marriage of individuals with the same income level, increase in opportunity inequalities are the factors that can cause the income gap between the poor and the rich. Since the increase in income inequality brings social unrest, policy makers should produce new programs to reduce income inequality and poverty.

In the fight against inequality, Stiglitz proposes to limit the excessive earnings of the upper income group, to strengthen the middle-income group by increasing their income, and finally to implement various programs that will help the poor group (Stiglitz, 2016).

Conflict of interest: none

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The Influence of the Level of Corporate Culture on the Ability to Implement Revenue Management Processes: Review

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Abstract: The aim of this review article is to examine the existing research on the relationship between a company's ability to apply revenue management processes in the hotel industry and the level of the corporate culture. Revenue management as a tool to help achieve desired occupancy levels at average room rates is widely reported in the literature. Similarly, the issue of corporate culture and corporate processes has been the subject of such research. However, the issue of the possible interdependence of these two concepts, i.e. the ability to apply revenue management on the one hand and the level of corporate culture in the hotel industry on the other, has not been sufficiently described in the literature so far. This review article aims to summarize the existing research on this issue, i.e. a possible influence of the level of corporate culture on the level of implementation of the revenue management tool. Given the results of the research, the authors present in the 3rd part the idea of the possible benefits of mutual integration of Revenue management processes and processes associated with the development of corporate culture.

1. Introduction

The hotel industry is a dynamically developing branch of the tourism sector. Like most other sectors of the economy, the hotel industry is facing new and emerging challenges. Economic pressure on the bottom line, ever-increasing costs, especially personnel costs, and other influences are forcing hoteliers to continuously increase revenues. In today's globalized world, sales strategy is the alpha and omega of success for almost every company. In the hotel industry, this is certainly true as well. Revenue management as a tool for achieving higher yields was established in the 1960s. Since then, it has evolved considerably. Nowadays, revenue management is firmly established in the processes of all major hotels and hotel companies. The acceptance of its importance is evidenced, among other things, by the number of research studies on this topic, both in terms of general definition and focusing on the hotel segment. Today it is seen as a reflection of particular management culture. Similarly, there can be no doubt about the importance of corporate culture in the ability to achieve desirable economic results. As with the concept of revenue management, the amount of scholarly

work on corporate culture is considerable. However, when focusing on the topic of Corporate Culture and the Hotel Environment, it is impossible not to see the underrepresentation of the topic. It can be assumed that management culture is based on the level of the corporate culture.

The aim of this review article is to suggest a possible relationship between the ability of hotels to apply the Revenue Management tool and the level of their corporate culture. At the same time, the authors aim to explore the level of research on this topic.

2. Research Methodology

The authors conducted seven, respectively 14 individual searches of research articles in the Scopus and Web of Science databases on February 11, 2022, using the keywords:

- "Revenue management"
- "Hotel revenue management"
- "Hotel corporate culture"
- "Hotel revenue management" AND "corporate culture"
- "Hotel performance" AND corporate culture
- "Hotel performance" AND "organizational culture"
- "Corporate culture"

The filter was set as follows: Scopus: Search within: Article title, Abstract, Keywords. No other limitations. In case of Web of Science: Search within: All fields. No other limitations.

The values in Table 1 show how many articles were found in the listed databases, taking into account the effect of the specified filters.

The search results indicate that the topic of corporate culture is very abundantly represented (see Table 1), hotel revenue management as well as hotel performance is widely represented in the literature. The topic of hotel corporate culture is less represented. In contrast, the connection between hotel revenue management and corporate culture and hotel performance and corporate culture seems to be almost unrepresented. Firms, and therefore hotels, are miniature communities, and if we want to understand their behavior, we need to understand the belief systems within the firm, a key component of what is called corporate culture (Stiglitz & Greenwald, 2014). Although some authors, such as Chen and Li (2007), Han (2012), and Murimi et al., (2021), have addressed the relationship between corporate culture in hotels and their performance, it is clear that the issue would merit deeper research.

Table 1. Terms "Hotel revenue management" and "corporate culture" in databases

	Scopus	Web of Science
"Revenue management"	2,925	4,107
"Hotel revenue management"	127	124
"Hotel corporate culture"	0	2
"Hotel revenue management" AND "corporate culture"	0	0
"Hotel performance" AND corporate culture	1	5
"Hotel performance" AND "organizational culture"	7	6
"Corporate culture"	4,621	3,559

3. Revenue Management

Revenue management is a management tool that is used by hoteliers to achieve the desired results, particularly in terms of occupancy and the achieved price per available room (ADR). Revenue management techniques have been adopted by hotels as an essential tool to maximize profits. This tool is based on the analysis of the amount of data available to the hotel. It is used not only in the hotel industry, but also to a large extent in other service sectors that are characterized by fixed capacity. The main idea is to sell identical services at different prices according to predetermined criteria (Lee & Bai, 2014).

Revenue management is a comprehensive and analytical view of management that not only uses disciplines, such as statistics, mathematics, and marketing but also uses technology. Its implementation and successful use are made possible mainly by a significant change in the understanding of revenue management by business managers themselves. This is the prioritization of profitability over occupancy (Talón-Ballestero & González-Serrano, 2012).

The existing research on the importance of revenue management in the hotel industry has mainly focused on the potential of the revenue management tool and its effectiveness from several perspectives:

1. the influence of the size of the accommodation facility and its accommodation capacity (Ivanov & Ayas, 2017) on the potential of the revenue management tool and its effectiveness,
2. the impact of the level of the accommodation facility as declared by the number of stars (Ivanov et al., 2021). Alternatively,
3. whether the level of the revenue management tool is affected by whether or not (a) the hotel is integrated into a hotel chain (Ivanova et al., 2016).

Alternatively, revenue management is examined from a purely technological perspective, with data subjected to various simulation models, such as in the study by Bandalouski et al. (2021). Some research on revenue management and its impact on hotel performance focuses on some specific issues related to the hotel industry, such as the study by Lentz et al. (2021), *Uncovering the relationship between revenue management and hotel loyalty programs*.

Demand forecasting is another important area of Revenue management application capability issues. Demand forecasting is at the very beginning of the Revenue management process and is a key (Webb et al., 2020) in terms of the whole follow-up process concerning the very basis of Revenue management which is: to offer the right price, to the right customer, at the right time.

According to some authors (Talón-Ballestero et al., 2014), Revenue management is not only an application or a system, but also a level of a certain management culture, the implementation of which has its costs. This process can be implemented gradually, considering the resources that are currently available. For this reason, it is more important to set the overall corporate culture at the beginning of the Revenue management implementation process than to invest heavily in software tools and systems at the outset (Abad et al., 2019).

The authors of some previous studies have addressed the complexity and multidimensionality of Revenue management (Okumus, 2007; Ivanov, 2014), which describe recommended practices for the proper implementation of Revenue management. Like other management practices, the application and proper use of Revenue management have become more sophisticated and widespread within the tourism industry (Anderson & Xie, 2010). The results of these studies highlight the importance of working with the data available to businesses.

A number of authors have focused on the usual characteristics of accommodation establishments, such as the category of accommodation, the size and position of the accommodation within a hotel chain or stand-alone establishment when evaluating the success of Revenue management use (Tallón-Ballestero & González-Serrano; Abrate & Viglia, 2016; Ivanov & Ayas, 2017; Rodríguez-Algeciras & Tallón-Ballestero, 2017). However, the literature review revealed a lack of articles on the relationship between the success rate of Revenue management implementation and use and the corporate culture of data retention and their transfer.

A closer examination shows the connection of the term revenue management with other headings demonstrating the links to the individual components of the system. In other words, revenue management is logically linked in the literature to other keywords related to the issue of revenue maximization. In particular, strong links can be seen in the following map with the terms "demand", "customer satisfaction", "hospitality", "yield management". All these concepts are related to processes in the organization whose quality is influenced by the level of company culture. On the other hand, the result shows the absence of a connection between the term revenue management and the direct ones listed in Table 1 – corporate culture or organizational culture. This finding suggests a possible lack of research on this topic. The authors of this article find it helpful to point this out.

A map of keywords associated with the term revenue management was generated from the results of a search of the Web of Science database generated in VOSviewer 11.2. 2022 (see Figure 1). The filter was set as follows: Type of Analysis: Co-occurence; Unite of Analysis: Author Keywords; Minimum number of occurences of a keyword:1; In total 91 met the threshold, finaly 66 items was selected.

For completeness, the authors present a map of the most important authors publishing on the topic of hotel revenue management in terms of representation in professional databases and their citations. The introduction of important authors publishing in the field of revenue management can be beneficial for the readers of this article in terms of inspiration for further research in the field of possible connection between revenue management and corporate culture.

The map of citations of authors publishing in the field of revenue management generated from the results of a search in the Scopus database in VOSviewer 11.2.2022. The filter was set as follows: Type of Analysis: Co-citation; Unite of Analysis: Cited author; Minimum number of citations of an autor:5; In total 19 authors met the threshold, finally 19 authors were selected.
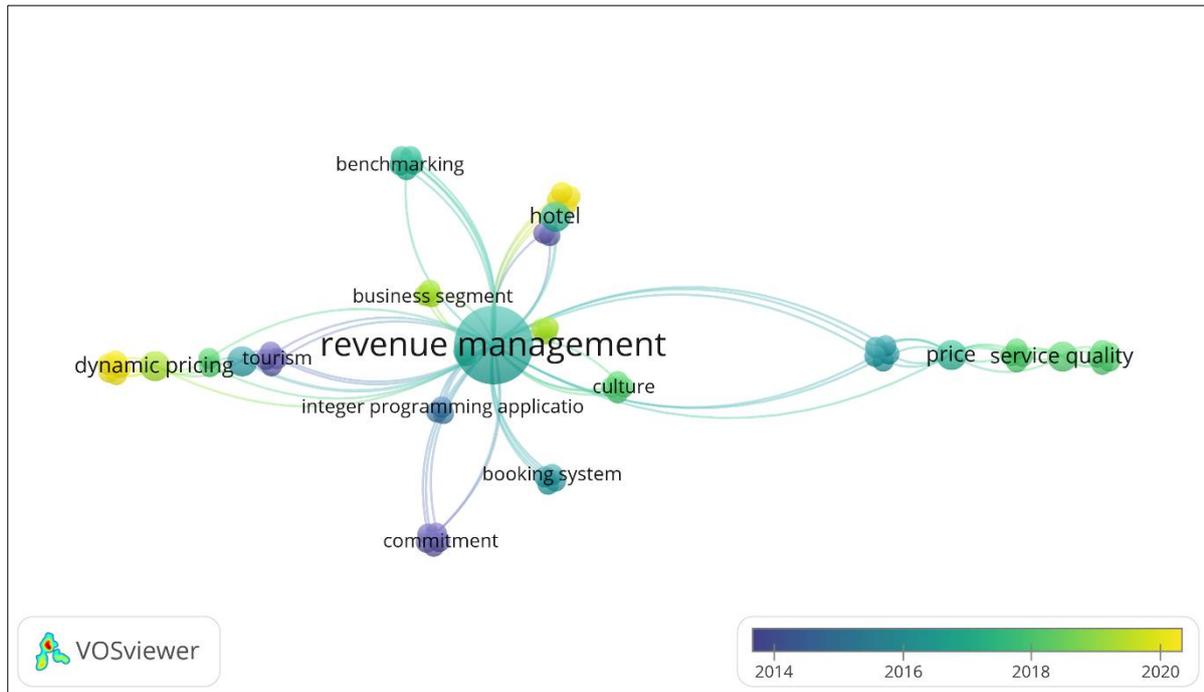
Figure 1. A map of keywords associated with the term revenue management
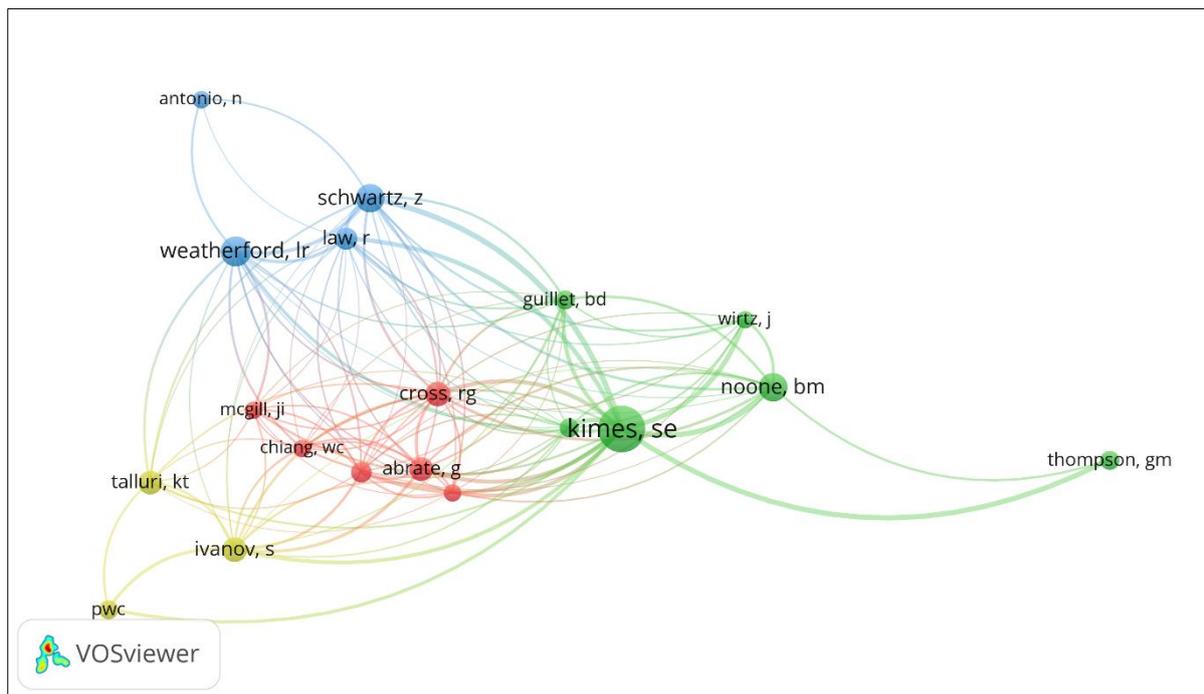
Figure 2. The map of citations of authors publishing in the field of revenue management

4. Corporate Culture

Corporate culture has received considerable attention in the international management literature regarding its importance as a coordination mechanism in the international business environment (Gardini, 2018). The findings indicate that another important factor in the Revenue management process is the human element in the organization and the ability of the organization to ensure knowledge and knowledge sharing between individuals. Knowledge

is seen as the primary asset or resource that drives the growth of the company and hence its performance (Yli-Renko et al., 2002). In recent years, knowledge and the ability to share it within companies has become an important part of building a competitive advantage (Ha & Nguyen, 2020). The quality of every single human element in an organization is influenced by management processes. Management processes and organizational structures can be seen as the building blocks of the enterprise architecture, which fundamentally constrain the flow of processes (Straková et al., 2021). In the service sector, the human element is one of the most important factors (Hán et al., 2020).

In the last decade, there has been a dramatic increase in the number of studies on strategic human resource management, with an emphasis on research on the performance of talented workers in individual positions in organizations (Lewis & Heckman, 2006). While various approaches to building talent management and concepts aimed at developing high-performing key employees are being developed (Hughes & Murray, 2018), there is a growing need to assess the impact of the maturity level and quality of key employees in small-scale enterprises on management processes, their continuity, and maturity. It is reasonable to believe that large-scale hotels in terms of capacity, as well as hotels belonging to reputable chains that have allocated resources to create, nurture and develop business processes, are in a fundamentally different situation than small hotels and hotels operating independently. Based on the above, the ability to apply Revenue management principles is one of the key processes that contribute to the economic sustainable development of these businesses.

The level, maturity, and quality of corporate processes are among the key factors for sustainable economic development. The effectiveness and quality of business management are determined by the ability to address and innovate approaches, principles, and methods (Hila, 2019). Corporate culture is seen not only as a selling point of hotel operations but also as a pillar of sustainable hotel development (Ma & Sun, 2014).

The authors do not include maps as in the case of the section on revenue management due to the minimal representation of the term corporate culture in the hotel industry in the literature. Based on the analysis of the occurrence in the Web of Science database made on February 11th, it can be stated that the most cited authors dealing with hotel performance and corporate culture are Susita Asree, Rizal Mohd Razalli and Mohamed Zain with 86 citations. The most cited article is the "Influence of leadership competency and organizational culture on responsiveness and performance of firms" of above-mentioned authors.

5. Relationship between Corporate Culture and Revenue Management

The authors believe that there may be a relationship between business processes embedded in corporate culture and the level of application and use of Revenue management principles. The literature, whether in management theory or in sociology and psychology of management, does not contain generally accepted views on the role of corporate culture in relation to other corporate activities (Šigut, 2004). The level of corporate processes, on the other hand, certainly contributes to other corporate activities. Since Revenue management belongs to corporate processes, it can be concluded that the level of corporate processes corresponds to the level of Revenue management in the enterprise. The corporate processes that influence the

level of Revenue management, in this case, include data collection, data evaluation, data storage, as well as data transfer in case of a personnel change in a given position.

Revenue management processes, their level of implementation, and the application include a number of sub-processes. The most important is then the work with data. This refers to the ability of the business and the person assigned to this task to collect relevant data, store those data, analyze them, and continue to work with them. The primary task is to determine which data and from what sources should be used for the purposes of an effective Revenue management application. Hotels commonly forecast future demand for accommodation by combining historical data and booking levels on specific days (Talluri & Van Ryzin, 2004). The ability of the business to ensure data continuity is also an important element. This means ensuring that the data stored in the enterprise are maintained in such a way that their continuity is not interrupted by, for example, a change of personnel in a given position, insufficient or incorrectly set up control mechanisms in the enterprise or, for example, incorrectly set up training programs. Inadequacies in the quality of these processes would probably lead to the inability or interruption of the Revenue management implementation and application processes. The authors of this study believe that the level of corporate culture and the resulting ability of the organization to manage data and processes have a direct impact on the level of implementation and application of the Revenue management tool.

6. Conclusions and Discussion

There is a large body of research on the feasibility of implementing revenue management tools, as well as research evaluating the usefulness of using revenue management tools themselves. In the current period of the Covid-19 pandemic, at a time of extraordinary declines in demand for accommodation, the role of the Revenue Management tool is even greater. Similarly, there is a number of papers focusing on research in the area of demand forecasting methodology, which is closely related to the revenue management tool. Corporate culture is also a topic in research that is widespread. If the aforementioned is true, that despite the unprecedented emergence of IT technology in hotel processes, the employee is still the most important element, the importance of corporate culture is obvious. As it has been mentioned above, the use of the Revenue Management tool depends, among other things, on the quantity and quality of data that the hotel or the person responsible for Revenue Management in the hotel can work with. Furthermore, the text shows that a very important asset of the hotel from this perspective is knowledge. This means the knowledge of the individual members of the work team and their willingness to work with, expand and share this knowledge. The authors believe that the level of quality of the corporate culture can have an impact on these necessary prerequisites. There are many studies that evaluate corporate culture from many different perspectives. However, the authors of this paper believe that the topic of the link between the level of corporate culture and the level of revenue management implementation has not been sufficiently explored yet, and therefore, further research should focus on this topic. The authors of this article acknowledge the possible limitations of not including additional search terms, which may be related to the concepts of revenue management and corporate culture, the inclusion of which could affect search results.

Another possible direction of research may be a deeper analysis of the relationship between the level of implementation of the Revenue Management tool and the level of quality of corporate culture. Research focusing on hotel management perceptions of corporate culture, its attributes, and comparison of hotel performance against competitors could suggest a possible association. The aim of this review article is to open the topic of the influence of corporate culture on the level of revenue management in the hotel industry. The authors believe that the research results provided point to insufficient research on this topic and believe that the article will motivate further research.

Conflict of interest: none

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CSR Web Communication by Controversial Enterprises in the Context of Stakeholder and Legitimacy Theories

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Abstract: The study of CSR communication and CSR web communication is based on many theories. The most frequently mentioned of these is stakeholder theory and, in the context of controversial enterprises, legitimacy theory. This article aims to assess whether controversial enterprises, such as chemical enterprises, operating in selected countries communicate their socially-responsible behavior in line with stakeholder and/or legitimacy theories. The subject of this study was the TOP chemical enterprises located in Czechia, Norway, Slovakia, and Ukraine. Descriptive and inferential statistical tools were used to process the data obtained from content analysis. From a methodological point of view, "The Method of Communication of Economic, Environmental, Ethical, Social and Philanthropic Activities" was used. The study which was performed shows that the TOP chemical enterprises in Czechia, Norway, Slovakia, and Ukraine communicate environmentally-responsible and economically-responsible measures to the greatest extent on their web pages. This confirmed the hypothesis that environmentally sensitive enterprises communicate their CSR measures in line with legitimacy and stakeholder theories.

Keywords: stakeholder theory; legitimacy theory; corporate social responsibility; web communication

JEL Classification: M14; L65; M39

1. Introduction

The origins of the modern concept of corporate social responsibility (CSR) are associated with the year 1953, when H. R. Bowen published the book "Social Responsibilities of the Businessman", in which he expressed the idea of the responsibility of businessmen towards society (Bowen, 1953). The fact is that the application of socially-responsible behavior by enterprises can be a source of benefits not only for society but in the event of effective communication, it can also become a source of valuable benefits for the enterprises themselves. Thanks to effective CSR communication, enterprises strengthen their legitimacy (Roy & Quazi, 2021; Sorour et al., 2020) and image (Guan et al., 2021; Tetrevova & Patak, 2019), increase their reputation (Jelinkova & Vancova, 2020; Vrontis et al., 2020), build a competitive advantage (Ageeva et al., 2019; Ramya et al., 2020) and credibility (Maier & Ravazzani, 2019; Smith, 2017), increase customer loyalty (Gurlek et al., 2017; Moure,

2019) or positively influence the behavior of their employees (Lee-Wong & More, 2016; Roy & Quazi, 2021).

Sharing these benefits by the enterprises requires the choice of the appropriate communication channel to provide information to stakeholders and the selection of the appropriate form and content of CSR communication. Alternative channels for CSR web communication are on the one side traditional channels in the form of annual reports and standalone CSR reports, and on the other hand, modern communication channels in the form of corporate web pages and social networks (Tomaselli et al., 2016). Based on Lee et al. (2009), the ideal channel for CSR communication is the corporate web pages. This view is also shared by Coombs and Holladay (2012), who consider corporate web pages to be a crucial communication channel for disseminating CSR information. However, the issue of CSR communication, unlike CSR, is a relatively new topic that has only received attention since the end of the first decade of this century (García-Orosa, 2019). In view of the fact that web pages are a very effective tool for CSR communication (Pollach, 2005) and the topic of CSR web communication is a topic that deserves more in-depth attention, we will focus in this article on the theories which constitute the basis for the study of CSR web communication. As is evident from our systematic literary research into articles published in journals that are indexed by the Thomson Scientific Web of Science database over the last ten years, authors primarily rely on stakeholder theory and legitimacy theory when studying the issue of CSR web communication. Therefore, the research question is whether CSR web communication by enterprises confirms consistency with these theories. The aim of this article is to assess whether controversial enterprises, such as chemical enterprises, operating in selected countries communicate their socially-responsible behavior in line with stakeholder and/or legitimacy theories. The reason for focusing on enterprises in a controversial sector, namely chemical enterprises, is that these are environmentally sensitive enterprises, characterized by certain specifics from the point of view of CSR web communication (Tetrevova et al., 2021). Attention will be focused on the TOP chemical enterprises located in Norway as well as in three post-communist countries, namely Czechia, Slovakia, and Ukraine. This selection will allow comparison from the perspective of developed and emerging countries, whose scope and structure of CSR web communication are often very different (Tetrevova, 2019; Vilar & Simão, 2015).

From the perspective of enterprises in all industries, regardless of whether they operate in a controversial or non-controversial industry (Vollero et al., 2019), the consistency of CSR web communication with stakeholder theory plays an important role. Stakeholder theory, formulated by R. E. Freeman in 1984, posits that managers should cater to a variety of persons and entities who can subsequently influence the organization's results. This concerns the so-called stakeholders, which Freeman (1984, p. 46) defines as "any group or individual who can affect or is affected by the achievement of the organization's objectives". Garvare and Johansson (2010) emphasize that every organization should satisfy the demands and wishes of its stakeholders. This assumption is supported by the studies of Mitchell et al. (1997) and O'Riordan (2014), according to which it is essential for well-functioning companies to not only identify but also subsequently manage their stakeholders. One of the effective

stakeholder management tools is CSR communication (Castelo et al., 2014). Kakabadse et al. (2005) further note that while the concept of CSR focuses on the definition of corporate responsibility and its fulfillment, stakeholder theory addresses accountability towards stakeholders in any way affected by or associated with the company. In doing so, stakeholder pressure may encourage companies to implement a proactive approach in the dimension of CSR (Cordeiro, 2015).

The consistency of an enterprise's behavior with stakeholder theory is confirmed on the one side by a high overall level of CSR web communication and on the other side, a high level of CSR web communication in the dimension of economic responsibility. As regards the overall level of CSR web communication, this concerns the extent of communication in all of the dimensions of CSR under consideration (in the basic concept, these being in the economic, social, and environmental dimensions and in the extended concept, also in the ethical and philanthropic dimensions (Tetrevova, 2019). In the case of the level of communication of economic responsibility, this concerns the communication of measures consisting in strengthening relations with stakeholders, which are part of precisely this dimension of CSR. A high level of CSR communication and, in particular, a high level of communication in the dimension of economic responsibility shows that the company recognizes its commitment towards its stakeholders, including society as a whole.

In the case of enterprises operating in controversial industries, such as those in the chemical industry, compliance with legitimacy theory is crucial from the point of view of CSR web communication. The origins of this theory are based on organizational legitimacy, specified by Dowling and Pfeffer (1975) as the assumption under which a company's value system is consistent with the values of the wider social system of which the company is a part. Should any discrepancy arise between these systems, it is possible that this would undermine the legitimacy of the organization. According to Colleoni (2013), legitimacy indicates a mutual understanding with the standards, values, or assumptions which are accepted by the whole of society. According to Brown and Deegan (1998) and Sawyer et al. (2010), the basis of legitimacy theory is the "social contract", which assumes that the existence of the company is dependent on the determination of boundaries, standards, and expectations of society regarding the appropriate behavior of the company. If the company signals performance of various socially desirable activities and fulfillment of determined requirements within the expectations of society, it gains or strengthens its legitimacy in the eyes of society, which also guarantees the continuation of the business (Cramer, 2002; Pitroff, 2013; Fernando & Lawrence, 2014). Companies operating in industries with a higher environmental or social impact are in particular expected to provide sufficient information to the public to ensure their legitimacy (Branco & Rodrigues, 2006). In fact, companies in controversial sectors need to work harder to gain, maintain and strengthen their legitimacy (Tetrevova et al., 2021). In the case of environmentally sensitive enterprises, such as those in the chemical industry, the focus should be on communication of measures in the dimension of environmental responsibility, in line with legitimacy theory (Chong et al., 2016; Hoffmann & Kristensen, 2017).

2. Methodology

The starting point of the article was a literature review, the subject of which was mainly professional articles dealing with the issue of online communication of CSR and the theories underlying the study of this issue. Primary attention was paid to publications in journals that are indexed by the Thomson Scientific Web of Science database. The selection of sources was influenced by their relevance and topicality. The following hypotheses were formulated based on literature review:

H1: Environmentally sensitive enterprises, such as chemical enterprises, communicate their CSR measures in line with legitimacy theory.

H2: Environmentally sensitive enterprises, such as chemical enterprises, communicate their CSR measures in line with stakeholder theory.

The literature review was followed by qualitative research in the form of content analysis. Using latent content analysis (Gaur & Kumar, 2018), data were obtained in 2018-2020 about the scope of CSR web communication performed by the TOP chemical enterprises located in Czechia, Norway, Slovakia, and Ukraine. The subject of this content analysis was the web pages of the TOP 56 chemical enterprises located in Czechia, the TOP 100 chemical enterprises located in Norway, the TOP 60 chemical enterprises located in Slovakia, and the TOP 50 chemical enterprises located in Ukraine. Specifically, this content analysis concerned the web pages of chemical enterprises in a wider spectrum – according to NACE Revision 2 classification, this concerned enterprises from Division 20, 21, 22, and Group 19.2 enterprises (European Commission, 2008). In view of the fact that not all of the enterprises examined had functional web pages, the content of the web pages of only 55 chemical enterprises located in Czechia, 70 chemical enterprises located in Norway, 56 chemical enterprises located in Slovakia, and 50 chemical enterprises located in Ukraine were subject to further analysis.

From a methodological point of view, "The Method of Communication of Economic, Environmental, Ethical, Social and Philanthropic Activities" (Tetrevova & Patak, 2019; Tetrevova et al., 2019), was applied. This method evaluates 40 CSR measures/activities structured into 5 CSR dimensions.

The data obtained was then evaluated using IBM SPSS Statistics, where descriptive and inferential statistical tools were applied. The scope in which CSR measures/activities are communicated in individual dimensions of CSR and as a whole in all CSR dimensions was measured with the aid of the average number of CSR measures/activities communicated. Differences in the scope of CSR web communication between individual dimensions was measured with the aid of the relative average number of activities. A two-sample t-test was used to assess statistically significant differences between the overall scope of CSR measures/activities communicated in individual dimensions of CSR on the web pages of the TOP chemical enterprises located in Norway and the TOP enterprises located in Czechia, Slovakia, and Ukraine. Statistically significant differences were assessed as significant at a 5% level of significance.

3. Results

3.1. The Extent of CSR Measures Communicated by the TOP Chemical Enterprises in Czechia, Norway, Slovakia, and Ukraine on Web Pages

The performed study (Table 1) shows that the TOP chemical enterprises in Norway communicate CSR measures on their web pages to the greatest extent (43% of the assessed measures), followed by the TOP chemical enterprises located in Czechia (39% of the assessed measures). Chemical enterprises located in Slovakia communicate the CSR measures which they perform on their web pages to the least extent (28% of the assessed measures).

Table 1 also shows that the TOP chemical enterprises located in Czechia and Norway communicate environmentally-responsible measures on their web pages to the greatest extent, followed by economically-responsible measures. The monitored TOP chemical enterprises located in Slovakia and Ukraine communicate economically-responsible measures to the greatest extent on their web pages, followed by environmentally-responsible measures.

Table 1. The extent of CSR measures communicated by the TOP chemical enterprises in Czechia, Norway, Slovakia, and Ukraine on web pages (own processing based on the data taken from (Tetrevova et al., 2021))

Dimension	The average number of measures communicated				The relative average number of measures communicated			
	Czechia	Norway	Slovakia	Ukraine	Czechia	Norway	Slovakia	Ukraine
Economic responsibility	6.0	5.6	5.0	5.4	60%	56%	50%	54%
Environmental responsibility	4.6	4.1	2.7	3.2	66%	58%	39%	46%
Ethical responsibility	0.5	1.8	0.4	0.9	7%	26%	6%	8%
Social responsibility	3.4	4.5	2.6	3.5	31%	41%	24%	32%
Philanthropic responsibility	0.9	1.1	0.5	0.9	18%	22%	11%	18%
Total	**15.4**	**17.0**	**11.3**	**13.6**	**39%**	**43%**	**28%**	**34%**

3.2 Comparison of the Extent of CSR Measures Communicated by the TOP Chemical Enterprises in Norway, Czechia, Slovakia, and Ukraine on their Web Pages

Tables 2-4 shows differences in the scope of communication of individual CSR measures on enterprise web pages in the selected countries. Table 2 shows that the monitored TOP chemical enterprises located in Norway communicate ethically-responsible, socially-responsible, and philanthropically-responsible measures to a greater extent as compared to the monitored TOP chemical enterprises located in Czechia. In the case of ethically-responsible measures, this concerns a statistically significant difference. On the other hand, the monitored TOP chemical enterprises located in Czechia communicate their measures in the dimension of economically-responsible and environmentally-responsible measures to a greater extent on their web pages.

Table 2. Comparison of the extent of CSR measures communicated by the TOP chemical enterprises in Norway and Czechia on their web pages (own processing based on the data taken from (Tetrevova et al., 2021))

Dimension	The average number of measures communicated		t-test		
	Norway	Czechia	t	df	Sig.
Economic responsibility	5.6	6.0	-0.838	120.616	0.404
Environmental responsibility	4.1	4.6	-1.361	122.909	0.165
Ethical responsibility	1.8	0.5	4.813	100.521	*<0.0005*
Social responsibility	4.5	3.4	1.920	117.955	0.057
Philanthropic responsibility	1.1	0.9	0.666	123.000	0.507
Total	17.0	15.4	0.983	114.974	0.356

Table 3 shows that the monitored TOP chemical enterprises located in Norway communicate CSR measures to a greater extent in all five assessed CSR dimensions as compared to the monitored TOP chemical enterprises located in Slovakia. With the exception of the dimension of economic responsibility, the given differences are statistically significant.

Table 3. Comparison of the extent of CSR measures communicated by the TOP chemical enterprises in Norway and Slovakia on their web pages (own processing based on the data taken from (Tetrevova et al., 2021))

Dimension	The average number of measures communicated		t-test		
	Norway	Slovakia	t	df	Sig
Economic responsibility	5.6	5.0	1.343	123.830	0.182
Environmental responsibility	4.1	2.7	3.304	124.000	*0.001*
Ethical responsibility	1.8	0.4	5.189	97.224	*<0.0005*
Social responsibility	4.5	2.6	3.235	117.351	*0.001*
Philanthropic responsibility	1.1	0.5	2.296	123.771	*0.023*
Total	17.0	11.3	3.420	119.911	*0.001*

Table 4 shows that the monitored TOP chemical enterprises located in Norway communicate CSR measures to a greater extent in all five assessed CSR dimensions as compared to the monitored TOP chemical enterprises located in Ukraine. However, a statistically significant difference was identified only in the case of ethical dimension, the same as in the case of chemical enterprises located in Czechia.

Table 4. Comparison of the extent of CSR measures communicated by the TOP chemical enterprises in Norway and Ukraine on their web pages (own processing based on the data taken from (Tetrevova et al., 2021))

Dimension	The average number of measures communicated		t-test		
	Norway	Ukraine	t	df	Sig
Economic responsibility	5.6	5.4	0.405	114.000	0.686
Environmental responsibility	4.1	3.2	1.846	114.000	0.067
Ethical responsibility	1.8	0.9	4.453	101.911	*<0.0005*
Social responsibility	4.5	3.5	1.520	108.779	0.131
Philanthropic responsibility	1.1	0.9	0.667	114.000	0.506
Total	17.0	13.6	1.813	109.136	0.073

4. Discussion and Conclusions

The study shows that in all four countries under consideration – Czechia, Norway, Slovakia, and Ukraine – the TOP chemical enterprises monitored communicate environmentally-responsible and economically-responsible measures to the greatest extent. This suggests that the monitored chemical enterprises behave in accordance with the two basic theories on which the study of CSR communication is based – stakeholder theory and legitimacy theory. Therefore, hypotheses H1 and H2 were confirmed.

In line with legitimacy theory, the monitored TOP chemical enterprises located in Norway and Czechia focus primarily on web-based communication of environmentally-responsible measures. This confirms the conclusions reached by Chong et al. (2016) and Hoffmann and Kristensen (2017). In line with stakeholder theory, they also pay special attention to the communication of economically-responsible measures. This confirms the conclusions reached by Ruban and Yashalova (2021) or Tetrevova et al. (2019). In the case of the TOP chemical enterprises monitored in Slovakia and Ukraine, the opposite is the case. These enterprises pay primary attention to communicating their economically-responsible measures in line with stakeholder theory. These environmentally sensitive enterprises also pay special attention to communicating environmentally-responsible measures. This means that they also act in line with legitimacy theory (Tetrevova et al., 2021).

It is worth noting that, with two exceptions, the TOP chemical enterprises monitored located in Norway communicate measures in all five CSR dimensions to a greater extent as compared to all three post-communist countries. These exceptions are web-based communication of economically-responsible and environmentally-responsible measures by the TOP chemical enterprises located in Czechia. However, the fact is that the given difference is not statistically significant. This confirms the findings of Ageeva et al. (2019) or Tang et al. (2015) regarding the higher level of CSR web communication in developed countries as compared to emerging countries such as post-communist countries.

The presented study develops knowledge of the context of CSR web communication and the theories on which the study of this issue is based. At the same time, it reveals the approach taken by the management of environmentally sensitive enterprises to CSR web communication. It, therefore, represents a source of knowledge, in particular for management theory, as it confirms the frequently discussed and often denied relationship between theory and practice. It also contributes towards the development of knowledge that can be used by company managers and policy makers, specifically regarding the priority dimensions of CSR web communication of controversial enterprises.

A limiting factor of the study is its focus on the selected four countries and the one controversial industry chosen. This leaves room for further follow-up studies which should focus on studying the issue from the perspective of a larger number of countries, both developed and emerging, and not only in Europe. It would also be interesting to monitor the relationship between CSR web communication and the theories which form the basis for their study over a longer period of time and to assess any developments. Alternatively, attention could be focused on other controversial sectors, such as the energy, food, or gaming

industries. It would seem useful in the future to study the relationship between CSR web communication and other theories, such as institutional theory, attribution theory, or signaling theory.

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Smart Cities: GIS Data for Realistic Simulations

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Abstract: More and more cities are incorporating smart elements for their better management, increased service quality and resource optimization. A digital twin is suitable for creating the concept of a smart city. Smart cities, digital twins and agent-based simulations are mutually intertwined research fields. It is an accurate simulation of a real entity, thanks to which it is possible to explore and predict various situations and respond better to them. The usage of GIS data is important part of the process of development of realistic spatial simulations. GIS data is the essential source of parameters of the environment surrounding agents. This paper summarizes the usability of GIS data in agent-based simulations in the development of digital twins of smart cities. Sample traffic model in NetLogo was designed to demonstrate this approach.

1. Introduction

A smart city is where the combination of modern information technology and IoT results in better governance, quality of service, security, and reduced management and resource costs (Kumar et al., 2020). According (Nam & Pardo, 2011), there are numerous objectives of smart cities such as improving convenience, preserving energy, improving water quality and air quality, recovering from disasters or collecting data for better decision making. Four major contributes of smart cities are sustainability, urbanization, quality of life and smartness (Khan et al., 2022). Recent reviews show that the research of smart city models and methodologies grows significantly, see Myeong et al. (2022), Winkowska et al. (2019).

The digital twin is the most accurate virtual copy of a real entity. It helps to understand, explore and predict the behavior of real subjects. Digital twin simulations exist in parallel with real entities (Grieves & Vickers, 2017) in our case smart cities. Other areas where digital twins can be used are engineering, robotics or healthcare (Barricelli et al., 2019; Boje et al., 2020). Agent-based simulation is the methodology successfully applicable in creation of digital twins (Clemen et al., 2021; Mykoniatis & Harris, 2021).

The aim of the paper is to show how it is possible to use existing geographical data for agent-based simulations. The first part of the paper describes GIS data and how to obtain them for the purpose of the realistic traffic simulation in NetLogo. The extraction of parameters of the urban environment from GIS data is explained, maps from OpenStreetMap serve as a source of data for our sample model. It is also explained how to modify the data in relation to

subsequent simulation scenarios. The sample model of traffic in urban area is presented to demonstrate the approach.

2. Methodology

Agent-based simulations are composed of agents and environment. Agent-based models of cities were summarized by (Crooks et al., 2021). Important trends are the development of large-scale simulations (see e.g., Santana et al. (2018), Manzoor et al. (2021), Huang et al. (2022)) and real-time GIS applications (Li et al., 2020).

Realistic simulation requires a precise specification of the environment, especially if it asked to be even an exact copy of the original (digital twin in this case). If the simulation is about a representation of building interior, it is possible to use BIM data to create environment (Kořínek et al., 2021). On the contrary for geographical area, importing data from Geographic Information Systems (GIS) is the most efficient method.

Geographic Information Systems are used for storing and visualizing data related to a specific place on Earth at a specific time. The two main representation methods are raster and vector representation of spatial entities and their relations. Both types of representation can be applied for visualization of the space. Vectors are used to display the elements, raster image data is preferred to visualize the background of the scene (Decker, 2001).

A raster representation is focused on the detailed display of the area using images and photographs. The basic building blocks are pixels that are arranged in a 2D grid. The pixel is represented by the color as in the photo and can be extended by other parameters. The raster representation does not have to be used only to display a photograph of the area, but, for example, to display temperature, population density or elevation. The raster representation is used to represent continuous space. It is easier to use raster representation for computational operations, but at the same time it is not as accurate when the scale changes.

A vector representation focuses on specific elements from the area, such as buildings, roads, rivers, etc. Because the vector representation shows the elements as separate objects, it is easier to work with and edit other parameters that are hidden under these objects and do not need to be displayed. These components are represented by three basic geometric elements (points, polygons, curves) which can change their purpose depending on the level of detail required:

- The representation of **points** may vary depending on the scale of the display area or the way the data is used. The point can represent a city or a building or even the entrance of the building. See **Figure 1**, for example of the point outside the polygon area: here the point is the center of the object.
- **Polygons** are used to represent object, e.g., buildings. Furthermore, it is possible to use polygons to display areas, similarly to raster representation, but with a discrete space (i.e., having precise dimensions and boundaries of objects).
- **Curves** consist of connections of two or more points and are used to represent roads, rivers, or the boundaries of areas, but in this case, it is only an edge, not the space inside (polygons are used for this).

Some tools can also work with another formats like 3D representations of buildings or terrain. This can be especially useful for various visualizations.

There are numerous freely available sources of GIS data such as ArcGIS HUB (ArcGIS HUB, 2022), Natural Earth Data (Natural Earth, 2022), Google Maps (Google, 2022b) Google Earth (Google, 2022a) etc.

The source of GIS data for this article is OpenStreetMap (OpenStreetMap, 2022), which is an ODbL-licensed project focusing on creating and sharing geographic data around the world. It works on the principle of Wikipedia, where users contribute, edit and use all available data, including the access to the history of edits. When viewing maps on the web, it is possible to immediately see a preview of the GIS parameters added to objects (**Figure 2**).

GIS data contains a large amount of information of different type. When creating the environment for agent-based simulation, it is advisable to use one of the commercial software designed for data preparation, e.g. ArcGIS (Esri, 2022).

Figure 1. Example of point and polygon representation of the space
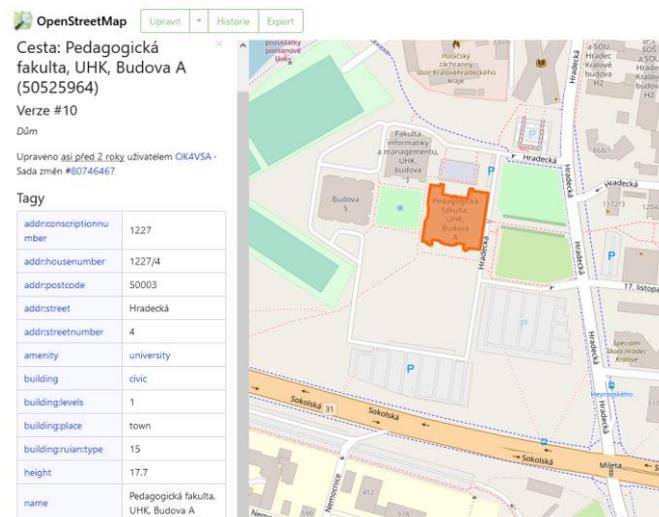
Figure 2. OpenStreetMap object with parameters. (https://www.openstreetmap.org)

Autodesk company offers AutoCad Map 3D (Autodesk, 2021) software which is suitable for 3D models or Building Information Model (BIM) data. It is also possible to use freely available software, e.g. Grass GIS (Grass GIS, 2022), gvSIG (gvSIG, 2009) or QGIS (QGIS, 2022). QGIS was created in 2002, but receives regular updates and is suitable for article sample model.

Finally, the agent-based platform is suitable for development of the smart city simulation. The overview of platforms such se NetLogo (NetLogo, 2016), AnyLogic (AnyLogic, 2022), Repast (Repast, 2021) and others (Morvaj et al., 2011; Lom & Pribyl, 2021).

3. Realistic Traffic Simulation

To demonstrate the applicability of GIS data in realistic agent-based simulation of smart cities, a sample model of urban traffic was designed in NetLogo. The model is composed of GIS-based environment and agents. The specification of the environment is as follows.

OpenStreetMap was used to get real world data (maps). Data is stored in OpenStreetMap format, which would be converted to one of the GIS formats (University of Delaware, 2022) (in article example it will be *.shp* format).

There is no need to download data from OpenStreetMap before, because QGIS, like many other software, already has built-in access to maps. Therefore, it is possible to open OpenStreetMap directly in the application, select the area and save it. This tool works similarly to graphical editors and data are divided into layers. After selecting and confirming the area, the previously mentioned geometric objects (polygons, lines and points) can be seen on the left side. The layers can be turned on and off as needed.

To obtain specific elements from OpenStreetMaps, it is recommended to use another plugin that uses query data editing. In case of traffic agent-based model, information about buildings and routes has to be obtained. In the simulation, it would be required to apply an exact representation of the routes where agents move. For our model, a simplified representation of the movement along the lines (more precisely, between the endpoints of the lines) is sufficient. This decision was made for optimization of the course of the simulation using desktop agent-based platform NetLogo. For this reason, node information needs to be attached to the data.

When working with OpenStreetMap objects, *QuickOSM* plugin is used to create layers of objects. The list of objects is written on the OpenStreetMap wiki page under the map features tab. Objects are divided here into keys (parent category) and values (sub-categories). For example, buildings and roads are required to be specified for the simulation.

The building layer will be created firstly. Buildings are marked with the keyword *building*. It is also possible to specify a sub-category (e.g. small houses or hotels correspondingly to the purpose of the simulation). In article example model, all objects from category building are required. Queries can be chained to select multiple categories or multiple subcategories. Individual selections can be combined using the logical operators *and, or*. Finally, it is also possible to select in which geographical area the objects are searched. After running the query, a new layer with the extracted data is created. **Figure 3** shows example of buildings extraction.

Further adjustments are needed for the roads. If roads were exported as they were extracted, point information would be missing. Roads would contain endpoints and some midpoints, but many would be missing. The simulation would be too simplified. QGIS includes many editing tools. One of the geometric tools is the breakpoint extraction tool. This creates a new layer with all points. This completes the editing of the roads (**Figure 4**). Other adjustments could follow, such as evenly adding more points along the way or simplifying. The path layer together with the newly created point layers can be exported as another file. The important thing is that extracted objects retain their parameters. This completes the preparation of data that can be used subsequently in simulation tools.
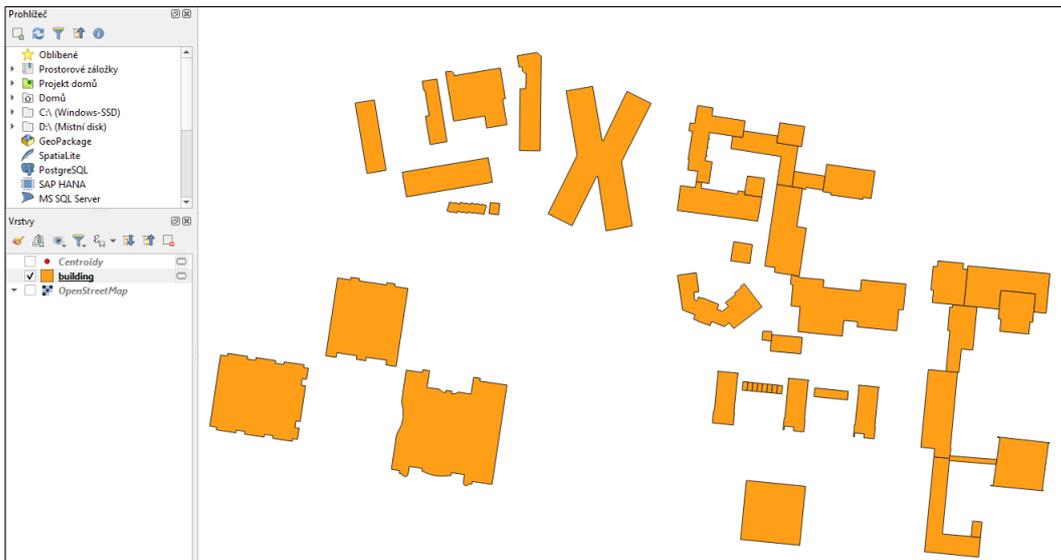
Figure 3. Extracted building layer

Figure 4. Extracted roads with generated breaking points

Now that the data are prepared and it is possible to start creating an agent simulation. To create a traffic model, a NetLogo was chosen. As mentioned earlier, agent simulation consists of two main parts. The environment was made from prepared GIS data. Lines and nodes were created from GIS path data using NetLogo datasets. These objects store all parameters from GIS data. Buildings are represented by GIS data without further modification. In the next step, agents need to be added. They will move and interact in the exact copy of the city thanks to the GIS data.

Figure 5. Traffic model

Figure 6. Extracted data of the area around the castle Oheb. Tourist places (red), parking places (green) and camps with wheelchair access (orange).

Figure 5 shows created traffic model with buildings and roads information extracted from GIS data.

Similarly, there is a simulation of tourist areas with extracted information about tourist places (**Figure 6**). Creating simulations is all the easier, because many important parameters are already contained in the data.

4. Discussion

The realistic simulations are important tool in smart cities research. The specifications of the environment have to build on GIS data. OpenStreetMap and QGIS were successfully adopted in sample model of urban area. NetLogo simulation was developed to demonstrate the applicability of agent-based approach for development of digital twin of smart city.

The next research will be focused on refinement of agents´ behavior and extending the simulation with smart city elements such as intelligent traffic lights, information systems and mobile applications.

Conflict of interest: none

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Utilisation of Online Public Relations Tools in Chemical Companies in the Czech Republic

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Abstract: Effective online marketing communication is one of the basic prerequisites for the company's success in the market. Today, however, it is not only focused on customers, but also on other stakeholders. Most often used for this purpose are digital public relations, the intention of which is to influence public opinion and create a positive image of the company. The aim of the paper is to summarise data from primary research focused on the analysis of websites of chemical manufacturers regarding the current use of digital messages and communication channels in their online public relations. The study was prepared using descriptive statistics tools. The results show that in terms of written forms, companies most often use the news section. Audio-visual content can only rarely be found on the websites. Links to social networks are also not a matter of course on the web. The most frequently presented social networks include Facebook, LinkedIn and Twitter.

Keywords: online communication; online marketing; digital public relations

JEL Classification: L60; M21; M31

1. Introduction

Digital, or online public relations are based on traditional public relations (PR) (Tong, 2021), which are intended mainly to create and support effective two-way communication between the company and its surroundings (Tong, 2021; Mckie & Sriramesh, 2017). The company's goal within this mutual dialogue is to build or increase brand awareness through persuasion, influencing and informing so that it contributes to its reputation and positive image (Stedron et al., 2018; Petrovici, 2014) while creating interest and building long-term relationships and trust between the organisation and its stakeholders (Tetrevova, 2017). In this context, all entities related to the company and its activities are considered stakeholders (Tong, 2021; Tetrevova, 2017; Karlicek, 2016). These typically include, for example, owners, investors, employees, customers, suppliers, the media, etc. (Tetrevova & Patak, 2019; Fageha & Albinu, 2016). It is obvious that each of these groups of the public will have its own priorities and requirements for information provision, and therefore it is important that PR communication always tries to ensure a specific, precisely targeted two-way information flow. And this is exactly what modern digital communication technologies taking advantages of online PR allow.

Digital communication technologies allow companies to effectively use both classic and proven, previously only printed, forms of communication and new forms for their online PR

communication. According to the degree of their innovativeness, online PR messages can be divided into two groups – traditional written and new modern audio-visual forms (Janouch, 2014). Classic written forms of online PR communication include (Rosokhata et al., 2020; Janouch, 2014):

- **press releases** – intended to objectively and reliably convey to readers basic information (who, what, when, where, how and why) about phenomena or events that have (not) happened or will (not) happen. The structure of press releases is fixed in PR. Each of them should contain the title, place and date of issue as well as contact details (Karlicek, 2016).
- **articles** – intended to provide a clear, factual and logical explanation of an idea, fact, phenomenon or event. They often describe the context, causes or consequences, classify and analyse data (Osvaldova et al., 2007).
- **annual reports** – the purpose of annual reports is to provide comprehensive, balanced and comprehensive information on the development of the company's performance, activities and current economic status. In the Czech Republic, they are an official document that entities with audited financial statements are legally obliged to publish (Svoboda, 2009).
- **Corporate Social Responsibility** (**CSR) reports** – provide both positive and negative information about the impact of organisations' activities on society, the environment and the economy (Tetrevova, 2017; Hyrslova & Kubanova, 2015).
- **questions and answers (Q&A)** – are a specific form of discussion where users ask questions and wait for a relevant answer. Some companies list this form of communication on their websites as a "Frequently Asked Questions" (FAQ) section. (Janouch, 2014; Prikrylova & Jahodova, 2010).

The following can be included in modern audio-visual forms of online PR communication: (Rosokhata et al., 2020; Janouch, 2014):

- **podcasts** – these are audio recordings that users can listen to via digital streaming platforms (Janouch, 2014). The popularity of the podcast has grown extremely in recent years. This is probably because, unlike other forms of communication, the listener can receive the information presented here in a passive way while performing other activities. (Active radio, 2020).
- **videos** – within online PR they can take various forms, e.g. tutorial, demonstration video, case study, interview, company video, etc. (Janouch, 2014). Each of the formats has a different recommended length (Gillespie, 2019).

PR messages should be presented in all forms that appear to be effective for the target audience. The communication must then be presented through the appropriate media. If the company chooses the wrong communication channels, the impact of the message may not be as originally intended (Janouch, 2014). Frequently used communication channels in online PR include websites (Rosokhata et al., 2020; Janouch, 2014), blogs (Rosokhata et al., 2020; Janouch, 2014) and social networks (Janouch, 2014).

Websites are the most important element of the organisation's online presentation (Prikrylova & Jahodova, 2010). They are intended to present information about the company, their products and activities (Janouch, 2014; Prikrylova & Jahodova, 2010). The number of pages and sections is at the discretion of each company; however, each website should include a homepage, general information about the company and contact details (Hornakova, 2012).

A blog is a type of website (Phillips & Young, 2009) where the content is presented in chronological order from newest post to oldest. There are three basic types of blogs – corporate, product and branded. Company blogs are used to publish everything related to the company, such as news, various announcements, but it also includes the publication of various textual and audio-visual materials for products. Product blogs are designed to promote and sell a specific product or service. Brand blogs are used to market and promote the brand in new business markets and with new customers (Byron & Broback, 2008).

Social networking sites, which have become an absolute hit in recent years (Cawsey & Rowley, 2016), are used by around 3.5 billion users worldwide (Statista Research Department, 2021). The huge advantage is that they allow easy and fast communication, sharing information, photos, videos, etc. with other users from around the world. They also bring users up-to-date information, allow them to build or change their own identity, create a community of people with the same interests and opinions, educate, refine and expand knowledge, etc. (Losekoot & Vyhnankova, 2019; Brandtzæg & Heim, 2009). Today, there is already an inexhaustible number of social networks that use various communication tools or focus on specific (interest) groups (Frey, 2011). The five most popular social networks used in online PR on the Czech B2B market are Facebook (87%), LinkedIn (62%), YouTube (54%), Instagram (34%) and Twitter (10%) (B-inside, 2020).

The paper presents the results of an analysis of the current utilisation of various digital forms of PR communication on the official websites of chemical companies in the Czech Republic and evaluates the connection of monitored websites with other modern communication channels, such as popular social networks. The subject of the analysis were all chemical companies associated in the Association of Chemical Industry of the Czech Republic, which represents more than 70% of production from the chemical, pharmaceutical, petrochemical and plastics and rubber industries in the Czech Republic, being thus the largest Czech organisation of its kind. The following chapters describe the research methodology and present the results, on the basis of which recommendations are formulated for streamlining the online PR communication of the investigated chemical companies.

2. Methodology

The starting point of the research was a systematic literary search of both printed and Internet sources. The literature search was followed by the collection of primary data. Primary data were obtained using content analysis. Data collection was performed from March to April 2021.

The official websites of the chemical companies associated in ACI CR were the subject of the analysis. Only enterprises that are engaged in at least one chemical production of the 19+, 20+, 21+ or 22+ NACE classification category in their main or secondary activity were included

in the database. With the help of the online register of economic entities, 54 companies were included in the basic database in this way. For selected companies, their official websites were subsequently identified using the official ACI CR website and Google search engines.

The analysis of the website first focused on the following sub-areas – identifying the basic characteristics of the surveyed companies (number of employees, year of establishment); verifying the existence of key elements of their website (homepage, general information about the company, contact details). Due to the importance of the Responsible Care (RC) initiative in the chemical industry, information on their membership in this organisation was added to the basic characteristics of the surveyed companies, including verification of the validity of the relevant certificate. The information was obtained through the official RC website.

Subsequently, the research focused on answering the following research questions:

- What are the most frequently used types of written and audio-visual forms of online PR communication in the surveyed companies?
- What other online communication channels are referred to on the websites of the surveyed companies?
- Are there any differences in the level of use of the examined forms of communication and communication channels, depending on the various characteristics of the surveyed companies?

To determine the results of an analysis of the differences in the level of use of the examined forms of communication and communication channels, depending on the various characteristics of the surveyed companies, the χ-test (chi-square test) was used. If the basic test conditions were not met, an exact Monte Carlo significance estimate was used (χmc). Yates's correction was applied to 2x2 tables. After establishing statistically significant differences, post hoc tests were performed to reveal more detailed information about the difference. All tests were performed at a 95% confidence level.

Statistical data processing was performed using Microsoft Office Excel and IBM SPSS 24 software.

3. Results

3.1. Basic Characteristics of the Surveyed Companies

The primary analysis of the basic characteristics of the surveyed companies (a total of 54 manufacturing companies in the chemical industry) showed that the surveyed companies can be classified into three categories – small companies with 10 to 49 employees (13%); medium-sized enterprises with employees in the range of 50-249 (54%) and large enterprises with more than 250 employees (33%). Based on the date of establishment of the surveyed companies, it was found that the research sample consists of 56% of companies established between 1972 and 1999, 33% of companies established in the first decade of the 21st century and 11% of enterprises established in 2010 or later. At the time of the research, 76% of the surveyed entities were registered for the voluntary RC initiative, 71% of which had a currently valid certificate, comprising 54% of the total number of surveyed companies.

Subsequently, it was found that all surveyed companies have created an official corporate website, which in all cases contains all three basic recommended elements of the website – home page, general information about the company and contact details.

3.2. Degree of Presentation of Various forms of Online PR Communications in the Surveyed Companies

In the first phase, a detailed analysis of the company's website focused on determining the degree of presentation of various written forms of online PR communications, i.e. press releases, articles, annual reports, CSR reports and questions and answers. During the data collection, it was found that a large number of companies uses the news section to publish information about events in the company and its surroundings, and therefore it was included among the examined written forms of communication. The results are shown in Figure 1.

85 %	67 %	44 %	28 %	7 %
NEWS SECTION	PRESS RELEASES	ANNUAL REPORTS	CSR REPORTS	FAQ SECTION
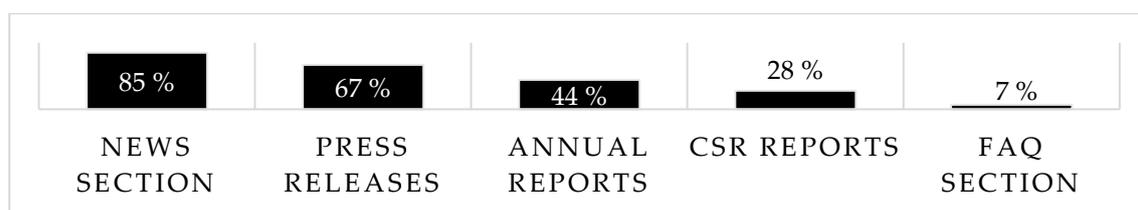
Figure 1: Presence of individual written forms of PR communication on the websites of the surveyed companies

Figure 1 shows that the most widely used form of online PR written communication is the news section (85%), which allows the company to quickly and concisely inform the public about what is happening in the company and its surroundings. Their structure often oscillates between a press release and an article. By contrast, the least used tool is the "Frequently Asked Questions" (FAQ) section (7%). The low interactivity of the researched sites is evident here.

In connection with the ever-growing popularity of the corporate social responsibility issue, it was an interesting finding that a relatively small number of the surveyed companies (28%) publish CSR reports on their websites. It seems that the reason may be the fact that from the point of view of companies it is often enough to share information about their social responsibility activities in other parts of the website, e.g. in annual reports or on the *"environment"* tabs, etc. Our research has confirmed this assumption. It turned out that less than a third (16) companies have a *"Social Responsibility"* or *"Sustainability"* tab on the main page of their website, another 13% of companies have this information available in tabs such as *"About Us"*, *"About the Company"*, *"Our Policy"* etc. The remaining 56% of companies do not explicitly mention sustainability, resp. social responsibility on their websites, but inform about selected aspects of corporate social responsibility – such as ecology, quality, etc.

Furthermore, the presence of audio-visual forms of online PR communication – videos (e.g. business tours/field trips in the company, description of the history and its operation, acknowledgements by the company director) and podcasts was ascertained on the official websites of the surveyed companies. It turned out that audio-visual forms of online PR communication are still not the standard for the companies surveyed. While less than half of companies (48%) have published videos, none of the surveyed production companies publish

podcasts on their websites, despite their being, according to published research (Active radio, 2020), a very popular form of communication.

3.3. Interconnection between Communication Channels

The final part of the website analysis focused on finding out the current state of interconnection between individual communication channels, or the existence of click-through possibility between websites, blogs and social networks. The analysis revealed that only two companies (4%) provide a link to the blog on their own website, doing so thereto only in a fictitious way as bookmarks only redirect users to another part of the official website. By contrast, links to social networks are almost a standard issue on companies' websites. The location of links to social networks within the examined sites is evident from Figure 2.
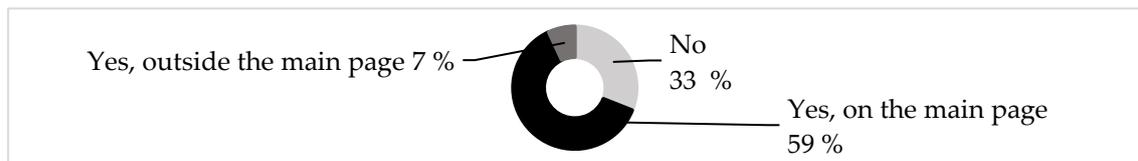
Figure 2: Presence of links to social networks on the websites of the surveyed companies

Figure 2 shows that links to social networks can be found on the official websites of 66% of the companies surveyed. Less than 2/3 (59%) provide them directly on the main page. This can be assessed positively, as it undoubtedly increases the probability of potential visits thereto. Somewhat striking is the finding that 33% of the companies surveyed do not link to any social network on their website. It is obvious that a relatively large group of surveyed companies does not yet fully appreciate the importance of modern communication channels for corporate PR, which can significantly undermine their desired image of modernity, innovation and flexibility.

Given the current development of social networks and the ever-increasing interest in targeting stakeholders through them, it was analysed in more detail which specific social networks the surveyed companies link to on their websites. Namely, the links to social networks that are currently most frequently used on the Czech B2B market were monitored, i.e. Facebook, LinkedIn, YouTube, Instagram and Twitter (B-Inside, 2020). If there was a link to another social network on the website, it was included in the "other" category. The results are summarised in Figure 3.
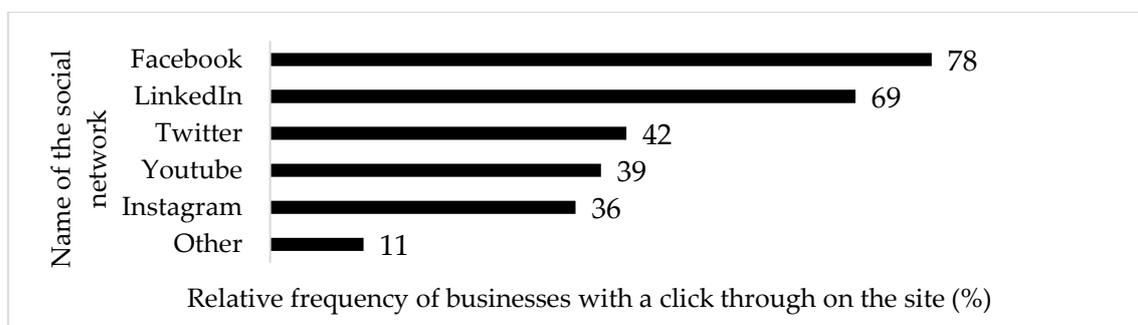
Figure 3: Presence of links to individual social networks on the websites of the surveyed companies

Figure 3 shows that the most used social network in the monitored companies is Facebook, which according to public research is one of the most popular (Statista Research

Department, 2021; Wozniak, 2015) and therefore it can be considered appropriate of the surveyed companies to prefer it. Not surprisingly, most of the businesses surveyed link to LinkedIn. It is understood as an important professional network connecting employers with job seekers and thus making it easier for companies to find their potential employees (Frey, 2011). It should be noted that current trends in the use of social networks need to be carefully monitored, as the preferences of social network users change and evolve quite dynamically. It is interesting that 11% of the surveyed companies have published a link to other than the most preferred social networks. Specifically, these are the social networks Vimeo, Google+, Vkontakte and Xing.

3.4. Differences in the Levels of Use of Diferent Forms of Online PR Communication and Links to Other Online PR Channels Depending on the Characteristics of the Surveyed Companies

As part of the analysis of the results, it seemed interesting to analyse the differences in the levels of use of researched forms of online PR communication and links to other PR communication channels depending on the identified characteristics of the surveyed companies, i.e. depending on the size, age and degree of involvement in the RC initiative.

No statistically significant differences were found when monitoring the differences in the levels of use of the examined variables according to the size of the company in terms of the number of employees. As regards the year of establishment, there was only one statistically significant difference, namely the presence of the FAQ section on the website (χmc = 8.640; sig = 0.020) (see Figure 4).
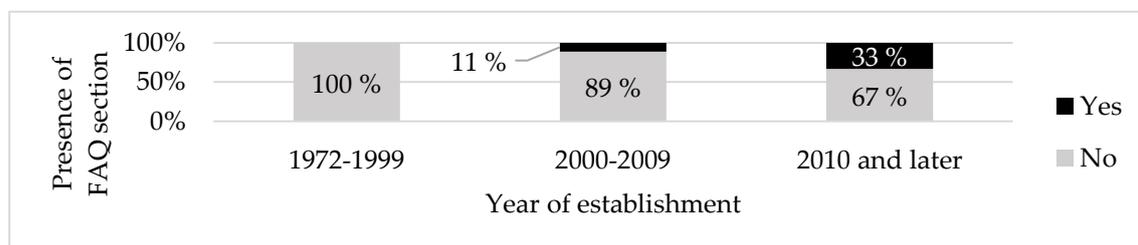
Figure 4: Differences in the presence of the FAQ section on the websites of the surveyed companies according to the year of establishment

The results revealed that younger companies are more likely to use the FAQ section in online PR communication than older companies.

Other interesting information was provided by the testing of variables depending on the membership of companies in the RC initiative and subsequently according to the current validity of the relevant certificate. In relation to the membership of companies in the RC, only one statistically significant difference was demonstrated, namely in the presence of information on social responsibility, or sustainability on the website of the surveyed companies (χmc = 8.640; sig = 0.044) (see Figure 5).

Figure 5 shows that RC members report on sustainability on the web more often and comprehensively than non-membership companies.
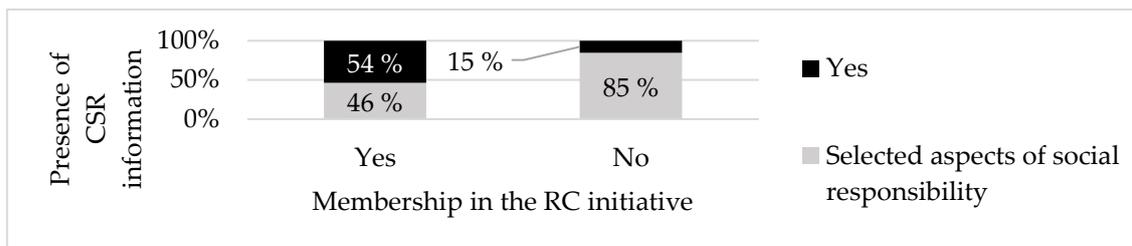
Figure 5: Differences in the presentation of CSR/sustainability information on the websites of the surveyed companies according to the membership in RC

Depending on the validity of the RC certificate, statistically significant differences were again identified in the presence of a tab informing about CSR, or sustainability (χmc = 9.631; sig = 0.047) and also in the publication rate of CSR reports (χmc = 9.078 sig = 0.010). The obtained data are summarised in Figures 6 and 7.
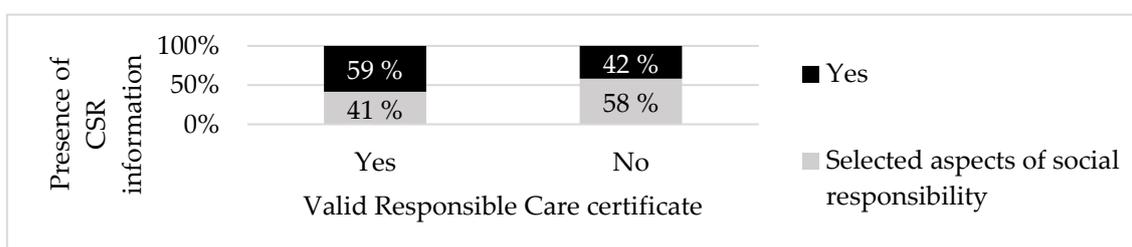
Figure 6: Differences in the presence of CSR/sustainability information on the websites of the surveyed companies according to the validity of the RC certificate
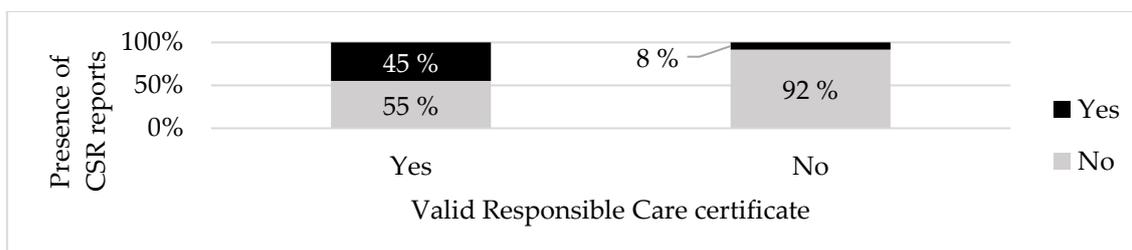
Figure 7: Differences in the presence of CSR reports on the websites of the surveyed companies according to the validity of the RC certificate

The above graphs (Figures 6 and 7) show that companies without a currently valid RC certificate mainly focus only on some selected aspects of social responsibility (58%), logically publishing less CSR reports than companies with a valid certificate. The given statistically significant differences were also confirmed by post hoc tests.

4. Discussion

Online PR communication is certainly a very current and important topic, as it allows companies to easily and effectively address not only customers but also the general public. A wide range of tools and forms of online PR communication can be, if suitably combined, an interesting way to pass on the necessary information to the target group and at the same time to establish and deepen the mutual relationship. Nevertheless, it seems that some companies, especially in the industrial market, are still lagging behind as for initiatives in this area of PR. Our research also aimed to find out the current state in the issue of using various tools and means of modern digital PR in chemical companies.

The results of the research show that most of the surveyed companies apply a more conservative method of PR communication in the online environment, where the main fundamental shortcoming can be seen in the lack of space for possible dialogue with stakeholders. As regards written forms of online PR communications, companies most often use the News and Press Releases sections. In the case of audio-visual forms, video communication is preferred, but it is only used on less than half of the websites examined. Modern forms of online PR communication are used only sporadically here, specifically it is only the FAQ section, which only historically younger companies have included in their communication. While it can be assumed that chemical companies, often operating exclusively in B2B markets, certainly traditionally prefer direct contact (personal, telephone, etc.), especially with customers, the dialogue with other stakeholder groups, especially the general public, should be available through an online environment where official corporate websites play an irreplaceable role.

Another proof of the more conservative online PR communication of the surveyed companies is the low willingness to publish information on today's very current CSR issues on the web. Only a minority comprehensively communicates data on their social responsibility; less than 2/3 of the surveyed companies publish only partial, selected aspects on the website in this area, which can be considered insufficient. The research exposed an interesting fact that companies that participated in the voluntary RC initiative have published information about CSR and publish separate CSR reports on their website more often than companies without membership. It can be therefore concluded that joining the RC allows for an easier transition from solving only selected areas of social responsibility to a full-fledged CSR concept.

The initiative of companies in providing links to other online PR communication channels on their websites can be evaluated more positively. While only two surveyed companies link to a blog, almost 70% of the surveyed companies provide a link to social networks on their website. We can therefore deduce an effort to follow modern trends, as evidenced by the selection of presented CIS. The most presented as well as the most popular is Facebook, which can be found in 78% of companies with published links to the social network sites. The second most popular social network is LinkedIn (69%), as also confirmed by the research of B-Inside (2020). Twitter ranked third in our survey (42%), while it was YouTube in the B-Inside survey. Twitter finished fifth with 10% (B-Inside, 2020).

It is obvious that the companies surveyed are trying to use their websites for online PR communication, however, we can see a huge potential to improve and streamline it. Based on the obtained data and the results of the analysis, the following recommendations can be proposed to the companies surveyed:

- **clearly set priorities and communication goals in the field of online PR** and adapt any further communication strategy accordingly.
- **conduct a survey of corporate website visitors** to determine their satisfaction with existing content and user friendliness and provide suggestions for improvement.

- **update the existing website design** due to the often outdated look and the lack of responsive display components on mobile devices of various sizes.
- **provide comprehensive information about socially responsible activities on the company's website**, thereby supporting, among other things, the company's competitiveness and reputation.
- **introduce new modern and interactive forms of online PR communication** and thus create, for example, blogs, podcasts or a FAQ section, by which the company can attract even hard-to-reach groups of the public and thus secure an interesting competitive advantage in the field of communication.
- **create modern profiles on social networks and publish links thereto on the website** in order to establish other high-quality communication channels that can be used in areas other than online PR communication.

5. Conclusion

Online PR is becoming an integral part of modern marketing communication. The interactivity enabled by new communication technologies has traditionally been used mainly in the consumer market. The industrial market seems to be a bit of a latecomer, yet current trends in online PR communication are beginning to be used to advantage here as well. The research we have presented shows the situation in this area for chemical manufacturing companies in the Czech Republic.

The results revealed that the majority of Czech companies with chemical products do not have well-developed online PR communication. The companies mainly use traditional written forms of online PR communication on their official websites, such as various news in the news section or press releases. Audio-visual content in the form of corporate videos is present on the websites of just under half of the companies surveyed. The neglect of the benefits of web interactivity is evidenced by the very low representation of the FAQ section, where only historically younger companies included it in their online communication. The presentation of information about the company's CSR activities is also far from ideal. Less than 1/3 of the surveyed companies deal comprehensively with CSR on their websites, while most of them offer information only on selected CSR topics, especially in the area of environmental responsibility. However, research has shown that those companies that are involved in the voluntary RC initiative report their CSR activities more comprehensively on the web or even publish separate CSR reports more often than companies without membership. Although modern audio-visual forms of online PR communication, such as podcasts, are only sporadically encountered on the websites surveyed, the fact that 70% of the enterprises surveyed provide a link to their official company social media profiles on their websites indicates a certain positive development of online PR communication. Facebook, LinkedIn and Twitter are among the most preferred by the chemical companies surveyed.

The results of the research allowed us to propose the following recommendations to the surveyed companies, which should contribute to the effectiveness of their online PR communication:

- modify the content and modernize the appearance of the website in accordance with visitor requirements;
- provide comprehensive information about socially responsible activities on the company's website;
- introduce new modern and interactive forms of online PR messages;
- create modern social media profiles and publish links thereto on the web.

We believe that these recommendations could have a positive effect, especially in the development of important public relations, improving the company's image and market position. Although the research had its limitations – a relatively small number of companies surveyed and a focus only on the chemical industry – given the similar situation in communication in B2B markets, it can be assumed that the results could be applicable in other industries as well. However, this should be verified by follow-up research.

Conflict of interest: none

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Evidence on the Use of Information and Communication Technology for Employee Training in Selected Companies in U.S. – Pilot Study

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Abstract: The aim of this pilot study is to analyze the state of information and communication technology use during employee training in selected US companies. The study used a mixed-methods research design. First, a questionnaire survey was used which consisted of 18 questions. Some were closed, some were semi-closed and some were open ended. At the same time, the questionnaire survey used a 6-point Likert scale for several statements. The mean and standard deviation were then calculated from the results. A total of 21 respondents were obtained. Based on the data obtained from the questionnaire, 3 semi-structured interviews were conducted to obtain more detailed information regarding use information and communication technology for employee training. in these U.S. companies. Based on the results of the research, it can be said that the use of information and communication technology for employee training is popular and a positive trend in the number of such trainings is expected in companies in U.S.

1. Introduction

What role does ICT play in human life? The information and communication technology (ICT) does not drain. What role does it play in our society? How can it be put to use in a variety of situations?

Managers and specialists, especially institutions of higher education and academic centers, must work to answer these concerns. Study fields, such as the function of information and communication technology in developing countries, as well as its influence on the organization and the influence of the training process in the organization, can be investigated.

Recently, we can see how this rapidly changing environment is threatening the existence of many businesses. Global economic changes are pushing regional economies forward. Similarly, new technologies, consumer culture, global standards, the impact of environmental changes and the cost-sharing perspective of today's businesses. Many organizations' survival was jeopardized by their inability to adapt to environmental changes (Goudarzi & Gmynyan, 2003). According to evolutionary theory, environmental variability and uncertainty need a diversity of distinct organizations, and that environmental changes have corresponded with great flexibility. Organizational strategies such as education and improvement have become

highly significant. In reality, training is viewed as a technique for determining the range in which an organization's human capital resources are deemed to be stable. Because it can be challenging to measure the payback on investment in training and development, particularly over a short time period (Malomo, 2018).

2. Theoretical Background

2.1. Employee Training

In a modern society, knowledge and skills requirements are constantly changing and it is therefore essential that employees continuously deepen and broaden their knowledge and skills. An individual can no longer make do throughout his or her economic activity with only what he or she has learned in preparation for a future career. Education becomes a lifelong process (Raymond & Amitabh, 2018).

Employee training in companies is a way for employers to shape employees' skills and enhance their capabilities. It is a systematical procedure for modifying working attitudes and levels of skills (knowledge, abilities and competencies), including employee motivation (Urbancová et al., 2021, Shahzadi et al., 2014) which can help to narrow the gap between subjective competence (the capacity to act and use competencies to organisational goals) and objective competence (the maximum educational attainment and requirements placed on employees) and increase productivity (Kijek et al., 2020).

The overall aim of training and development is learning. Learning means that employees acquire knowledge, skills, competencies, attitudes or behaviors. Referring to Raymond and Amitabh (2018), training and development are not just about employees learning for themselves. Simply offering training programmes today is not enough to gain the support of managers and to give credibility to the learning and development function for employees and managers. Training must show how it helps the company's competitive advantage by boosting employee performance and enhancing business strategy.

The current development of enterprises is facing very serious problems and challenges (Amor-Esteban et al., 2019). In modern globalized economic environment, the question is how to secure a dominant position in market conditions has been an issue that many companies are addressing nowadays (Kimiloglu et al., 2017). More and more companies are realizing this. At a time when people consider human resources as "the second source of profit", companies have elevated human resource development to a strategic level and are currently trying to regard human resource training and development as an important task for the enterprise development (Halbouni et al., 2016).

2.2 Information and Communication Technology

Information and communication technologies (ICT) are widely adopted worldwide, especially in the field of human resource development. According to research, correct use of information and communication technology can shift the location of content and educational technology in the 21st century, which is at the heart of educational reform, will accelerate. If correctly planned, ICT-supported education can help people acquire the knowledge and skills

they need for lifetime learning. ICT If it is used appropriately, rather than just teachers and students, it allows those who have performed higher overall performance, and it provides new means of education. These new techniques of teaching and learning are based on fundamentalist teaching learning theories and a transfer of technology from science teachers to student-centered education.

According to a review of the literature, many studies have been conducted to explore the significant implications of information and communication technology in various companies with various samples and demographics, with all of the results pointing to its favorable effect on individual performance. A few studies in this area are mentioned in the following paragraphs.

Navaie (2007) discovered that training courses lead employees to be ready and increase their efficiency and performance by investigating and assessing the quality of information technology training courses for employees in the Tehran courthouse. In his research, MacDuffi (1995) investigated the relationship between human resources training and increased efficiency and improved quality of human resources performance, concluding that there is a significant link between human resources training and increased efficiency and improved quality of human resources performance. Other research has linked ICT-related stress, sometimes known as technostress, to greater work strain (Ayyagari et al., 2011), as well as decreased work performance (Tarafdar et al., 2010; Tarafdar et al., 2015; Sumiyana & Sriwidharmanely, 2020), unfavorable psychological responses and mental health deficits (Califf et al., 2020; Khedhaouria & Cucchi, 2019).

HajizadeMoghadam and Dastgerdi (2010) investigated the relationship between employee job satisfaction and the degree of reliance on IT tools to complete work tasks, with the premise that there is a positive relationship between job and life satisfaction as long as employees spend the majority of their time doing their jobs. In their research, they discovered that the computing environment in an IT project-based workplace had an impact on employee job satisfaction, particularly among those with advanced computer skills. In other words, it was discovered that the computer environment, through the organization environment and job character, might have a favorable impact on job satisfaction. As a result, it was also indicated that management and giving employees with computer training classes would assist them have a positive perception of the organization's environment, which would impact their job satisfaction.

In his examination of the effects of ICT, Kaushalesh (2004) discovered that adopting new technology does not always imply employment loss. Following the introduction of ICT, employment has increased significantly in all of the organizations studied, with skilled workers accounting for the majority of the increase. Furthermore, ICT acceptance has resulted in the creation of indirect jobs in these businesses, which vary depending on the type and scale of the business. In his study of the impact of health and safety training on employee empowerment, Lippin (2000) discovered that in-service training results in certain changes in safety preservation, employee and workplace health hygiene, and that these aspects empower employees to carry out their obligations. Fasanghari and colleagues (2008) conducted study on this topic. The impact of information technology on supply chain management was examined, and the importance of information technology in supply chain management was emphasized. It is suggested in this research that information technology can be beneficial in establishing

group works, improving inter-organizational communication, and giving chances for firms to extend their markets in the Iranian automotive supply chains. In their study, Nejadirani, Rasouli, and Behravesh (2011) looked at the substantial differences in the effectiveness of Mashhad Municipality's Parks and Green Space Organization before and after the use of information technology. According to the findings of their research, adopting information technology in this organization has boosted the efficiency of human resources and information resources, hence increasing the efficiency of the organization and lowering expenses in the organization under review.

In another study, Gilmor (1998) found that faculty members who have taken IT courses have a higher propensity and motivation for teaching than faculty members who have not taken IT courses, and their information literacy has also improved. Furthermore, Jahanian and Noroozi (2011) attempted to investigate the effect of IDCL training courses on improving employee performance with a different sample in population, and it was discovered that there is a meaningful relationship between ICDL training courses and the employees'new skill, their accuracy, their efficiency, their speed and the amount of work done, their career success, and creating interest in them. Ghorbani and Sangani (2011) conducted a case study to look into the role of information technology in city hall organizational effectiveness, and they discovered that there is a substantial link between the use of information technology and city hall organizational effectiveness. In fact, it was determined that the use of information technology in these businesses can improve their efficiency. They also advised that using information technology professionals and knowledgeable staff, creating a more culture of using information technology among managers and employees, manager and employee training to improve their skills in using current systems and other minor systems, we can improve the application and efficiency of information technology facilities in organizations, resulting in increased effectiveness.

Bloom et al. (2014) and Di Maggio and Van Alstyne (2013) have demonstrated that the implications of employees' use of ICT in their working lives are varied and can have contradictory effects on their discretion and accountability. In their study of the effect of using computers on raising employment rates and human resource capability, Card et al. (1999) discovered that those groups who use computers have a significant increase in group employment and human resource capability. Azari and Amuie (2008) investigated the effective variables in knowledge management at universities in another study. Organizational culture, organizational learning, human resources, and information technology are all considered to be relevant elements on knowledge management at universities, according to this paper. Because knowledge management is dependent on information technology and IT supports the process, information technology is regarded as the most significant. Information technology is actually presented as a solicitor and facilitator of the knowledge management process.

3. Methodology

The primary design of the pilot study is a mixed method approach. The mixed method is a strong case that combines quantitative and qualitative elements. In this pilot study, the researcher mixes both quantitative and qualitative research approaches within a stage of the

study and across two of the stages of the research process. Methodological triangulation was applied by gathering data through interviews and a questionnaire.

Based on the previous research results, the research question was set: *Is ICT used for employee training in selected, ranked in the top 100 best companies to work for, U.S. companies?*

Quantitative data was obtained by a questionnaire survey done in United States (n = 21; Criteria-based selection). The results can only be generalized for the research sample. In total, 534 emails to owners or management of organizations were sent out, 21 replies were received (return rate 3.93%, it is not possible to identify directly which companies participated in the research due to the anonymity of the questionnaire). The sample was based on a ranking compiled by Fortune magazine – the 100 best companies to work for. These rankings are based on votes by individual employees of these companies and only the best ones make it into the top 100. Therefore, the research criteria were that the company had to be based in the U.S., and that it ranked in the top 100 companies to work for in magazine. The questionnaire was designed to comply with ethical rules and with the requirement for anonymity, and contained 18 questions. The questions were closed (allowing only the listed answer choices) and semi-closed (allowing the listed answer choices plus the option to add your own answer) and with more than one or only one answer options. Qualitative measures included data from questionnaire and semi-structured interviews that were used for three respondents to report their relationship to ICT and the way of acquiring ICT into employee training. The structure of the organizations by size, participating in the research (n = 21), was as follows (see Table 1):

Table 1. Structure of the organizations by size

Size of the organization	Number of	Percentage
0-19	3	14.3%
20-49	2	9.5%
50-99	3	14.3%
100-249	1	4.8%
250-499	0	0.0%
500+	12	57.1%
Total	21	100%

The research sample included a very diverse range of field of business. The largest number of companies were from the healthcare sector (4), followed by education (3) and production (3). Other field of business include virtual events, telecom, real estate, outdoor tourism, senior living, retail or recruitment.

4. Results

The first question focused on what training methods are currently used in the organization. The answers to question What kind of Training methods does the organization provide to train the employees? are shown in the Figure 1 below. The most used method is coaching or mentoring, identified by 18 out of 21 respondents. Group discussion and activities are also a highly used method, as well as hands-on training, eLearning and instructor-led training.
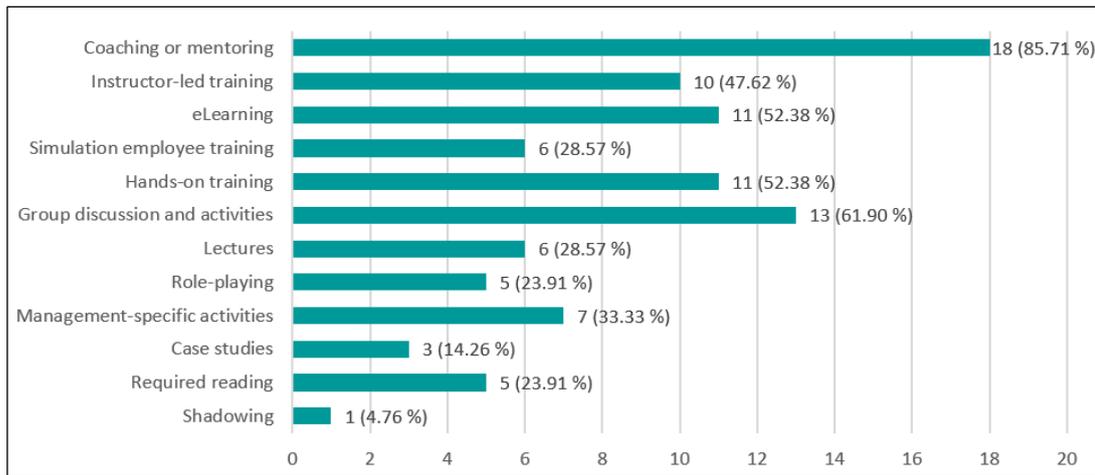
Figure 1. Structure of kinds of training methods used in selected organizations

On the question of whether companies use ICT for employee training, the survey was very positive, with 18 respondents indicating yes and only 3 no. The answer chosen twice as the reason why the organization does not use ICT for training was „The company does not have a budget to develop or deliver ICT-supported training" and „The company does not have a content or learning management system to administer ICT-supported training". One answer each had „The company does not have the hardware or software required to implement ICT-supported training, The company does not have the technical support staff needed to deliver or maintain ICT-supported training" and „The company feels that more traditional methods of training (on-the-job, classroom) are the most successful."

The next question focused on what kind of ICT training the company offers to employees. There were several possible answers for this question. Webinars, eLearning and Online courses were the top most used employee training using ICT. All these three options were chosen by 13 respondents. An overview is shown in the Table 2.

Table 2. Types of ICT-supported employee training provided by the company

Types of ICT-supported employee training provided by the company	Number of	Percentage
Webinars	13	72.2%
Online courses	13	72.2%
eLearning	13	72.2%
mLearning (mobile learning)	4	22.2%
LMS systems	3	16.7%
MOOC courses	1	5.6%

Respondents most frequently cited providing employees with more flexibility for accessing and completing training and providing opportunities for geographically diverse audiences to participate in synchronous training sessions as reasons for introducing ICT into corporate training. An overview of all the reasons is shown in Figure 2.
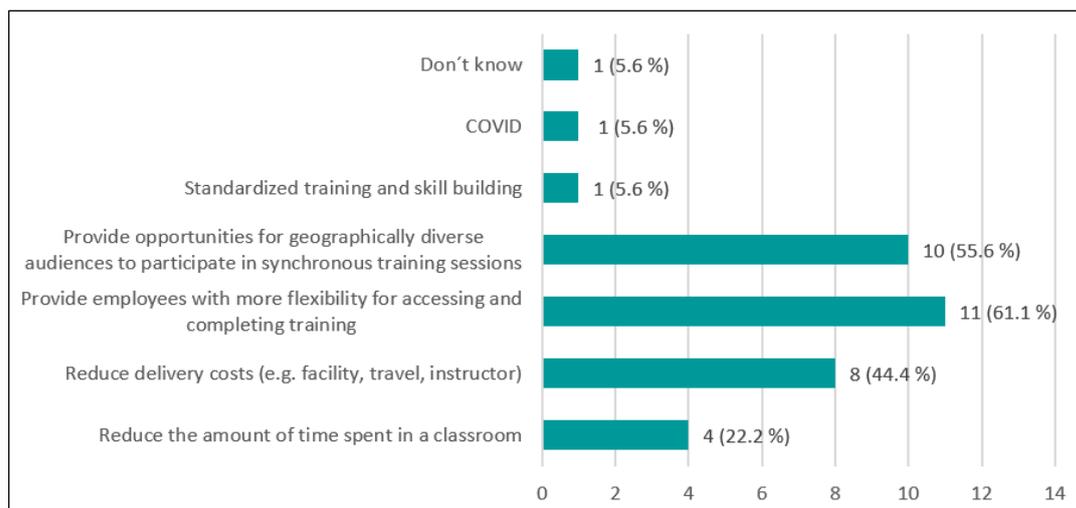
Figure 2. Reasons for implementing/choosing to use ICT-supported training at the company

Resistance to change, technical problems and lack of time were mentioned most as barriers for implementing ICT into employee training. Less common were lack of quality software, limited budget and number of PCs, and lack of relevant content. Respondents (50%) also stated that ICT-supported training for employees is mostly used to develop supplemental training for existing training (e.g. blended training). ICT-supported training also replaces content provided by traditional means like on-the-job or classroom training (38.9% respondents). Last option was ICT-supported training is mainly used in the development of new training courses, selected by 27.8% of respondents.

In order to make ICT-supported training available to employees, the company most often had to acquire a learning management system (44.4%), recruit support personnel to manage and maintain information and communication technology hardware and software (38.9%), provide employees the opportunity to increase digital skills (33.3%) and purchase hardware and software (22.2%). On the issue of content development for this training, the results were almost indecisive. 55.6% of respondents replied that company creates the content and 61.1% that the company pays for the preparation of content to specialized companies. Four respondents chose both answers.

More than half of respondents plan to expand the number of courses offered using ICT in the next 3-5 years. This is a very positive finding for the authors' future research. Another nearly 30% of respondents answered, that they maintain the number of courses offered using ICT. The results can be seen in Table 3.

Table 3. In the next 3 to 5 years the company intends to…

In the next 3 to 5 years the company intends to…	Number of	Percentage
Acquire ICT for the purpose of training employees	2	9.5%
Acquire or develop training delivered by ICT	2	9.5%
Expand the number of course offered using ICT	11	52.4%
Maintain the number of courses offered using ICT	6	28.6%
Reduce the number of course being offered using ICT	0	0%
Total	21	100%

It is also interesting to note the breakdown of this question by the number of employees in the enterprise. Companies over 50 employees mostly want to increase the number of course offered using ICT. For small businesses with up to 49 employees, they would like to introduce these courses into the company or maintain the status quo.

Table 4. In the next 3 to 5 years the company intends to…by the number of employees in the enterprise

In the next 3 to 5 years the company intends to…	Number of How many employees does your organization have?					
	0-19	20-49	50-99	100-249	500+	Total
Acquire ICT for the purpose of training employees	1				1	2
Acquire or develop training delivered by ICT	1				1	2
Expand the number of course offered using ICT			3	1	7	11
Maintain the number of courses offered using ICT	1	2			3	6
Total	3	2	3	1	12	21

Respondents see the biggest advantage of implementing ICT for employee training as the ability to provide training to employees anytime, anywhere and from anywhere (66.7%). Another advantage they identified was the acceleration of the learning process (42.9%), repeatability and unlimited number of participants (28.6%), increasing creativity possibilities (23.8%) and better demonstrativeness (9.5%).

On the contrary, the biggest disadvantage is low level of interactivity (42.9%), high acquisition costs (33.3%), resistance of employees to changes (33.3%), technical problems (23.8%), high demands on digital knowledge (14.3%) and company nuances (the ICT program may need to be flexible to fit each company´s specific needs).

As another part in the questionnaire survey, statements with a 6-point Likert scale were used. The six-point Likert scale was chosen to avoid ticking the middle neutral box, i.e. respondents always had to lean towards either agreement or disagreement. The resulting data is shown in the Figure 3 below and the Table 4 below calculates the mean and standard deviation for each individual statement.
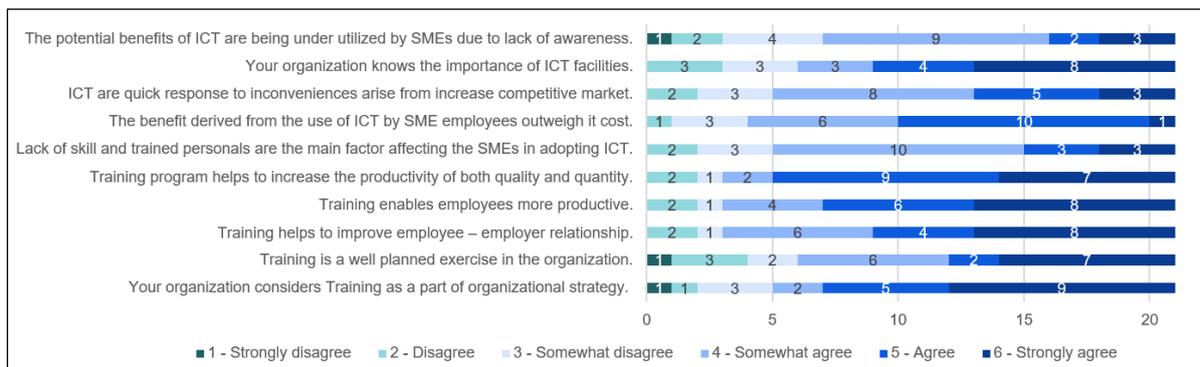
Figure 3. Results of Likert scale

As can be seen in the Figure 3, the majority tends to agree (4-6) with all the statements used in the questionnaire survey. Equally, when looking at the Table 5 showing the mean of all selected responses for each statement, it is clearly evident that respondents tended to agree with the statements.

Table 5. Results of Likert scale

Claim	Mean	Standard deviation
Your organization considers Training as a part of organizational strategy.	4.71429	1.48461
Training is a well-planned exercise in the organization.	4.23810	1.57071
Training helps to improve employee – employer relationship.	4.71429	1.15077
Training enables employees more productive.	4.80952	1.26885
Training program helps to increase the productivity of both quality and quantity.	4.85714	1.20656
Lack of skill and trained personals are the main factor affecting the SMEs in adopting ICT.	4.09524	1.10861
The benefit derived from the use of ICT by SME employees outweigh it cost.	4.33333	0.94281
ICT are quick response to inconveniences arise from increase competitive market.	4.19048	1.13888
Your organization knows the importance of ICT facilities.	4.52381	1.46772
The potential benefits of ICT are being under-utilized by SMEs due to lack of awareness.	3.85714	1.28307

The last part of the questionnaire survey was about the respondents' interest in conducting a 30minute interview with the author regarding the implementation of ICT in education in their organizations. 6 people expressed interest, but only 3 of them were eventually interviewed. The author received permission from 2 respondents to record the interview, all three were conducted under the promise of anonymity. In this interview, open-ended questions were used. One interview was conducted on a mobile phone, two through the Google Meets platform.

During the interview, the author agreed with everyone that ICT is important nowadays and that it is becoming more and more in the consciousness of all organizations across the world. In one company, the author learned from the interviews that based on the evaluation of the company's training by the employees, the management of the company decided just to diversify the training of the employees by introducing new modern techniques. Employees complained that they were looking at the computer all the time and could not ask questions or otherwise respond and interact during training. In this same company, there was a problem when implementing new technologies to training employee resistance to change, where the respondent recommends announcing the change in advance, really making sure that all employees have the necessary digital skills to handle the new form of training and that they are not discouraged. Even in the second company, the author agreed with the respondent that the use of ICT may or may not be an advantage. It is certainly important to choose the right type of training to which ICT training will be used. For some types, such training is pointless.

5. Discussion

The results of the research show that there is a positive trend in the USA companies towards the introduction of ICT in employee training and that modern enterprises will not do without modern technologies in the future. As the results of previous research mentioned in the research show, the use of ICT in employee training has a positive effect on employee satisfaction. This research focused only on companies in the Top 100 companies to work for in the U.S., which is ranked based on the satisfaction of each company's employees. Thus, the answer to the research question is positive, namely that highly ranked companies use ICT for training and even consider increasing the number of such courses in the future. Therefore, the author would like to focus further research directly on employees and their opinion on the use of such courses in their companies. The author would also like to conduct further research with specific companies that would not be anonymous and could compare the results of a given company over a given period and therefore compare the effectiveness of this ICT training.

6. Conclusions

It can be concluded from the results of the pilot study that majority of respondents believe in importance of ICT in learning process. It can be suggested on the basis of research results that most companies already use ICT for employee training. This is a positive finding for the author's future research focus. A large number of respondents also indicated that they are likely to increase the number of such courses in the future and therefore that using ICT for employee training will become more and more common. U.S. will see a growing trend in the adoption of ICT in employee training. Companies know the advantages and disadvantages of ICT training and anticipate the spread of this type of training to their companies. In future research, the author would like to focus on this type of employee training in more depth and also make a comparison with the Czech Republic.

Conflict of interest: none

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Coefficients for Real Estate Tax in Statutory Cities of the Czech Republic

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Abstract: The paper focuses on real estate tax coefficients and their use in selected municipalities in the Czech Republic. Real estate tax is one of the tax revenues, which make up on average 67% of municipal budget revenues in the Czech Republic. Municipalities in the Czech Republic can, based on the decision of the council, adjust the amount of coefficients and thus increase the real estate tax revenue. The objective of our paper is to evaluate the use of real estate tax coefficients in the period 2016-2020 by statutory cities in the Czech Republic: Děčín, Frýdek-Místek, Havířov, Chomutov, Jablonec nad Nisou, Karviná, Kladno, Mladá Boleslav, Most, Opava, Prostějov, Přerov, Teplice and Třinec. Municipalities use the possibility to correct or set the coefficients only to a limited extent, as follows from the results of the analyzes. In the analyzed period, the coefficient was adjusted according to the number of inhabitants in the given statutory cities. A coefficient of 1.5 was set in 10 cities out of a total of 14. The local coefficient was determined for at least a certain period of the analyzed period in only 6 statutory cities. The results show that in municipalities where the local coefficient is set, the share of income from real estate tax in the tax and total income of the municipality increases significantly. This also increases the financial independence of the municipalities.

Keywords: real estate tax; municipality; coefficient; revenues; budget

JEL Classification: H71; H21; H24

1. Introduction

Territorial self-governing units compile their own budget, which is based on planned revenues and expenditures. Tax revenues and subsidy programs play a key role in financing the expenditure side of municipal budgets. They also play a crucial role on the revenue side of municipal budgets. Land tax revenues generate revenue for city budgets in more or less all EU countries. Real estate taxes are not harmonized in the EU. According to Janoušková and Sobotovičová (2021), real estate taxation in the EU has significant autonomy and is based on national traditions in connection with the redistribution of public resources.

Previous research has addressed the importance of real estate tax based on different aspects. According to Drabek (2015), a conscious tax policy is a basic condition for the autonomy and financial self-sufficiency of municipalities. Correct determination of the real estate tax base also according to the research Źróbek et al. (2016), affects the amount of revenue from this tax. A study by Cammeraat and Crivelli (2020) points to the importance of

considering all the factors that affect real estate tax revenue in Italy. The size of the real estate tax rate can be according to Makovská et al. (2020) also dependent on local policy strategy. According to Olejniczak et al. (2020) Polish municipalities have more freedom in shaping real estate rates than Czech municipalities. As reported by Blazic et al. (2016) the introduction of these taxes is perceived by differently qualified professionals and the public. The issue of collecting this tax in China is also addressed in the Huang (2018) study.

The real estate tax in the Czech Republic consists of two partial taxes: land taxes and taxes on buildings and units. Unlike most EU countries, the Czech Republic prefers the principle of determining the tax base using physical indicators (i.e., land area, built-up area, number of floors). The entire revenue of this tax goes to the municipal budget, so it is important that municipalities can, within their partial tax jurisdiction, influence the total amount of funds that become part of the municipal budget by adjusting the basic rates of both land tax and building and unit tax (Janoušková & Sobotovičová, 2021; Pfeiferová et al., 2020).

The Real Estate Tax Act (Collection of Laws, 1992) allows municipalities to adjust or set 3 types of coefficients. The municipality has the possibility to increase or decrease the coefficient by which the basic tax rate is multiplied (the coefficient assigned to individual municipalities according to the number of inhabitants). For specific taxable buildings, the municipality may introduce a coefficient of 1.5, which multiplies the basic tax rate (Collection of Laws, 1992). In addition, municipalities may set a local coefficient. This is a coefficient of 1.1 to 5 determined to one decimal place, which allows to increase the calculated tax liability for real estate in the whole territory of the municipality or in individual parts of the cadastral territory of the municipality (Collection of Laws, 1992).

According to Kameníčková (2019), real estate tax in 2017 accounted for 7% of total revenues for all municipalities. Bečica (2014) also addresses the relationship between real estate tax revenue and the introduction of a local coefficient for municipalities in the Czech Republic. According to Sedmihradská and Bakoš (2016), only 8% of municipalities in the Czech Republic use the local coefficient and its determination depends on the political composition of their executive bodies and the overall structure of budget revenues and expenditures.

By setting coefficients for real estate tax, municipalities can influence the amount of real estate tax revenue. Based on the analysis of Kukalová et al. (2021b) shows that municipalities in the Czech Republic use this power only partially. The use of individual coefficients also differs. Real estate tax revenue is low and below potential.

Conferring to these studies, an increase in real estate tax coefficients can serve as an alternative to strengthening the financial self-sufficiency of municipalities. The aim of the analyzes is to evaluate how selected municipalities in the Czech Republic use the possibility of introducing or adjusting real estate tax coefficients. The paper is part of a comprehensive analysis (Kukalová et al., 2021a), which evaluates the potential of real estate tax in the Czech Republic.

2. Data and Methodology

The article evaluates the coefficients usage in the Czech statutory cities. The analysis does not include Czech regional cities, which are also statutory cities, because the analysis of the use of coefficients in regional cities in the Czech Republic has already been performed for the

period 2016-2020. The data for analyzes and subsequently also the results of analyzes are clearly presented in tables, where the following abbreviations are used for individual statutory cities: Děčín (DE), Frýdek-Místek (FM), Havířov (HA), Chomutov (CH), Jablonec nad Nisou (JN), Karviná (KA), Kladno (KL), Mladá Boleslav (MB), Most (MO), Opava (OP), Prostějov (PV), Přerov (PR), Teplice (TP) and Třinec (TR).

Comparison of the use of coefficients in selected municipalities (statutory cities) is part of the analyzes. The general binding regulations have been analyzed in chronological order and provide an overview of whether the said statutory cities have adjusted the coefficient according to population or set a coefficient of 1.5 or a local coefficient (Table 1).

Table 1. The real estate tax coefficients set in the Czech statutory cities (General binding regulations of the mentioned municipalities)

	Effectiveness of the general binding regulation	Coefficient assigned to the municipalities according to the population (CP)	Coefficient 1.5 (C1.5)	Local coefficient (LC)
DE	since 01/01/2015	3.5 in the whole territory	1.5	has not been set
FM	01/01/2016 – 12/31/2017	4.5 or 2.5 for specific parts of the territory	1.5	2
	since 01/01/2018	4.5 or 2.5 for specific parts of the territory	1.5	has not been set
HA	since 01/01/2007	2.5 or 2.0 or 1.6 for specific parts of the territory	1.5	has not been set
CH	01/01/2012 – 12/31/2019	4.5 in the whole territory	1.5	2
	since 01/01/2020	4.5 only for building plots in the whole territory	1.5	2
JN	since 01/01/2015	2.5 in the whole territory	has not been set	has not been set
KA	since 12/31/2009	3.5 or 1.6 for specific parts of the territory	1.5	2
KL	since 01/01/1994	3.5 or 2.5 or 2.0 or 1.6 for specific parts of the territory	has not been set	has not been set
MB	01/01/2016 - 31/12/2017	2.0 in the whole territory	1.5	4
	since 01/01/2018	2.0 in the whole territory	1.5	3
MO	since 01/01/2016	3.5 or 2.0 or 1.6 for specific parts of the territory	1.5	2
OP	since 01/01/2011	3.5 or 2.0 or 1.6 for specific parts of the territory	has not been set	2
PV	01/01/2013 - 31/12/2020	3.5 or 2.5 or 1.6 for specific parts of the territory	has not been set	has not been set
PR	since 01/01/2013	3.5 or 2.5 or 2.0 for specific parts of the territory	1.5	has not been set
TP	since 01/01/2012	4.5 for the whole territory	1.5	has not been set
TR	01/01/2008 - 31/12/2018	2.5 or 2.0 or 1.6 or 1.4 for specific parts of the territory	1.5	has not been set
	since 01/01/2019	2.5 or 2.0 or 1.6 for specific parts of the territory	1.5	has not been set

Data on real estate tax revenues in absolute terms were obtained from the final accounts of individual statutory cities. Revenues for individual years of the analyzed period are shown

in Table 2. These data were used for the following analyzes and comparison of revenues from real estate tax per capita of a particular statutory city. The following analyzes evaluate the share of income from real estate tax in the total income of the municipality and the share in the tax income of the municipality.

Table 2. Real estate tax revenues in the Czech statutory cities (in thousand CZK) (The final accounts of the mentioned cities)

	2016	**2017**	**2018**	**2019**	**2020**
DE	27,785	28,568	28,053	28,639	28,428
FM	65,519	65,301	37,766	37,587	37,318
HA	40,500	40,655	42,097	41,468	42,965
CH	65,000	69,061	72,092	65,478	64,248
JN	20,244	20,215	20,717	20,704	20,804
KA	53,935	56,309	59,607	61,104	60,011
KL	37,583	38,151	37,543	37,800	37,105
MB	143,176	147,400	114,292	114,645	117,560
MO	83,707	80,014	79,207	80,124	80,389
OP	64,831	65,266	65,138	66,247	65,357
PV	28,875	29,529	29,612	30,014	28,330
PR	36,550	36,482	36,268	37,694	36,866
TP	35,761	36,459	36,464	36,329	36,431
TR	35,805	35,066	35,778	36,032	36,112

3. Results

The performed analyzes of generally binding decrees show that the approach of statutory cities to the determination or correction of coefficients is different. Most statutory cities have made some correction of the coefficient according to the number of inhabitants and often set it differently for different parts of the municipality. The coefficient of 1.5 was not determined in the analyzed period in only four of the 14 statutory cities. The local coefficient was set by only five statutory cities throughout the analyzed period, the city of FM had a local coefficient set only in 2016 and 2017. The local coefficient was set by the municipalities at 2, only in Mladá Boleslav, when this coefficient was set in 2016 to 2017 at 4, since 2018 it has been reduced to 3 (Table 1).

The amount of income in absolute terms was almost constant for the individual statutory cities during the analyzed period, with the exception of the cities of Frýdek-Místek and Mladá Boleslav. With effect from 1 January 2021, the generally binding decree issued by the statutory city of Frýdek-Místek abolished the local coefficient, which was set at 2 in 2016 and 2017. This reduced real estate tax revenue from CZK 65 million to CZK 37 million. (Table 2). The statutory city of Mladá Boleslav reduced the local coefficient from 4 to 3 from 1.1.2018. There is also a significant reduction in absolute real estate tax revenues from CZK 147 million to CZK 114 million (Table 2).

Real estate tax revenues per capita are highest in statutory cities, where a local coefficient is set. Mladá Boleslav shows the highest yields per one inhabitant in the analyzed period (Table 3), especially in the period 2016-2017, when a local coefficient of 4 was set. After its reduction, incomes decreased by approximately CZK 800 per one inhabitant. The average

income from real estate tax in 2020 was CZK 980 per one inhabitant in the monitored cities. In 2017, however, the average income from this tax was 1,046 CZK per one inhabitant. The difference was mainly due to the reduction of the local coefficient in Mladá Boleslav and the abolition of the local coefficient in Frýdek-Místek (Table 1, Table 3).

Table 3. Real estate tax revenues per one inhabitant (in CZK)

	2016	2017	2018	2019	2020
DE	557	577	570	587	593
FM	1,147	1,151	670	672	678
HA	551	555	582	577	612
CH	1,335	1,417	1,481	1,344	1,329
JN	443	442	453	452	459
KA	981	1,035	1,114	1,157	1,179
KL	549	556	546	547	539
MB	3,257	3,346	2,588	2,577	2,641
MO	1,252	1,198	1,189	1,211	1,230
OP	1,123	1,137	1,142	1,170	1,167
PV	654	671	676	687	653
PR	831	833	833	873	868
TP	719	734	736	733	733
TR	1,001	985	1,013	1,026	1,038
average (all statutory cities)	1,021	1,046	971	972	980

Table 4. Percentage of the real estate tax revenues in the total revenues of the selected municipalities (in %)

	2016	2017	2018	2019	2020
DE	3.18	3.07	2.67	2.59	2.54
FM	5.84	5.51	3.00	2.74	2.60
HA	3.13	2.83	2.67	2.58	2.53
CH	6.63	7.13	6.53	5.05	5.39
JN	2.40	2.33	1.91	1.77	1.84
KA	4.17	4.41	5.01	4.61	5.03
KL	1.94	1.80	2.08	2.13	2.17
MB	14.57	14.51	8.43	8.62	9.58
MO	6.55	5.54	5.34	5.14	4.92
OP	5.22	5.16	4.80	4.35	4.37
PV	3.37	3.14	2.66	2.64	2.32
PR	4.00	3.92	3.27	3.24	3.04
TP	3.82	3.63	3.36	3.12	3.10
TR	4.88	4.96	4.73	4.33	4.43
average (all statutory cities)	4.98	4.85	4.03	3.78	3.85

The average share of real estate tax revenues in the total revenues of the analyzed municipalities in 2020 was 3.85% (Table 4). Only in 6 of the 14 statutory cities was this share higher (Table 4). Mladá Boleslav has the highest share of income from real estate tax in the total income of the statutory city. In 2016 and 2017, this share was almost 15%, after reducing

the local coefficient from 1 January 2018, it was approximately 9%. The influence of the determined local coefficient is evident within the performed analyzes; in the municipalities that set it, the average share of real estate tax revenues in total budget revenues is higher.

The most important (and highest) aggregate item of the revenue part of municipal budgets is represented by tax revenues. Real estate tax accounts for an average of 6.16% of the total tax revenues of the monitored statutory cities in the period 2016-2020 (Table 5). The average share for the period of 2020 alone is 6.59%. The trend of the share in the period 2016-2019 is declining with one exception (Karviná 2017-2018). The highest values of the share are reported by Mladá Boleslav, which together with Chomutov exceeded the 10% share in 2020 (Table 5). In Mladá Boleslav, the share has decreased significantly since 2018 (Table 5), when the local coefficient decreased (Table 1). Jablonec nad Nisou shows the lowest share of real estate tax in total tax revenues in 2020 (Table 5).

Table 5. Percentage of the real estate tax revenues in the tax revenues of the selected municipalities (in %)

	2016	2017	2018	2019	2020
DE	4.10	3.85	3.46	3.35	4.10
FM	8.06	7.44	4.10	3.83	8.06
HA	4.17	3.77	3.65	3.40	4.17
CH	10.47	9.55	9.15	7.64	10.47
JN	3.52	3.16	2.94	2.71	3.52
KA	6.76	6.37	6.48	6.39	6.76
KL	3.75	3.45	3.15	2.90	3.75
MB	18.13	17.36	13.18	11.80	13.16
MO	8.51	7.29	6.79	6.57	8.51
OP	7.44	6.73	6.39	6.23	7.44
PV	4.42	4.14	3.85	3.66	4.42
PR	5.74	5.40	4.93	4.80	5.74
TP	4.71	4.57	4.27	3.91	4.71
TR	7.50	6.76	6.42	6.05	7.50
average (all statutory cities)	6.95	6.42	5.63	5.23	6.59

The approach of statutory cities to the use of coefficients can be compared with the results of other studies, which are part of comprehensive analyzes within the real estate tax in the Czech Republic (Table 6). The results of the current analysis show that the share of statutory cities that have adjusted the coefficient by population (CP) in the total number of statutory cities (excluding regional cities) is 92.85%. A similar analysis for regional cities (Pfeiferová et al., 2020) showed the use of CP in all regional cities, i.e., 100% share. The analysis performed for all municipalities in the Czech Republic shows that the share of municipalities with CP correction in the total number of municipalities is approximately 11% in the analyzed period (Table 6). The use of the coefficient 1.5 (C 1.5) can also be compared within the above analyzes. The share of statutory cities with a set C 1.5 is 71.43%, the share of regional cities is 100%, the share within all municipalities in the Czech Republic is less than 24% (Table 6). Coefficient 1.5, like CP, is used more in large municipalities (with a higher population). Janoušková and Sobotovičová (2016) proved the dependence between the

number of inhabitants and the determination of C 1.5. The results of the analyzes further show that the share of statutory cities that use the local coefficient (LC) is significantly lower than for other coefficients. In the period 2016-2017, the share was 42.86%, since 2017 only 35.71%. The use of LC in regional cities shows similar results, the share of regional cities with a set LC was 41.67%. Within all municipalities in the Czech Republic, this share was only about 10% (Table 6).

Table 6. Shares of municipalities that corrected or set real estate tax coefficients (in%)

Type of analysis	coefficient	2016	2017	2018	2019	2020
Share of statutory cities with set / corrected coefficients in the total number of analyzed statutory cities (our research)	CP	92.85	92.85	92.85	92.85	92.85
	C 1.5	71.43	71.43	71.43	71.43	71.43
	LC	42.86	42.86	35.71	35.71	35.71
Share of regional cities with set / corrected coefficients in the total number of regional cities (excluding Prague) (Pfeiferová et al., 2020, own research)	CP	100.00	100.00	100.00	100.00	100.00
	C 1.5	100.00	100.00	100.00	100.00	100.00
	LC	41.67	41.67	41.67	41.67	41.67
Share of municipalities with set / corrected coefficients in the total number of municipalities in the Czech Republic (Kukalová et al., 2021; own research)	CP	11.23	11.29	11.36	11.34	11.37
	C 1.5	23.41	23.76	23.71	23.65	23.72
	LC	9.16	9.57	9.72	9.53	10.34

4. Discussion

By setting real estate tax coefficients, the municipality can influence the amount of income from this tax as well as its share in total revenues and tax revenues. The determination of the local coefficient has a fundamental effect on the amount of income from real estate tax. Bečica (2014) also addresses the relationship between real estate tax revenue and the introduction of a local coefficient for municipalities in the Czech Republic. The analysis of real estate tax revenues in the regional cities of the Czech Republic was performed by Pfeiferová et al. (2020). The results show that the income from this tax per capita is the highest in those municipalities where a local coefficient has been set.

The amount of the share of real estate tax revenues in total revenues and tax revenues is related to the use of coefficients by the analyzed cities, especially with the determination of the local coefficient (Pfeiferová et al., 2020). This is also confirmed by the results of the analysis in the statutory cities of the Czech Republic. In the municipalities that set the local coefficient, the average share of real estate tax revenues in total and tax budget revenues is higher. According to Kameníčková (2019), the share of real estate tax in total income in 2017 for all municipalities in the Czech Republic was 7%. The results of analyzes in statutory cities show that this share was only 4.85% in 2017. The different result is mainly due to the fact that these are municipalities with a higher population. A large number of municipalities with a small population figure in the average amount for the whole of the Czech Republic, and these municipalities generally have higher shares of real estate tax in total income (Kameníčková, 2019).

In general, it can be stated that municipalities set the local coefficient only to a small extent. A total of 596 municipalities had a local coefficient in 2019, which represented 9.5% of the total number of 6,258 municipalities in the Czech Republic (Kukalová et al., 2021a). The reason for the very limited use of the local coefficient was the fact that municipalities could set this

coefficient at 2 or 3 or 4 or 5, in the whole territory of the municipality, and thus would burden the increased tax for all inhabitants of the municipality (Kukalová et al., 2021a). From 1 January 2021, municipalities may set a local coefficient of 1.1 to 5 to one decimal place, for the entire territory of the municipality or for individual parts of the cadastral territory of the municipality (Collection of Laws, 1992). The advantage of this new way of determining local coefficients is that they can be determined, for example, only in certain parts of the municipality, where there are, for example, establishments that produce negative externalities. The increase in real estate tax due to the determination of the local coefficient will not affect the inhabitants of the municipality, but only these establishments (Kukalová et al., 2021a).

5. Conclusions

Revenues from real estate tax belong to the tax revenues of the municipal budget and form an important part of these budgets. Real estate tax is the only tax whose revenue can be influenced by the municipality by adjusting or setting selected coefficients. Any change in the coefficients must be determined by a generally binding decree, according to the rules. From the performed analyzes of generally binding decrees that in the monitored period 2016-2020, the correction of the CP was carried out in all the mentioned statutory cities. The coefficient of 1.5 was determined by 10 analyzed municipalities. During the period under review, the LC was set in six statutory cities for at least a certain period. In 2020, the LC was set only in five statutory cities (in Chomutov, Karviná, Most and Opava – in the amount of 2, and in Mladá Boleslav – in the amount of 3).

Municipal revenues from real estate tax per capita have always been highest in cities, which set a local coefficient. This also increases the financial independence of the municipalities, which can use these funds to finance other public goods. The share of real estate tax revenues in total revenues averaged 3.78-4.98% for each year of the period under review. The share of real estate tax revenues in the tax revenues of the budgets of the given municipalities averaged 5.23-6.95% for each year of the observed period. The amount of the share of real estate tax revenues in total revenues and in tax revenues is related to the use of coefficients by the analyzed cities, especially with the determination of the local coefficient. The statutory city of Mladá Boleslav had the highest share of real estate tax revenues in total and tax revenues, as it determined the highest local coefficient in comparison with other statutory cities. In the period 2016-2017 it was a LC of 4, since 2018 it was 3.

The results of the analyzes further show that the frequency of correction or determination of coefficients in statutory cities is similar to that in regional cities. The share of statutory cities that have made a CP correction is higher than 90% and the share of statutory cities that have set C 1.5 is higher than 70%. Within regional cities, these shares are 100%, but within all municipalities in the Czech Republic, the share of municipalities with CP correction is only about 11%, with the set C 1.5 it does not reach 24%. The shares of municipalities with the established local coefficient are lower when comparing the results of the above analyzes, however, in statutory and regional cities they are approximately 40%, while in the whole of the Czech Republic only 10%. Although it is possible to significantly increase real estate tax revenues and thus the financial independence of municipalities by setting a local coefficient,

municipalities use this option to a lesser extent than in the case of other coefficients. However, these coefficients do not have the same potential as the local coefficient.

Given that in the current economic situation, the motivation of municipalities to invest in their development will increase, it will be necessary to use all available funds on the revenue side. Increasing real estate tax revenues will continue to be one of the options for obtaining these resources. The use of this potential in other municipalities in the Czech Republic will be the subject of our further research.

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An Empirical Test of Stacked Autoencoder as Recommendation Model

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Abstract: The Autoencoder method can be used for multiple scenarios, as it is very variable. In this case, the method is used for suggesting actions. This paper describes the theoretical aspects of the recommendation models. The next section describes the use of the autoencoder. There will be provided two experiments. The first one, recommendations for movie lens dataset with process of transformation datasets and proper model dimension setting included. The results of the first experiment are favorable. The second experiment for suggesting actions from custom workflow inspired dataset. In this experiment, two ways of preparing a dataset for a model will be tested. Unfortunately, results are worse than model example. The article concludes with a discussion of the results achieved in comparison with other authors where results with movie datasets.

Keywords: neural networks; autoencoder; recommender systems

1. Introduction

Referral systems are technologies and techniques that can provide recommendations for items to be used by a user. The recommendations provided are aimed at supporting their users in various decision-making processes, such as what products to buy, what music to listen to or which way to go. Accordingly, various techniques for generating recommendations in commercial environments have been designed and implemented. The aim of this research is to impose a certain degree of order on this diversity by presenting a coherent and unified repository of the most common methods of recommendation for solving the problem of collaboration filtering: from classical matrix factorization to high-end deep neural networks.

The field of computer learning is undoubtedly a big trend at the moment. Deep learning (DL) is a subset of computer learning that uses neural networks to analyze various factors with a structure that is similar to the human nervous system. One of the basic problems in this area is the quality of the input data, which directly affects the result of the model. Algorithms of DL can search and represent both structured and not structured data – for instance, natural language processing, time series or image data (Abdel-Nasser & Mahmoud, 2019; Pena-Barragan et al., 2011) In image data processing can be found examples about fixing an image (Wolterink et al., 2017; Yang, et al., 2018), compression (Sun et al., 2020), super-resolution (Dobrovolny et al., 2020; Christian, et al., 2017), image classification (Ciresan et al.,

2012; Mambou, et al., 2020), forecasting (Dobrovolný et al., 2020) session based recommendations. (Dobrovolny et al., 2020)

The article (Sedhain et al., 2015) describes the AutoRec model. The authors describe the implementation of the model and compare the results with a conventional matrix factorization algorithm. Furthermore, the authors focused on the influence of the choice of the activation function. Linear functions, namely ReLU and nonlinear Sigmoid, were compared. The ReLU activation function, which generally has better properties, showed worse results in this case than the Sigmoid function, which is often replaced by the ReLU activation function in modern networks. The next article (Kuchaiev & Ginsburg, 2017) focuses on the DeepRec model. The authors of the article describe the mentioned method and examine, apart from the influence of the activation function, especially the influence of the number of hidden layers on the results. Their results support the claim that deep learning with the use of an autoencoder can be used for recommendations even with a relatively small dataset.

Authors of article (Wu et al., 2016) are focused on Collaborative Denoising Autoencoders (CDAE). They assume with the given method that the available list of preferences is not complete and use a model to try to reconstruct it. It effectively uses a pattern of common preferences. The differences between linear and nonlinear activation function also enter into the whole observation.

Article (Liang et al., 2018) focuses on Multinomial Variational Autoencoders (MultVAE). Authors of the article introduce with multinomial probability using Bayesian statistics for parameter estimation. It introduces another regularization parameter, which has proven to be essential for achieving competitive performance.

One of other method is called Sequential Variational Autoencoders (SVAE). There is an article (Sachdeva et al., 2019) that focuses on it. The authors of the article extend the previously mentioned method. The authors transmit data, including a time sequence, within their model and show that the processing of time information is essential for improving the accuracy of the neural network result.

Another article (Steck, 2019), focuses on Embarrassingly Shallow Autoencoders (EAEC). The authors of the last model focus on the simplicity of the algorithm. They combine simple elements of a basic model to create a linear model that focuses on simple data. The results of some tested scenarios surpassed the far more complicated models described earlier in this work.

The paper's organization is structured as follows: In Sect. 2, we discuss the methods of content recommendation. Section 3 describes autoencoder model with and its results of two experiments. Finally, in Sect. 4, we conclude the paper and provide an outlook on our future work plans.

2. Methodology

At the core of any advanced proposal framework, which has seen enormous achievement in organizations like Amazon, Netflix and Spotify, is shared sifting. It works by social affair human decisions (known as appraisals) for items in a given area and coordinating people with similar requirements for information or similar tastes. Collaborative filtering system

clients share their insightful decisions and perspectives on everything they burn-through so other system clients can all the more likely evaluate which things to burn-through (Dobrovolny et al., 2020). Consequently, for new items, the collaborative filtering system offers helpful customized suggestions. In particular, the Autoencoder model will be discussed in this paper.

2.1. Autoencoders

Autoencoder is a type of neural network that can be used to learn a compressed representation of raw data.

An autoencoder is composed of an encoder and a decoder sub-model. The encoder compresses the input, and the decoder attempts to recreate the input from the compressed version provided by the encoder. After training, the encoder model is saved, and the decoder is discarded. (Hinton & Salakhutdinov, 2006; Liu et al., 2019; Vaiyapuri & Binbusayyis, 2020)

Usually, autoencoders consist of three-part: encoder – the part that includes input layer and hidden layer, bottleneck – this is where learned/compressed data is stored, and decoder – the part that starts from hidden layer and ends with output layer (Hinton & Salakhutdinov, 2006; Liu et al., 2019), as shown in following Figure 1.
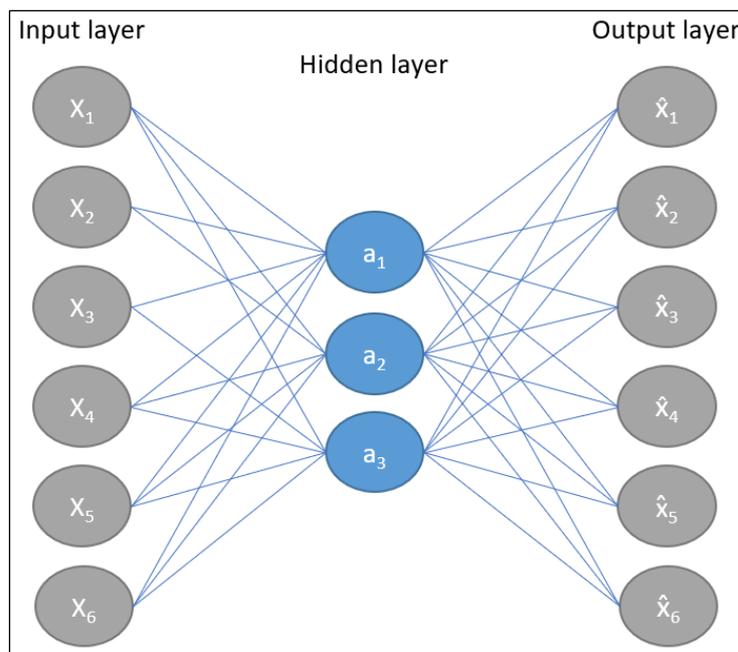
Figure 1. Autoencoder model schema

As visualized above, we can take an unlabeled dataset and frame it as a supervised learning problem tasked with outputting ($\hat{x}$), a reconstruction of the original input x.

This network can be trained by minimizing the reconstruction error, $(x, \hat{x})$, which measures the differences between our original input and the consequent reconstruction.

There are several main use cases for auto-encoders such as: Data compression, Denoising data, Classification and Collaborative Filtering (Recommendation). (Hinton & Salakhutdinov, 2006; Liu et al., 2019) In this paper, author will focus on the last one-use case

– Collaborative Filtering. There are many autoencoders model implementations. Some of them will be described and explained.

AutoRec In AutoRec, instead of explicitly embedding users/items into lowdimensional space, it uses the column/row of the interaction matrix as the input, then reconstructs the interaction matrix in the output layer.

On the other hand, AutoRec differs from a traditional autoencoder: rather than learning the hidden representations, AutoRec focuses on learning/reconstructing the output layer. It uses a partially observed interaction matrix as the input, aiming to reconstruct a completed rating matrix. In the meantime, the missing entries of the input are filled in the output layer via reconstruction for the purpose of recommendation. (Sedhain et al., 2015)

DeepRec DeepRec autoencoders extends idea of AutoRec. A deep autoencoder is composed of two, symmetrical deep-belief networks that typically have four or five shallow layers representing the encoding half of the net, and second set of four or five layers that make up the decoding half.

The layers are restricted Boltzmann machines (RBM), the building blocks of deep-belief networks.

A deep-belief network can be defined as a stack of restricted Boltzmann machines, in which each RBM layer communicates with both the previous and subsequent layers. The n nodes of any single layer don't communicate with each other laterally. (Kuchaiev & Ginsburg, 2017)

Collaborative Denoising Autoencoders (CDAE) is represented as a one hidden-layer neural network. CDAE consists of 3 layers, including the input layer, the hidden layer, and the output layer as is shown on next figure.

Collaborative Denoising Autoencoders extends idea of classic Denoising Autoencoders where key difference a latent vector for the user. In the input layer, there are in total I + 1 nodes, where each of the first I nodes corresponds to an item, and the last node is a user specific node (the red node in the figure), which means the node and its associated weights are unique for each user u ∈ U in the data. (Wu et al., 2016)

Variational Autoencoders (VAE) Is special implementation of autoencoder. VAE provides a probabilistic manner for describing an observation in latent space. Instead of building an encoder which outputs a single value to describe each latent state attribute, it will formulate encoder to describe a probability distribution for each latent attribute.

Rather than directly outputting values for the latent state as it would in a standard autoencoder, the encoder model of a VAE will output parameters describing a distribution for each dimension in the latent space. Decoder model will then generate a latent vector by sampling from these defined distributions and proceed to develop a reconstruction of the original input.

2.2. Other Models

As other methods of collaborative filtering can be considered many different network architectures. Some of them are listed below.

Neural colaborative filtering Neural Factorization Machines for Sparse Predictive Analytics (He & Chua, 2017) is another parallel work that combines Factorisation Machines and Multi-Layer Perceptron seamlessly. This model brings together the efficacy of linear factorisation machines for sparse predictive analytics with the representation potential of nonlinear neural networks.

Bolzmann Machines Stochastic and generative neural networks capable of learning internal representations of difficult combinatorial problems are Boltzmann Machines. These models are commonly used for learning representations and solving them. These problems belong also to collaborative filtering. Boltzmann machines are two types – restricted Boltzmann machines (RBM) and explainable restricted Boltzmann machines (ERBM). RBM are specific by the structure. There are no output nodes. They only contain hidden and visible nodes. (Abdollahi & Nasraoui, 2016; Salakhutdinov et al., 2007)

Sequence modeling Simple but smart method for collaborative filtering seems to be sequence modelling. In paper Session-based recommendations using Recurrent neural networks - Long short-term memory (Dobrovolny et al., 2020) we introduced another method of modelling user inputs as sequences and learning them by word-level Long shortterm memory (LSTM). This method has lower accuracy but brings a possibility of real-time predictions on demand.

3. Using AutoEncoder as Recomendation Model

The neural network was created in Python using the PyTorch library. The model is a stacked autoencoder. A stacked autoencoder is a neural network consisting of several layers of sparse autoencoders, where the output of each hidden layer is connected to the input of a subsequent hidden layer. The author of the article Sparse, Stacked and Variational Autoencoder (Jonnalagadda, 2018) deals with this model.

Within the proposed model, it is possible to easily change some hyper parameters, such as learning speed, number of epochs, type of activation function, or type of optimizer. The Comet library is used to store the results from individual experiments.

3.1. Experiment 1 - Recomendation with Movielens Dataset

The first sample dataset to test the efficiency and accuracy of a neural network based on the Autoencoder method was obtained from a GroupLens (Harper & Konstan, 2015) project of the University of Minnesota Department of Informatics.

The data consists of 100,000 ratings of 1,682 movies in the format 1-5 from 943 users. Each user has rated at least 20 movies. In addition, basic information such as gender, age and nationality are available to users.

The model has a variable number of inputs and outputs depending on the dataset used as you can see in Figure 2.

Process of learning is described with following algorithm 1 below.
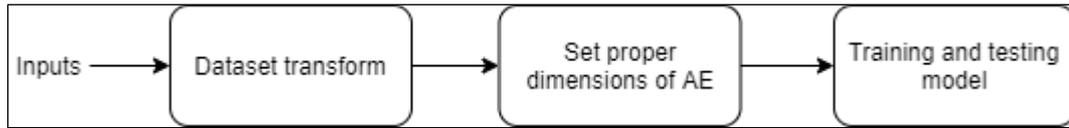
Figure 2. Flowchart of model processing

Algorithm 1: Prepare and train AE model

```
Result: list predictions
prepare datasets;
init modelwith proper dimensions and parameters;
init optimizer;
while epoch ¡ epochs count do
make prediction;
correct model using optimizer;
end
```

The network size with testing movie lens dataset is as follows:

```
SAE(
 (fc1):Linear(in_features=1682,out_features=20,bias=True)
 (fc2):Linear(in_features=20,out_features=10,bias=True)
 (fc3):Linear(in_features=10,out_features=20,bias=True)
 (fc4):Linear(in_features=20,out_features=1682,bias=True)
 (activation): Sigmoid()
)
```

Within the proposed model, it is possible to change some hyper-parameters and the result is monitored in the form of an error Mean Squared Error (MSE), which in this case indicates how much the final evaluation of the film by the user. For all experiments, a uniform number of epochs was chosen – 50 and the effects of the activation function and the optimizer were investigated.

Table 2. Measured values for different combinations of optimizers and activation functions

	Sigmoid	ReLU	Tanh
Adagrad	1.01909	1.03234	1.01908
Adadelta	1.00110	1.01802	1.01611
Adam	1.01772	1.01349	1.01775
RMSprop	1.00601	1.01704	1.01935

Table 2 shows that neither the activation function nor the type of optimizer used has a significant effect on the prediction results. In all cases, the error is around 1. This value indicates that the estimate of how the resulting film will like on a scale of 1-5 is with an error of 1. It can be said that the model is able to recommend films with high success based on previous evaluations.

3.2. Experiment 2 - Suggesting Actions with Workflow Inspired Dataset

The second experiment was focused on simulated workflow process. Simulated process is shown in Figure 3 below.
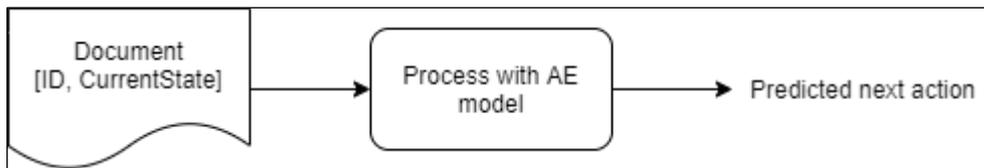
Figure 3. Flowchart of model processing

The aim of this experiment is to verify the ability to use an autoencoder for this type of use case. In document management software, the workflow for each document type would not have to be fixed and explicitly programmed for new customer types, but the model for predicting further action would learn the workflow itself based on a few examples.

Simulated dataset was about document's actions where part of the training dataset is shown below:

```
Document,currentState,nextAction
1,3,1
1,2,7
1,4,0...
```

This dataset consists of 50 records. Available actions and documents are shown below:

```
0::none                              1::invoice
1::toManager                         2::priceOffer
2::toAccounting                      3::order
3::toSecretary                       4::employmentContract
4::toControlling                     5::ITguideline
5::toHR                              6::EHSguideline
6::toPlantManager                    7::fine
7::toPurchasing
8::toIT
```

Dataset had to be transformed to model's readable array in a form:

```
[ currAction | Doc1:nextAct | Doc2:nextAct | ... | Doc7:nextAct ]
```

MSE loss was 1.442. A better view of accuracy in this case will provide the number of successful predictions that was 36%.

There was the second attempt with following dataset transformation.

```
[ Document, CurrentAction, NextAction ]
```

MSE loss was 1.216. A better view of accuracy in this case will provide the number of successful predictions that was 42%.

Model was computed on desktop workstation computer with one dedicated graphic card GTX1070 operating with 8 GB Graphic memory supported with Intel Core i5 9600KF and 16 GB RAM. As a programming language we used Python in version 3.7

4. Discussion & Conclusions

Autoencoders has proven to be a good model for recommending movie content in terms of estimating user ratings based on selected parameters describing the person. In the first experiment in this article, it was managed to build on the results already achieved by other authors.

In the second experiment, which aimed to verify the usability of the autoencoder for predicting actions instead of explicit workflow programming, the model proved to be strongly unsatisfactory, despite two attempts with different dataset transformations. The conventional convolution forward network probably appears to be better for this type of use case, and the autoencoder did not surpass it in its properties, nor did it approach its results.

In an effort to find an equivalent in the process data with the structure of the movielens dataset, it occurred to us to use it for general recommendation of action on selected parameters, for example, persons who manipulated the document. This structure could be the subject of a possible further study.

Conflict of interest: none

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Role of Eco-Innovation and Tourism towards Carbon Neutrality in the Czech Republic

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Abstract: Even though Czechia is flourishing economically, the country is the EU's fourth-largest carbon emitter, which indicates that its economic growth achievements are not sustained simultaneously with its environmental quality. Therefore, this study analyzed the effect of economic growth, international tourist arrivals, foreign direct investment, and eco-innovation on reduction of the carbon emissions of the country. Data spanning from 2003 to 2018 was used and several econometric methods were applied to assess the effect of these variables. Findings revealed that foreign direct investment (FDI) increases carbon emissions as 1% rise in FDI leads to a 0.002% increase in carbon emissions while international tourist arrival and economic growth significantly reduce carbon emissions, as 1% rise in tourist arrival leads to -0.02% decline in the long run. Based on these findings, it is recommended that policies be put in place to further promote the Czech Republic as a destination country while observing the carrying capacity to ensure long term tourism sustainability towards reducing environmental degradation and achieving carbon neutrality.

1. Introduction

Since 1990, the Czech Republic has been able to reduce its greenhouse gases (GHG) drastically; however it remains the EU's fourth-largest emitter per capita (Eurostat, 2021; Hanzlík et al., 2020) as shown in Figure 1. The majority of the emissions are generated from electricity/heat generation and industry, which is 45.3 and 36.2 $MtCO_2e$ respectively as of 2020. While the contribution of tourism to the Gross Domestic Product (GDP) of the Czech Republic is relatively low – tourism ratio on GDP was around 3% in the researched period (Czech Statistical Office, 2022) – (Nižić et al., 2017), the majority of energy consumption is realized by other industries such as the manufacturing industry. According to a report by Omondi (2019), the service sector is the largest contributor to the Czech Republic's economy. While the nation does not have a substantial ratio tourism on the GDP, the sector could serve as a facilitator in achieving carbon neutrality because tourism has the potential to expedite the transition to renewable energy and enhance its contribution to the global energy mix. As a result, tourism may assist to mitigate climate change, reduce greenhouse gas emissions, and

contribute to innovative and new energy solutions in both urban and rural locations by promoting long-term and smart investments in sustainable energy sources (UNWTO, 2021).
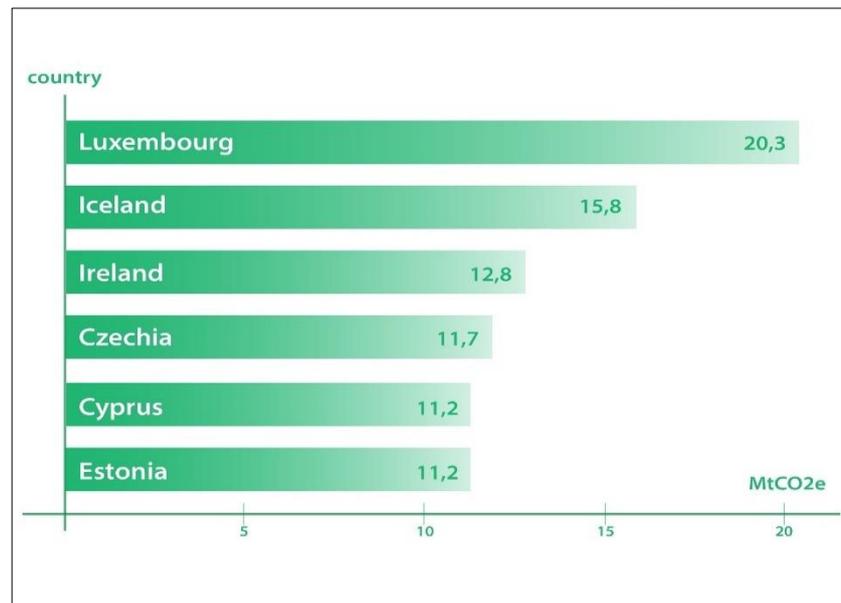
Figure 1. Greenhouse gas emissions per capita in 2019 (Eurostat, 2021)

A recent study has concluded that tourism can help in attaining carbon neutrality in Turkey context (Sun et al., 2021). Also, to reach net-zero, green technology and technological innovations have been identified by several studies (e.g. Dong et al., 2022; Shao et al., 2021; Wang et al., 2021) as important pathways towards carbon neutrality. Hanzlík et al. (2020) proposed in their study that Carbon Capture and Storage (CCS) technology represents an important system to reduce carbon emissions, therefore eco-innovation (environmental-related technology) is considered in this study. While recent studies (e.g. Yurdakul & Kazan, 2020; Geng et al., 2021) have attempted to investigate the effect of eco-innovation on environmental sustainability, most of these studies have used total spending on research and development, patent, trademarks, research and development, and technology cooperation grant as indicators of eco-innovation, which shows a gap in the theory that should be filled. Regarding tourism, the last decades show the growing importance of implementation of the concept of social corporate responsibility which leads to the increase of the eco-innovations in this sector (Pásková & Zelenka 2019).

Based on the aforementioned reasons, this study examines the nexus between foreign direct investment, economic growth, tourism, eco-innovation, and carbon emissions in the Czech Republic. This study has selected the Czech Republic because coal still accounts for half of the total domestic energy production (International Energy Agency, 2021). This study contributes to the relevant theory-building by using environment-related technologies (percentage of all technologies) and to the best of the authors' knowledge, no study has examined yet the mutual relationship of these variables in the Czech Republic.

2. Methodology

The study employs annual data between 2003 and 2018 when applying the estimation model that uses carbon dioxide emissions as the dependent variable. The explanatory

variables include Real Gross Domestic Product per capita (measured in constant 2010 USD), foreign direct investment, eco-innovation (the environment-related technologies), and international tourist arrivals. While several studies have observed the relationship between foreign direct investment, tourist arrival, carbon emission (Akadiri et al., 2021; Lasisi et al., 2020; Muhammad et al., 2021), this study applies this concept to the specific case of the Czech Republic. Additionally, the research model distinctively includes environmental-related technology, an indicator of eco-innovation, as such the research model specification is:

$$CO_2 = f\ (GDP, FDI, ERT, TOA) \tag{1}$$

$$lnCO_2 = b_0 + b_1 lngdp_t + b_2 fdi_t + b_3 ert_t + b_4 lntoa + u \tag{2}$$

For there to be constant variance in the data series, logarithmic transformation was applied. Hence, $lnCO_2$ against $lngdp_t, fdi_t ert_t,$ and $lntoa$ denotes the logarithmic transformed dependent variable versus the independent variables, where CO_2 is carbon emissions, *gdp* is Gross Domestic Product, *fdi* is foreign direct investment, *ert* is the environment-related technologies, *toa* is international tourist arrival, *u* is error term while b_0, b_1, b_2, b_3, and b_4 are regression coefficients for the parameters, in the long run, *u* is the error term and *t* is the period (2003-2018).

Several tests and methods were applied to determine the correlation of the variables. (i) The stationary of the variables were ascertained with the Fisher ADF (Dickey & Fuller, 1981) and Im et al., (2003) unit root test, (ii) long-run and cointegration regression analysis, and Dumitrescu and Hurli's (2012) causality analysis. Based on the existing theory, the following hypotheses are posited:

Hypothesis 1: There is a bidirectional causality between GDP and carbon emissions.

Hypothesis 2: There is an inverse and significant relationship between FDI and carbon emissions.

Hypothesis 3: Environmental-related technologies will reduce carbon emissions.

Hypothesis 4: There is an inverse and significant relationship between tourism and carbon emissions.

3. Results and Discussion

Table 1 shows the summary statistics. This is expedient to determine the fundamental extent of dispersion and central tendency of the variables and to know how they performed over the period considered (2003-2018). The descriptive statistics show that carbon emissions have a minimum value of 11.5104 from the start-up years with a maximum (highest) of 11.7251 over the period considered, while the gross domestic product has a minimum of 25.3293 and a maximum of 26.2405. All observed variables are positively skewed except for gross domestic product and environmental related technologies. The sample size for the study is 16 and is normally distributed.

Furthermore, the correlation matrix analysis was conducted to investigate the nexus between the observed variables, as shown in Table 2. An inverse statically significant relation between carbon emissions and economic growth has been identified, which indicates that economic growth mitigates carbon emissions. A plausible reason for this in the case of Czechia could be because of the economic freedom of the country (freedom score of 74.4 in

2022) (The Heritage Foundation, 2022) and economic freedom have been found to reduce carbon emissions (Shahnazi & Shabani, 2021). However, for foreign direct investment, there

Table 1. Descriptive statistics

	LCO$_2$	LGDP	FDI	ERT	LTOA
Mean	11.61891	25.95171	4.308955	10.79625	17.06539
Median	11.61796	26.06150	4.190054	11.46500	17.03134
Maximum	11.72505	26.24052	10.01153	12.89000	17.40645
Minimum	11.51042	25.32934	0.904051	7.63000	16.81663
Std. Dev.	0.079797	0.256574	2.209848	1.545876	0.172679
Skewness	0.060756	-1.238198	0.899010	-0.658171	0.684642
Kurtosis	1.420134	3.477105	4.022702	2.340895	2.439424
Jarque-Berra	1.673838	4.240108	2.852529	1.444783	1.459457
Probability	0.433045	0.120025	0.240205	0.485589	0.482040
Observations	16	16	16	16	16

is a positive and significant relationship with carbon emissions but an insignificant inverse relationship with economic growth. Environmentally related technology has an insignificant and positive relationship with carbon emissions and economic growth but a positive and statistically significant relationship with foreign direct investment, which implies that eco-innovation will increase foreign direct investment. For tourist arrival as *apriori* expectation, an inverse and significant relationship with carbon emission and a significant positive relationship with economic growth are noted. Notably, no outcome can be validated only by the correlation coefficient estimation analysis, as such, the study advances by conducting econometric analysis to reliably refute or validate the research objectives.

Table 2. Correlation matrix

	LCO$_2$	LGDP	FDI	ERT	LTOA
LCO$_2$	1.000000				
LGDP	-0.628588***	1.000000			
FDI	0.375255*	-0.212572	1.000000		
ERT	0.078663	0.281250	0.493417**	1.000000	
LTOA	-0.745575***	0.418047*	0.006842	0.064530	1.000000

Note: ***, **, * represents 0.01, 0.05, and 0.10 at 1%, 5%, and 10% significance level

Table 3. Result of unit root

	ADF- Fisher		Im, Pesaran Shin	
	Level	First Difference	Level	First Difference
LCO$_2$	-0.853065	-3.331654**	-0.791709	-3.568052**
LGDP	-2.914859	-2.727672	-3.324212**	-2.697627
FDI	-3.733431(0.0152)	-6.131453***	-3.751611**	-8.337362***
ERT	-3.773636(0.0141)	-6.497358***	-3.775384**	-6.671700***
LTOA	-0.105768	-1.645102	-0.105768	-3.375184**

In econometric analysis, the stationarity test was used to circumvent spurious regression trap and the result of the unit root analysis is shown in Table 3. At the first difference, it was observed that the foreign direct investment and environmental-related technologies are stationary at a 1% significant level in both ADF-Fisher and Im Pesaran Shin unit root test.

Carbon emission is stationary at 5% significant level at the first difference for both unit root tests, while gross domestic product is stationary at 5% significant level only in Im Pesaran Shin unit root test and international tourist arrivals are stationary at 5% significant level, first difference in Im Pesaran Shin unit root test. Therefore, it can be concluded that all series are mixed order integrated as stated by the unit root tests.

Furthermore, the long-run nexus between the variables were examined. Based on the Kao residual cointegration test, there is an equilibrium relationship (long-run) between carbon emissions, economic growth, foreign direct investment, environmental-related technologies, and tourist arrivals over the considered period. Therefore, the investigation of the cointegration magnitude of the variables ensued, and the result is shown in Table 4 through the ARDL model estimation. The long-run estimations show that the coefficients of economic growth are statistically significant and positive in the long run. The study reflects a statistically significant and inverse association between carbon emission and economic growth as a 1% increase in economic activities results in a 0.06% decrease in carbon emission which is in congruences with previous studies (e.g. Lee & Unger, 2012). This study supports the environmental Kuznets inverted U-curve hypothesis, which states that once rising incomes goes beyond a turning point, pollution levels begin to drop as increased national income necessitates greater measures to reduce pollution emissions. On the other hand, there is a positive and significant relationship between foreign direct investment and carbon emission which has been confirmed by several studies such as Do and Dinh (2020); Essandoh et al. (2020); Lee (2013) This indicates that with FDI, there will be easier or cheaper access to financial capital which can be used in constructing new factories or expanding existing operations, thereby increasing industrialization which may inevitably lead to an increase in carbon emissions.

Unexpectedly, environmental-related technologies have a significant and positive relationship with carbon emissions, as a 1% increase in environmental-related technologies will result in a 0.002% increase in carbon emissions, which opposes Xin et al. (2021) study of the United States, Ahmad and Zheng's (2021) and Danish and Ulucak's (2020) study of the BRICS countries. As expected, there is an inverse and significant relationship between international tourist arrival and carbon emissions. This result is noteworthy for environmental and tourism economists as a 1% increase in international tourist arrival leads to a 0.02% decline in carbon emissions. This opposes studies like Alola et al.(2021) but the negative association has been confirmed in previous studies (e.g. Ben Jebli & Hadhri, 2018; Gao & Zhang, 2021). A plausible reason could be the several agreements between the Ministry of Industry and Trade (MIT) and energy suppliers (both retail and distribution system operators) and energy-intensive industries. Also, the recent agreement with PKN ORLEN could also help in reducing carbon emission because the aviation-fuel supplier is considering low- and zero-carbon hydrogen renewable energy sources (PKN ORLEN, 2022). This indicates that the Czech Republic implements sustainable energy policies in the tourism industry to prevent carbon emissions in the long run as the share of renewable energy has increased by 71% since 2009 (International Energy Agency, 2021, p. 11).

Finally, following Dumitrescu and Hurlin's (2012) procedural outline, the study employed the Granger causality test and the report of the test is shown in Table 5.

Table 4. ARDL estimation result

Model: $\ln CO_2 = f\ (lnGDP, FDI, ERT, lnTOA)$				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP	-0.061923	0.000514	-120.4783	0.0000
FDI	0.002457	0.000737	3.335098	0.0087
ERT	0.002155	0.001299	1.659029	0.1315
LTOA	-0.023405	0.000220	-106.3488	0.0000
C	4.621947	0.146168	31.62072	0.0000
Hypothesized No. of CE (s)	Eigenvalue	Trace Statistics	0.05 Critical Value	Prob
None*	0.966503	78.81710	47.85613	0.0000
At most 1*	0.808696	31.26912	29.79707	0.0336
At most 2*	0.431910	8.114645	15.49471	0.4532

Table 5. Granger causality test

Null Hypothesis	F-Statistic	Prob.	Causality
LGDP "does not Granger Cause" LCO2	2.91801*	0.1055	
LCO2 "does not Granger Cause" LGDP	4.91307**	0.0361	$CO_2 \leftrightarrow GDP$
FDI "does not Granger Cause" LCO2	0.38818	0.6891	
LCO2 "does not Granger Cause" FDI	1.65082	0.2451	
ERT "does not Granger Cause" LCO2	1.27058	0.3266	
LCO2 "does not Granger Cause" ERT	1.03970	0.3924	
LTOA "does not Granger Cause" LCO2	0.56941	0.5850	
LCO2 "does not Granger Cause" LTOA	2.15315	0.1721	
FDI "does not Granger Cause" LGDP	0.90475	0.4385	
LGDP "does not Granger Cause" FDI	1.69723***	0.0009	$GDP \rightarrow FDI$
ERT "does not Granger Cause" LGDP	1.65227	0.2448	
LGDP "does not Granger Cause" ERT	0.72166	0.5121	
LTOA "does not Granger Cause" LGDP	3.36271**	0.0812	
LGDP "does not Granger Cause" LTOA	1.55692	0.2626	$TOA \rightarrow GDP$
ERT "does not Granger Cause" FDI	2.30635	0.1554	
FDI "does not Granger Cause" ERT	1.25846	0.3297	
LTOA "does not Granger Cause" FDI	4.78426**	0.0384	
FDI "does not Granger Cause" LTOA	1.56029	0.2620	$TOA \rightarrow FDI$
LTOA "does not Granger Cause" ERT	0.09980	0.9060	
ERT "does not Granger Cause" LTOA	1.08532	0.3782	

NB: The number of observations is 14

There is a bidirectional relationship between carbon emissions and economic growth. This suggests that economic growth is increased by industrial activities while the economy's structural interactions increase carbon emissions. It can indicate a feedback mechanism between economic growth and environmental deterioration in the Czech Republic. Therefore, it is imperative that there is a structural shift from a carbon and energy-intensive economy to a decarbonized services and economy to achieve carbon neutrality. There is

unidirectional causality from economic growth to foreign direct investment which is in accordance with Faisal, Muhammad, and Tursoy's (2016); Pao and Tsai's (2011) study.

Furthermore, there was a unidirectional causality from tourism to economic growth, which confirms the tourism-led growth hypothesis in the Czech Republic. This implies that Prague being the 22nd most visited city in the world (Johnston, 2019) increases foreign exchange income in the country, which has a significant impact on the nation's economy, and the trade balance and current account are influenced by tourism receipts (Sokhanvar et al., 2018). Lastly, there is unidirectional causality from tourism to foreign direct investment, which indicates that with tourism, the Czech Republic can expand its foreign direct investment, therefore the government should endeavor to promote tourism and ensure tourism sustainability to further attract the foreign direct investment. Succinctly, the first hypothesis which states that there is a bidirectional causality between GDP and carbon emission is confirmed, however, the second hypothesis (an inverse and significant relationship between FDI and carbon emissions) was rejected. Also, hypothesis three (Environmental-related technologies will reduce carbon emissions) was rejected, while hypothesis four was accepted.

4. Conclusions

The Sustainable Development Report in 2019 ranks the Czech Republic as the 7th most advanced nation (Pirodsky, 2019), however, despite a "…36% decrease since 2009, coal still accounts for half of the total domestic energy production…" (International Energy Agency, 2021, p. 11), as such, it is pertinent to identify the macroeconomics factors affecting the country. In this study, the effects of economic growth, eco-innovation, tourist arrivals, and foreign direct investment, on carbon emission of the Czech Republic between 2003 and 2018 are examined. The stationary of the variables was ascertained with the Fisher ADF (Dickey & Fuller, 1981) and Im et al. (2003) unit root test, cointegration, and long-run regression analysis, and Dumitrescu and Hurli's (2012) causality analysis were carried out to establish the relationships between the variables.

The ARDL model reveals a significant and inverse relationship between carbon emission and economic growth but a positive and significant relationship between foreign direct investment and carbon emissions. Environmental-related technologies have a positive and significant relationship with carbon emissions while there is an inverse and significant relationship between international tourist arrival and carbon emissions. The Granger causality test indicates a bidirectional relationship between carbon emissions and economic growth. There is unidirectional causality from economic growth to foreign direct investment and the tourism-led growth hypothesis was confirmed in the Czech Republic. Lastly, there is unidirectional causality from tourism to foreign direct investment, which indicates that with tourism, the Czech Republic can expand its foreign direct investment.

Considering that the objective of the study is to determine how the Czech Republic can achieve carbon neutrality and also to determine if eco-innovation can play a role in achieving this goal, the following recommendations are suggested: (i) Implementation of sustainable energy policies in the tourism industry to prevent carbon emissions; (ii) a structural shift from

carbon and energy-intensive economy to a decarbonized services; (iii) the governmental stimulation to promote tourism and ensure tourism sustainability to further attract the foreign direct investment, and (iv) increase of the tax rate on carbon emission from energy use because the country has the lowest rate in OECD countries.

In view of the findings, the study suggests that tourism plays a vital role in reducing carbon emissions in the Czech Republic, further research should consider how tourism innovation through innovation pillars (e.g., institutions, infrastructure, and human capital and research) can foster economic growth and help in achieving carbon neutrality. Recent studies have concluded that low-carbon smart tourism can also help in reducing carbon emission (Ma et al., 2021). From this reason, the future research should consider the role of ICT readiness by individuals and business in the tourism sector. In addition, the qualitative case studies should be realized to further confirm the findings of this study and to deepen understanding of the identified general patterns in the concrete contexts.

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A Review of Risk Management Tools for Small Business

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Abstract: The uncertainty in the business environment, especially in the last years, has increased due to more dynamic and unpredictable development in science or the economy. The paper aims to provide a summary of the risk management tools suitable for use by small enterprises, thru the use of a bibliometric analysis and a systematic review. The tools term was used in order to encapsulate all the models, methodologies and techniques encountered in the review process. The initial data set utilized is comprised of 243 papers for the bibliometric analysis, with only 30 articles being taken into consideration for the systematic review. The papers considered for the review fall into the Pareto distribution, accounting for approximately 80% of the total citations. The usefulness of the paper resides in the synthesized presentation of the tools discovered, providing a potential guide, for managers or business owners of small enterprises, in the research for risk management tools that could be implemented.

Keywords: small business; bibliometric analysis; systematic review; risk management tools

JEL Classification: M10; M21

1. Introduction

The business environment is characterized by a great amount of uncertainty. In only the last two years, the economy as a whole has been hit by a series of events not encountered in modern times, such as the Covid pandemic, the military invasion of a European country, high levels of inflation, or surges in the European energy markets prices. Given the actual circumstances, especially smaller firms should consider a high focus on risk management.

The definition of small business does not follow a generally accepted trend. Different approaches could be encountered around the globe, with complex takes seen in the USA (U.S. Small Business Administration, 2019), Argentina (Administración Federal de Ingresos Públicos, 2022) or China (Yang et al., 2006), in which the distinction between different business sizes was made according to the economic sector in which the firm operates, the number of employees, the annual revenue or assets under management. Simpler versions of the definition could be encountered in the EU (European Commision, 2020), Australia (Gilfillan, 2015), or New Zeeland (Small Business Council, 2019), where only the number of employees, revenue, or asset being the deciding factors.

In order to determine the types of methods or procedures utilized by the small firms for risk mitigation, an understanding of business risk would be necessary. One approach to risk

explains it as the outcome of an uncertain event (Manuj & Mentzer, 2008). Another take on the definition stated that business risk is the impact of situations or events on the objectives of the firm (Murray-Webster & Dalcher, 2019). A similar approach was proposed by Paino et al. (2014), in which the business risk was the chance of a business missing the set objectives due to external or internal factors. Is to be noted that the future risk that a business might encounter would not be a certain danger to the firm prospects, but rather could provide competitive advantages if the correct approach would be used. Hence, an important path for firms to follow in the hopes of higher returns or profits could be the implementation of risk management practices.

The objective of the paper is to conceive the summary of the literature regarding the risk management tools proposed for utilization in small businesses. By realizing the summary, business owners and managers are provided with a synthesized approach of the potential techniques that might help mitigate the uncertainty's effects.

The paper is structured as follows: after the introduction, a short review of the literature on the topic of risk management is performed, in order to uncover the principal areas of interest in the academic community. The third chapter presents the objectives and the methodological steps followed in the paper, with the fourth chapter presenting the data discovered. The fifth part represents the discussion emerging after the data presentation. The last chapter is comprised of the conclusions of the paper.

1.1. Review of the Scientific Literature

Research on the topic of small business risk management (RM) is scarce, the topic being covered under the bigger category of the small and medium-sized enterprises (SME). A systematic review that analysed the risk types for smaller organizations enlists several clusters with the capability of inducing risk: project RM, supply chain RM, and strategic RM (Lima et al., 2019). The SME's low number of risk-reducing techniques were thought to come from the lack of resources or the scarcity of resources (Crovini et al., 2021), but it was also theorized that the absence of ability from the entrepreneur could be a decisive factor in the lack of implementation of RM tools (Palich & Bagby, 1995). The conflicting interest of stakeholders influences the organisation's capability to identify and combat risk, and the tendencies were aggravated by the increasing information uncertainties (Burggraf et al., 2021). In addition, the lack of long-term planning was not suggesting an absence of RM strategy, but revealed a low priority for RM (Manuj & Mentzer, 2008).

The level of education of managers and owners constitutes a risk factor for SMEs in Slovakia (Hudáková et al., 2019). It has been proven that education was essential in recognition of the benefits of using RM tools and that the application of such methods increases with the level of education of the upper levels of management.

Supply chain risks were discovered in the literature to be covered by systematic review with the topic relating to risk management. Three main types of risk were discovered to influence the supply chain of an enterprise. Supply risk (supplier opportunism, inbound production quality, or transit time variability) alongside operational risks (inventory ownership or asset ownership) synergize with demand risks (demand variability or

forecasting error) to endanger the future prospects of the firm (Manuj & Mentzer, 2008). Alongside the aforementioned sources of risks, the network and the environmental forces were considered causes of uncertainty (Ghadge et al., 2012). Six types of risk management strategies were being proposed for supply chains: postponement, speculation, hedging and control/share/transfer, security and avoidance (Manuj & Mentzer, 2008).

In the attempt to manage the supply risk, the literature regarding artificial intelligence are proposing five general procedures: evolutionary computation used to detect, fuzzy logic, computational creativity, machine learning and probabilistic models (Nimmy et al., 2022).

In more recent times it can be seen that the focus is switching to a computer-based approach, with the prevalent use of machine learning and artificial intelligence algorithms growing as time marched forward.

2. Methodology

The objective of the paper was to synthesize the literature on the topic of RM on the level of a small business in order to determine what types of tools were suggested. To achieve the desired result, a bibliometric analysis was performed on the selected dataset, followed by a systematic review used for in-depth research.

The data was retracted from the Web of Science (WoS) website, provided by Clarivate. A large number of entries in the database motivated the selection, also the lower number of duplicated entries played a role in the decision (Pranckute & Raminta, 2021). The filtering of the database was realized on February 2, 2022.

The first phase of the research was represented by the process of selecting the keywords for the initial filtering of WoS. In order to achieve the stated objective, the following keywords were considered: small near/3 business* OR small near/3 firm* OR small near/3 organization* OR small near/3 enterprise* OR small near/3 venture* OR small near/3 company* AND risk management OR risk technique OR risk evaluation OR risk assessment OR risk identify. The NEAR operator was used to identify in the database those articles that used expressions such as "small and medium business" or "small or micro-enterprise", etc. In the hopes of eliminating any unwanted results, the operator was used for only three words adjacent to the partner keyword.

The initial query for the parameters selected returned 846 results. Subsequently, only the documents that were articles were retained. The reason behind the choice was represented by the higher quality of the type of papers and the availability or access to the material. Given the aforementioned criteria, only 537 articles remained. The following step was to keep only those research papers within the theme of business management and thus, the articles that corresponded to the WoS categories of "Management", "Economics", "Business Finance" and "Operations Research Management Science" were selected. The preceding elimination generated 249 results. Regarding the language of the papers, only those written in English were considered, ensuring thus a level of consistency, resulting in 243 papers. The first result of 243 articles represented the base for the bibliometric analysis.

Subsequently, two types of analysis were used on the extracted data: a bibliometric one and a systematic review. The bibliometric analysis could be defined as the quantitative and

qualitative procedure, on a specific research area, topic, or publication, used to uncover the underlining trends in the scientific field (Rey-Marti, Ribeiro-Soriano, & Palacios-Marqués, 2016). The data was processed with the help of the software VosViewer 1.16.17 and the informatics solution Publish or Perish 8 (PoP).

The keyword analysis was performed on the papers selected. The initial result of the research done thru VosViewer generated 623 unique keywords. Only 50 keywords were being encountered in more than five papers, so only those keywords were selected for the following step. For a better representation of the trends presented in the literature, the following list of words was eliminated: risk-management, SMEs, business, model, determinants, size, firm, firm performance, firms, risk, enterprises, small enterprises, uncertainty, methodology, empirical-evidence, small businesses, corporate, impact and perspective. The elimination was done on the basis that the aforementioned keywords were expected to appear, due to the query parameters. The keywords not considered were variations on the search terms in WoS, being similar in meaning with the concepts of risk or small business. Therefore, only 31 keywords were kept for an in-depth analysis.

In the process of reviewing the database, the distribution of citations was identified to follow the Pareto model, therefore the most cited papers account for more than 80% of the total citations, and thus 47 articles were considered for the systematic review, from the initial database. The review represents the process in which the literature is searched to discover the most relevant scientific contributions (Tranfield et al., 2003).

The abstract of the 47 articles, as displayed in WoS, was reviewed to determine the relevancy level relative to the subject of the paper. Therefore, from the starting set of papers, 12 were considered irrelevant. The contents of the aforementioned papers were also reviewed to evaluate if the papers were truly not in the theme of the research. From the remaining set, six articles were removed based on the lack of availability. The 30 papers that remained constituted the base for the systematic review.

3. Results

The results of the paper are going to be presented in two stages, the first being the bibliometric analysis with the subsequent stage being represented by the systematic review.

3.1. Bibliometric Analysis

Starting at the level of the publication, 154 journals were identified. The journal that contributed with the most number of articles was Safety Science with 12 entries. The result could be explained by reviewing the general themes covered by the journal, with the focus being represented by the safety of the people in the work environment or in other situations. Ranking the publication by the cumulative number of citations, the Journal of Financial Economics was identified as the category leader with 1,999 citations, accounting for more than 34% of the total citations. The overwhelming contribution was the result of one paper, with 1,962 that distort the overall picture. If the exception was not taken into consideration, the Journal of Banking & Finance emerges as the leader.

The most prolific authors ranked by the number of citations were Graham, J.R. and Harvey, C.R.with 1903 citations each, but generated by the same paper. From a quantitative perspective, Dvorsky, Jan has contributed with six papers. As a general rule, the authors have produced on average one paper each.

Researchers affiliated with the United States of America dominated the geographical distribution in terms of the number of citations, links and volume of documents, as shown in Table 1.

Table 1. The geographical distribution of the articles

Country	Links	Documents	Citations	Country	Links	Documents	Citations
USA	16	48	3,142	Denmark	6	5	92
England	15	28	759	France	11	10	84
Netherlands	12	9	333	South Korea	6	6	66
Peoples R China	4	21	205	Taiwan	8	5	59
Italy	10	14	178	Indonesia	2	5	51
Slovakia	5	13	177	Turkey	8	6	38
Czech Republic	5	15	174	India	4	9	33
Germany	5	10	168	Poland	8	8	27
Spain	12	10	168	South Africa	14	9	24
Canada	3	9	140	Malaysia	6	6	21
Scotland	10	7	119				

The dynamic of the articles in time has presented an upward trend, with the interest growing in the subject of small business RM as time marched forward, as shown in Figure 1. Seventeen articles were not listed with the year of publication, but for a better representation of the trend, the early access year was considered. A spike was identified as the Covid pandemic started, but the trend only accelerated, being similar to a representation of the compounding effect of the money over time.
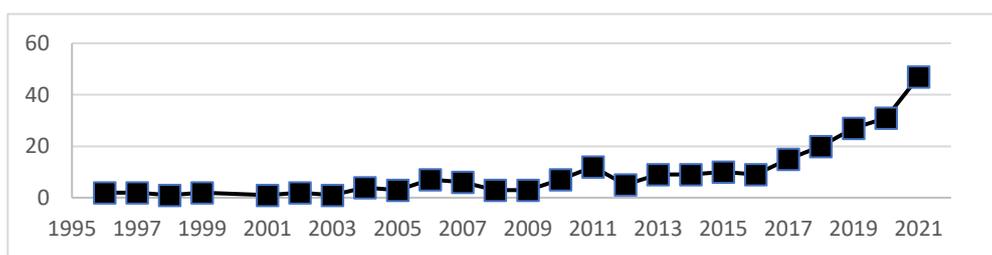
Figure 1. The chronological evolution in the research

From the perspective of the keywords, performance, management, innovation and investment were identified as the most prevalent, as seen in Figure 2. In the coupling of the 31 nodes discovered, six clusters emerged. The biggest cluster was the red coloured one, which covered themes regarding the safety aspects of the organizations. The green cluster was being comprised of keywords such as credit or finance. The third cluster covered topics in the realm of financial risk, suggesting a strong link between financial management and innovation. The yellow-colored cluster indicated an area of emerging risk in the components of the market and also in the attitude of the business toward information use. The smallest

clusters were referring on one hand to the bankruptcy risk and the potential of its avoidance, and on the other to the strategic vision of the enterprise.

Figure 2. Keywords mapping

A different grouping in clusters was observed, in regards to the keywords identified. A general tendency was observed, covering the financial risk encountered at a small business level. The cost, investment or debt could be grouped with bankruptcy prediction and the financial ratios. The second avenue of thought was represented by the knowledge-centric approach. Innovation, information culture or competitive advantages hits at a need of models, which helps, evaluate and manage the risk associated with knowledge. The last overall cluster contains the risk generated by the employees' safety regarding the occupational hazard.

The h-index for the data set was calculated thru PoP (Harzing, 2007) at a value of 35, meaning that only 35 papers received over 35 citations from publications until the date of the analysis. The g-index was 70 and analysed in correlation with the h-index, a discrepancy between the number of citations received by the top-cited papers and the rest of the articles was evident.

3.2 Systematic Review

The articles were reviewed in order to determine the types of methods proposed to be utilized in a small business setup. From the articles reviewed, the data source for the research was extracted, along with the research approach and the type of business analyzed. Table 2 represents the articles that were considered for the systematic review.

Table 2. List of articles included in the systematic review

References	Data source	Type of research	Type of business
Bajo, Borrajo, De Paz, Corchado, & Pellicer, 2012	Surveys	Qualitative/Quantitative	SMEs
de la Torre, Peria, & Schmukler, 2010	Surveys	Quantitative	SMEs
Behr & Guettler, 2007	German banks database	Quantitative	SMEs
Ye & Zhang, 2011	Financial report	Quantitative	All businesses
Yang, Ishtiaq, & Anwar, 2018	Questionnaire/interviews	Quantitative	SMEs
Li, Niskanen, Kolehmainen, & Niskanen, 2016	Financial report	Quantitative	SMEs
Brown, Ongena, & Yesin, 2021	Surveys	Quantitative	Small enterprises
Cioccio & Michael, 2007	Interview	Qualitative	Small enterprises
Walker & Tait, 2004	Audit	Quantitative	Small enterprises
Pennings & Garcia, 2004	Interview	Quantitative	SMEs
Vickery, 2008	Surveys	Quantitative	SMEs
Rosengard & Prasetyantoko, 2011	Surveys	Quantitative	SMEs
Forlani, Parthasarathy, & Keaveney, 2008	Surveys	Quantitative	Small enterprises
Kim & Vonortas, 2014	Surveys	Quantitative	Small enterprises
Thun, Drueke, & Hoenig, 2011	Surveys	Quantitative	SMEs
Hofmann, 2011	Literature review	Qualitative	SMEs
Canton, Grilo, Monteagudo, & van der Zwan, 2013	Surveys	Quantitative	SMEs
Killip, 2013	Interview	Qualitative	SMEs
Marcelino-Sadaba, Perez-Ezcurdia, Echeverria Lazcano, & Villanueva, 2014	Case study	Qualitative	Small enterprises
Wedawatta & Ingirige, 2012	Case study	Qualitative	SMEs
Rostami, Sommerville, Wong, & Lee, 2015	Surveys	Qualitative/Quantitative	SMEs
Ciampi & Gordini, 2013	CERVED database	Quantitative	Small enterprises
Danso, Adomako, Lartey, Amankwah-Amoah, & Owusu-Yirenkyi, 2020	Surveys	Quantitative	SMEs
Ellegaard, 2008	Surveys	Quantitative	Small enterprises
Sarkis, 2006	SGP database	Quantitative	SMEs
Hudakova, Masar, Luskova, & Patak, 2018	Questionnaire/interviews	Quantitative	SMEs
Belas, Smrcka, Gavurova, & Dvorsky, 2018	Albertina database	Quantitative	SMEs
Binks & Ennew, 1997	Surveys	Quantitative	SMEs
Graham & Harvey, 2001	Surveys	Quantitative	All businesses
Altman, Sabato, & Wilson, 2010	Financial report	Quantitative	SMEs

In the analysis of the papers, the principal data gathering method was the survey, being utilized in 46% of the articles. The preferred type of data interpretation was the quantitative analysis, being utilised in 23 articles. Only six papers performed an analysis specific to the level of the small business, with two-thirds of the papers studying the broader category of SMEs.

Four specific methodologies were identified in the studies reviewed, presenting the steps that are to be performed if the business or other third party wants to implement them. In the following paragraphs, the tools identified are going to be detailed.

CBR-BDI (case base mechanism – beliefs, desires, intentions) (Bajo et al., 2012) follows an architecture similar to the hierarchic pyramid, in which the business in need of consultation transmits data to a business agent. The benefits of the model reside in the cross

experience of the agents involved, opening a new perspective for the small business. In addition, given the fact that the analysis begins after an initial matching was realized, the previous experiences are providing at least a pattern for the current situation from which parallels could be drawn, thereby excluding the mistakes encountered in the past. Regarding the limitations of the model, the lack of data to feed into the system induces a slow process, especially at the beginning of the system. In addition, the success of the procedure will be influenced by the willingness of the businesses to provide data about the situations they have faced. In the cases where the problem is new, the system could provide a suboptimal result.

Artificial neural networks (ANN) is an artificial intelligence algorithm with the capability of learning based on experience (Li et al., 2016; Ciampi & Gordini, 2013). The technique explores the relation between the variables fed into the algorithm (Ciampi & Gordini, 2013). The data used by the studies analysed were in the spectrum of financial information. The benefit of the system resides in the self-correcting nature of the algorithm. The complexity of the model could be considered a hindrance in the implementation, at the level of a small business, requiring either a consultant or a dedicated employee in order to develop and implement the procedure. Given the smaller resources at the disposal of small businesses, the supplementary cost might represent a restriction. In addition, the algorithm requires data for training, and in specific cases, the information might not be available.

Project risk management methodology (Marcelino-Sadaba et al., 2014) was defined as a six-phase algorithm. The structure followed the next phases: initial risk evaluation, control indicators definition, indicators monitoring, project closure, risk final analysis, knowledge analysis.

The purpose of the model is to aid the small business in the project selection and in the knowledge which could be gained in the closing stages of the project. The proponents of the method identified that the small enterprises almost ignore the latter stages of a project, missing important feedback, which could be used in the implementation of future projects. The benefits of this approach reside in the reduction or elimination of the strategic risk, especially in the selection phase of a project. Given that some projects may require outsourcing, the model does not take into account the associated risk. In addition, the rich methodology could not be used in a project with a small-time span, the implementation could be more time-consuming than the project itself.

The z-score (Behr & Guettler, 2007) represent a binary regression logistic model, used in the reviewed case as a means to determine the associated default risk of SMEs. The data used to determine the default risk was the financial statement of German SMEs, including the balance sheet and the profit and loss statement. The benefit of implementing the methodology comes from the ability of the enterprise to estimate its own potential cost of debt. Regarding the limitation, the model lacks the qualitative element that could unpredictably influence the outcome.

4. Discussion

The ANN model emerged as a sole cross-study algorithm, being the only model present in more than one paper. The complexity of the procedure might not allow a small firm to

implement it, but given the fact that it can underline the hidden relation between different factors, the deployment of such a method might produce benefits in the long run for the company. Indeed, the algorithm might not be suitable for a new venture, taking into account the lack of data to train the system, but designing the data structure of the organization in such a manner that would allow the later implementation could be perceived as a route to follow.

The CBR-BDI presents an interesting approach to business management in general, and to RM in particular, but the infrastructure required could not be provided by one singular small enterprise. The model could be implemented in a business sector if only the organisations involved are willing to help each other. In a cross-countries knowledge exchange scenario, the architecture could provide benefits, if the platform already exists and experts that are willing to help can be recruited. It is to be noted that companies could become sceptical of this approach, considering an open history as an opportunity for competitors to reap the benefits of their past struggles, thereby gaining new information or even a competitive advantage without the costs paid by the current competitors.

Project risk management methodology would be a good feedback process from which the company could understand the shortcoming of their ways. It could be noted that the information about the hurdles faced in the implementation of the project would provide future guidelines for the management, but if the business environment in which the firm operates is highly volatile, the lessons of the previous projects might not work. The procedure could be useful in the development of a structure for project management.

The z-score seems to provide a way of analysing the whole business environment, so the firm using it could gain knowledge on the elements which are suboptimal compared to the competition. The lack of qualitative data could lead to wrong conclusions about the competitors. The models should be used in correlation with qualitative data that can provide useful feedback.

The financial risk emerged as a topic of interest in the majority of the articles, being the most analysed. Themes such as lending, the management of the financial resources or the bankruptcy risk were studied. It was found that small firms that finance the activity by using loans contracted in foreign currency were more likely to be the subject of an audit (Brown et al., 2021). In addition, SMEs with financing from venture capitalists or equity investors were more likely to default, given that the type of organization with needs for outside equity engages in more risky projects (Behr & Guettler, 2007). As an alternative to venture capital, state-backed programmes might be considered, but the impact of this type of aid was argued to be low for SMEs (de la Torre et al., 2010).

The SMEs incorporated as subsidiaries to large corporations encountered reduced pressure, the holding company providing aid in form of financial support, R&D help, etc., thereby mitigating the poor performance of the subsidiary (Altman et al., 2010).

Regarding the exposure to debt, a higher leveraged company faces a financial issue, in the sense that the organization could be forced into an adjustable-rate debt, especially if the lender was a bank (Vickery, 2008). As a company grows larger, the likelihood of tight debt management increases, with a reported 55% of the large firms having a stricter debt target as

opposed to 36% in the case of the small businesses (Graham & Harvey, 2001). In regards to higher long-term debt, a firm in this situation encountered a greater risk of failure (Altman et al., 2010). For small firms with high cash to total assets ratio, the propensity of bankruptcy was lower, similar to companies that can cover their debt with the obtained profits.

As donations in the name of corporate social responsibility exceed the expected values, the debt financing cost grows (Ye & Zhang, 2011). The inverse was also true, since, if the company was situated below the expected level of investment for corporate social responsibility, the financing cost also was higher, demonstrating a U shape relation.

Credit risk was correlated with the financial knowledge of the entrepreneur, therefore, as the complexity of the products offered by the banks grows, a financial illiterate manager could choose more risker solutions, inducing problems in the company (Belas et al., 2018). In addition, an SME was found to be more willing to change the current financial institution if the charges they practised were too high. Also, the relationship aspect was important, coming at a greater importance than even the interest rate (Binks & Ennew, 1997).

The smaller and newer the firm was, the lower the perceived access to loans was (Canton et al., 2013). As the company grows in size or age, the perceived access grows. The phenomenon can be related to the fact that a company with a better business model was more likely to reach maturity, and thus, the perception could be altered. In addition, the government policies could influence the willingness of banks to lend to small and medium enterprises, as shown in the case of Indonesia (Rosengard & Prasetyantoko, 2011).

The size factors were revealed crucial in the perception of market risk, with micro-enterprises reporting an increased level of risk compared to a medium-size business (Hudakova et al., 2018). The small businesses used as outsourced resourced by large companies receive the associated risks of the activities performed, such as labour disputes (de la Torre et al., 2010). In contrast, small businesses were more reluctant to use outsourced resources, purchasing managers were stating that they prefer to buy locally in order to reduce the associated risk (Ellegaard, 2008). However, the price changes for the raw materials or currency rates fluctuation could lead to losses or even bankruptcy. The phenomenon could be explained by the inability of the small firm to transfer the price risk onto its customers, especially in a previously agreed price contract (Hofmann, 2011).

The risk attitude and risk perception were two fundamental forces in the shaping of the business behaviour, the interaction between the two factors being linked with the management response to the future (Pennings & Garcia, 2004). The managers of a more competitive firm were more likely to risk the expected profits to mitigate the unexpected losses that might appear (Forlani et al., 2008). In addition, the supply chain managers exhibit a risk-averse character, preferring a lower risk as opposed to opportunities regarding purchase (Ellegaard, 2008).

The cost of implementation was identified as a potential obstacle in RM implementation, at the level of small businesses in the U.K., firms stating that investments in unclear RM procedures or methodologies were not considered as a benefit. In addition, the lack of knowledge was indicated as a factor in the absence of such protocols (Rostami et al., 2015).

As a second research area, supply chain-related risks emerged. Smaller companies were found to use a reactive type of strategy, with the focus being on the instruments that measure safety stock or logistics capacity, opposed to the preventive business model employed by large companies. In addition, small firms were typically engaged in including redundancies in the supply chain to mitigate the risk, the approach contrasting the elimination of risk factors performed by large enterprises (Thun et al., 2011).

Natural hazards could be an occurrence in the life of a small business, so, even though the premium for insurance could be considered prohibitive, the financial capability of the smaller organization could not provide enough resources to combat the uncertainty (Cioccio & Michael, 2007; Wedawatta & Ingirige, 2012; Rostami et al., 2015).

Small firms will try to develop and sell new products or services in the hopes of undermining the technological risk (Kim & Vonortas, 2014). In addition, for a better chance of accessing financial support, the businesses were more likely to maintain networks. The short life cycle of the products or services appears as a response to market risk. The additional demands of a client were not considered a hindrance in the activity of a small business, as opposed to the unwillingness to pay on time the supplementary work, as shown in the case of construction firms (Killip, 2013).

As the level of competitiveness grows, the smaller enterprises were more likely to engage in sustainable business models as a means to differentiate from other companies (Danso et al., 2020).

Smaller businesses were less sophisticated about the practices regarding the evaluation of risk. If a larger company was more likely to use techniques such as net present value or capital asset pricing model, the same tendency was not encountered for small businesses (Graham & Harvey, 2001). In addition, the lack of resources affects the number of RM practices regarding environmental performances (Sarkis, 2006).

The small firms that engage in enterprise RM could gain a competitive advantage, through lower costs of the provided services or the manufactured goods. In the deployment of the RM measures, the organization not only gains a competitive advantage, but also improves the overall performance of the business (Yang et al., 2018). However, risk assessment was not considered of high importance, with firms being oblivious to any preparation for the analysis of the risk, while other companies had less than a full A4 paper completed with risk assessments (Walker & Tait, 2004). The trend was shown to be influenced by as little as one and a half hours of training for each small business, so the cost must not be the deciding factor.

The general focus of the articles was to, either evaluate the risk, or to provide a way of identification for uncertainty. A general theme emerged, the impact of the risk on the financial state of the business. Even if topics like supply-chain management or natural hazards were encountered, the underlining trend was the protection of the small business. Unexpected disruption in the supply chain or natural events with a possible negative impact could directly influence the cash flow of the firm. By utilising the tools discovered, a business could predict, with a certain degree of confidence, the possible risks. Even if the anticipation is not possible, by understanding the present situation of the firm in relation to business environment, the decisions adopted could benefit from the additional support provided by the tool identified.

5. Conclusions

The objective of the paper was to synthesize the literature on the topic of RM in the hopes of identifying the types of tools used. Four such tools were discovered to be proposed for small businesses, with a singular model being encountered in more than one paper. Is to be determined if the literature is suggesting more models of RM for business, not accounting for size. The identified approaches were utilized by the academic environment, but none of the papers studied or identified what types of RM tools the businesses are using in practice. A potential cause could be that in the business practice, the RM tools are not considered RM methodologies, but rather considered operational aiding procedures, especially by smaller firms.

Small business RM was evaluated together with the RM for medium enterprises; hence a lack of particularization was identified. Given the restricted nature of the resources at the disposal of small businesses, the proposed methodologies could be inadequate. The restrictions could arise also from the lack of awareness or knowledge of the top management in smaller firms. Even if the necessity for RM is identified, more concerning matters might be considered more important by a new venture, so the focus could be on the product or services offered to the detriment of risk identification.

The limitations of the paper were represented first by the use of a singular database, namely WoS, others sources of information not being included. In addition, while the paper reviewed the top 80% of the most cited papers in order to highlight the RM methods used, a possibility arises that some underappreciated works might be overlooked.

As future research paths, the need for only small businesses analysis was identified. The RM techniques were proposed for the bigger category of SMEs. Is to be studied if the same approach could work in a more resource-deprived venture. The risk for small firms could be different, or the impact or manifestation of risk could vary, so specific practices are considered as an opportunity for study.

Conflict of interest: none

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The efficiency of exercising self-government bodies' competencies in the building sector in the Slovak Republic: a study of selected regions

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Abstract: The significance of resolving the effective functioning of competency performance in the construction sector stems primarily from the impact on the efficiency and quality of the competencies exercised. Currently, municipalities in the Slovak Republic exercise the delegated competencies of spatial planning and building regulations, either individually or jointly on a contractual basis. The paper's primary goal is to evaluate the performance of municipal competencies in building/construction sector in selected regions of the Slovak Republic (Nitra and Košice region) from a quantitative point of view from 2014 to 2019. We used in our research mainly quantitative analysis of efficiency - two basic output-oriented DEA models, namely the CCR model and the BCC model. The current model in building sector has shown that joint building authorities are, on average, less efficient than single municipality building authorities, and this applies to both the overall efficiency indicator and the scale efficiency indicator. However, in terms of the net effect of the organizational form, single municipality building authorities are on average 13.4 percentage points more efficient than joint building authorities. Our research looks at the net effects of the new model in the construction sector.

Keywords: self-government; building order competence; efficiency

JEL Classification: H76; H83; R58

1. Introduction

The Slovak Republic is a relatively small state, which as of 31.12.2018 (Bačík, 2019) had 2927 municipalities. However, nearly 92% of them have a population of fewer than 3,000 people, which harms the efficiency of public services. (Moderné a úspešné Slovensko, 2020)

Act no. 416/2001 Coll. on the Transfer of Certain Competencies from State Administration to Municipalities and Higher Territorial Units was adopted. As a result, more than 300 competencies were transferred to self-governing units (Leško, 2015).

According to §117 of Act no. 50/1976, Coll. Building Act as amended, each municipality of the Slovak Republic is building authority.

In the case of building regulations competencies, the municipality is following the law. no. 50/1976 Coll. on Spatial Planning and Building Regulations (Building Act) as amended

by the Building Authority, while the Building Authority's activity is a delegated performance of state administration. Municipalities as self-governing units and district offices as part of state administration ensure competence in building sector in Slovakia. According to Act No. 416/2001 Coll. on the transfer of some competencies from state administration bodies to municipalities and local authorities, there was a transfer of competencies from the state to municipalities in building regulations. The significance of resolving the efficient functioning of competencies exercised by administrative bodies of self-government and state administration stems primarily from the impact on the efficiency and quality of competencies exercised by local governments and the apparent financial undersizing of transferred competence. The summary report on the results of the efficiency and effectiveness check in the exercise of powers by Slovak municipalities (NKÚ, SR, 2015) confirmed the financial underestimation of transferred competence in the area of building regulations (58% of the inspected municipalities paid extra for the exercise of competence in 2011-2013). Inter-municipal cooperation is one possible response of local governments to this situation. According to domestic authors such as Klimovský, Nižňanský, Slávik and Černěnko, the fragmentation of the territory has an inefficient effect on the performance of self-government and the associated financing of its competencies. Here, however, we meet the views of domestic experts on the problematic performance of delegated competencies in the construction sector to municipalities, as stated by Kováčová (2014): "the smaller the municipality, the greater the problems securing the transferred competencies". The principles of public administration are subject to two key requirements worldwide: efficiency and effectiveness. In terms of methodology and model tools and area coverage, a systematic examination of the efficiency and effectiveness of administrative bodies in the field of construction competencies in our conditions is still in its infancy. Change efforts are not always met with a positive response, not only from self-government or the state.

2. Methodology

We used two basic output-oriented DEA models in the fundamental analysis of building authority efficiency: the CCR DEA model (Charnes et al., 1978) and the BCC DEA model (Banker et al., 1984).

We estimated the measures of technical efficiency using the CCR DEA model, assuming constant returns to scale. This rate represents what is known as overall technical efficiency, which expresses the efficiency of the evaluated authorities in comparison to the most efficient authorities in the sample, regardless of size. On the other hand, the BCC DEA model estimates technical efficiency under variable returns to scale. This measure is known in the literature as pure technical efficiency or managerial efficiency because it expresses the efficiency of the evaluated authorities compared to the best authorities of a similar size class and thus does not account for inefficiencies caused by the office's inability to be of optimal size.

Comparisons of the efficiency of organizational forms of exercising building regulations competencies (joint building authorities vs independent building authorities) were carried out using a two-phase method proposed by O'Donnell et al. (2007)

This method compares the technical efficiency of decision-making units, classified into different groups, using the concept of a meta-frontier.

We calculated group efficiency rates and meta-efficiency rates using the CCR DEA model:

$$MTR^k = \frac{TE^M}{TE^k} \tag{1}$$

where: MTR = meta-technology rate; k = decision-making unit of the k-th group (organizational form - in our case the building authority).

Using regression analysis, we investigated the impact of various external factors on authority efficiency. We used the number of inhabitants living in the building authority's district as an explanatory variable to determine the optimal size of the building authority.

We used data on the number of acts of building authorities and the amount of financial contribution to the performance of construction competencies of a sample of building authorities in the Nitra and Košice region from 2014 to 2019. These regions were piloted in our examination within the framework of the legislative changes in building sector being prepared by Slovak Republic. All analyses were carried out using the spreadsheet software program Microsoft Excel.

3. Analysis of the efficiency of building authorities

The first phase examines whether the size of building authorities (determined by populations served) affects their performance efficiency and whether there is a particular size class of building authorities that could be considered optimal in terms of served population.

Additionally, we assess the efficiency of current building authorities in terms of organizational structure. We compare the efficiency of so-called single municipality building authorities and joint building authorities to see if merging independent building authorities of municipalities into joint building authorities improves their performance.

Performance data from a sample of building authorities in the Nitra and Košice regions were used in the analyses. See basic characteristics. Table.1.

Table 1. Characteristics of building authorities

Descriptive statistics	NR	KE	NR&KE
Number of building authorities	36	69	105
Number of independent building authorities	10	43	53
Number of joint building authorities	26	26	52
Number of municipalities	353	392	745
Average number of municipalities at building authorities	9.8	5.7	7.1
Average number of municipalities per joint building authorities	13.2	13.4	13.3
Average population at building authorities	14,457	13,186	11,380
The average number of inhabitants per independent building authorities	5,116	2,593	3,069
Average population per joint building authorities	24,156	15,548	19,852

The basic characteristics shows that joint building authorities serve approximately 6 times the number of inhabitants and 13 times the number of municipalities than independent municipalities.

According to an analysis of current building authority efficiency, building authorities (further BA) serving up to 1,000 inhabitants have the best overall efficiency (0.505). On average, BA of this size have the highest efficiency (0.885), indicating that they are close to the optimal size (the most productive scale size class) at 88.5%. BA with 1,000-4,000 inhabitants achieve roughly the same high indicator of average scale efficiency. BA of the largest size class of 15,000-100,000 inhabitants achieve the best average values in terms of net (so-called managerial) efficiency.

We then focused on a more acceptable distribution of size groups when investigating the dependence of BA's efficiency on their size.

According to this analysis, BA achieves the highest average efficiency in a group of up to 500 inhabitants in terms of overall efficiency and scale efficiency. On the other hand, the previous analysis confirmed that the largest BA achieves the highest average pure, resp. managerial efficiency and it can be specified that these are authorities with more than 30,000 inhabitants.

A comprehensive evaluation of BA size groups with up to 500 inhabitants reveals that they achieve 62.8% performance of the most efficient BAs in the sample on average. Admittedly, their performance is hampered by managerial inefficiencies, but it is enhanced by the fact that they are 91.4% of the optimal size.

Only in the case of economies of scale did regression analysis confirm a statistically significant dependence of efficiency measures on the size of BA at the level of independent authorities. Moreover, this efficiency is negatively correlated with office size, accounting for up to 70% of its variability.

The size of BA has no statistically significant effect on overall efficiency and net efficiency. The size of the office explains only 2% of the variation in overall efficiency and 7-8% of the variation pure/managerial efficiency.

We paid particular attention to determining whether the organizational form of exercising construction-related competencies affects the efficiency of current joint BA and independent BA are considered special organizational forms by us. Joint BA serve 19,853 inhabitants on average, six times more than independent municipalities and nearly twice the average for all BA. The effect of economies of scale was assumed because of the size differences between joint and independent BA.

A basic comparison of efficiency rates for both organizational forms reveals that independent BA outperform joint BA by 4.6 percentage points (p.p.) on average. This difference, however, is statistically insignificant, most likely due to the large variability in size in both the subgroups of separate and joint BA.

When we compared pure efficiency, we came to the opposite conclusion. Joint BA outperform stand-alone BAs by 4.9 p.p. on average, indicating a more efficient workforce. Even in this case, however, the difference is not statistically significant.

We discovered a statistically significant difference in the distributions of scale efficiency measures. On average, separate BA appear to be 15.1 p.p. more efficient. This conclusion is consistent with previous analyses of the relationship between efficiency and size of BA, i. e. smaller independent BA are more scale efficient than large joint BA on average.

As shown by the results of the analyses presented above, the differences between joint and individual BA are due to both managerial inefficiencies and inefficiencies. If organizational forms represent specific competency technologies, the net effect of technology on efficiency can only be measured if both types of inefficiency are formally eliminated. We used a method based on the so-called meta-frontiers approach proposed by O'Donnell et al. (2007) to calculate the net effect, employing the meta-frontier indicator (MTR) to express the distance to the best performing technology.

A comparison of joint and independent BA as organizational forms revealed that independent BA are more efficient on average, by as much as 13.4 p.p. (see Table 2). There is a statistically significant difference.

Table 2. Net effect of the impact of different technologies on BA

Meta-technology ratio (MTR)	
Independent BA vs joint BA	
Result 1 - U-value	
The U-value is 287.5.	
Result 2 - Z-ratio	
The Z-Score is 6.98594. The p-value is < .00001. The result is significant at p < .05.	
Average MTR - all BA	0.878
Average MTR indicator - independent BA	**0.945**
Average MTR - joint BA	0.811
Difference	13.4 p.p.

4. Discussion

Currently, two models are used to carry out municipalities' delegated competencies in the area of building regulations: (1) at the municipal office if the competencies are exercised for residents of a single municipality; (2) at the joint BA if the competencies are exercised for several associated municipalities. The cooperation of municipalities led to the establishment of the joint BA according to Section 20a of Act No. 369/1990 Coll.

Several studies have found that joint exercise of competencies helps small municipalities compensate for their inability to perform them or increase their efficiency; such a method also leads to better self-government competencies (Bel, Fageda, Mur 2011, Fandel 2019 and others)

The purpose of this article is to examine the impact of the joint BA on the efficiency of service performance, using indicators of technical efficiency as an indicator of overall efficiency, scale efficiency as an indicator of the optimal scale size of the office for achieving maximum productivity, and the potential to improve efficiency from the perspective of the served population.

Our research compared joint and independent BA and discovered that independent BA are up to 13.4 p.p. more efficient. There is a statistically significant difference. However, this is the only result indicating that independent BA exercise their competencies more efficiently,

as small BA face significant challenges in exercising their building competencies due to a lack of financial, material, and technical resources. Nonetheless, the BA collaborate and establish joint BA, which lack legal personality and are formed haphazardly, as stated in the NKU's final report in 2015, and are also devoid of legal subjectivity. (Mederly et al., 2019) Our study also tested the hypothesis that large BA do not exercise building regulations competencies more efficiently than small BA. Only in the case of of scale efficiency did a regression analysis of the dependence of efficiency measureson the size of BA at the level of individual offices confirm a statistically significant dependence. This efficiency is negatively related to office size, with office size accounting for up to 70% of its variability in scale. The size of BA has no statistically significant effect on overall efficiency or pure efficiency.

The study concluded that, while the hypothesis of poorer efficiency of large BAs was confirmed in the cases of overall efficiency scale efficiency, it was not confirmed in the case of pure efficiency.

Our future research will also concentrate on structural changes in government administration. In the construction sector, the Government of the Slovak Republic intends to abolish BA as self-governing units in its program statement for the period 2020-2024. Simultaneously, it intends to strengthen the role of specialized district authorities as representatives of the state administration. This is an option that can lead to a more efficient exercise of competence in various ways. District offices are more uniform in size (in terms of population served). The Slovak Republic currently has 72 district offices, with an average of 75,200 inhabitants per office. The following are the prerequisites for legislative changes:

- Scope efficiency of district offices may occur.
- It will be easier to examine the effect of merging of BA by merger of efficiency on the basis of estimated size efficiencies.

Change efforts are not always met with a positive response, not only from self-government or the state. Nevertheless, the citizen is the clear beneficiary of the positive effects of reforms and streamlining. As a result, our future research will aim to analyze the net effects of the new model in the construction sector in the Nitra and Košice regions of the Slovak Republic using sophisticated methods of quantitative efficiency theory.

5. Conclusions

We conducted quantitative research to determine whether there are significant differences in the efficiency of competency exercises based on the organizational form of the building authority, the size of the building authority, and the legal framework governing competency exercises.

Since Slovak law allows municipalities to collaborate in the performance of a specific task or activity based on a contract (Section 20 of Act No. 369/1990 Coll.), and thus BA exercise their competence as independent BA or joint BA, we investigated whether the organizational forms of the authorities have a significant impact on the overall efficiency of the exercise of competencies as well as the scale efficiency.

Because the size of BA in Slovakia measured by population served varies, independent authorities of large cities can theoretically be much larger than the most prominent joint authorities. In comparison, the smallest joint authorities can be smaller than independent municipal authorities. The Slovak Republic's legislation does not specify the organizational structure or size of the BA.

Based on efficiency measures, we have found that independent BA have an overall efficiency by 4.6 p.p., better than joint BA. However, this result is not statistically significant due to the wide variation in the size of BA based on the number of inhabitants. In terms of scale efficiency, we discovered statistically significant differences in the performance of construction competence of joint and independent BA. Independent BA are 15.1% more efficient than joint BA on average.

A comparison of joint and independent BA as organizational forms revealed that the organizational form of independent BA is more efficient on average, by as much as 13.4 p.p. The difference is statistically significant. Or current research is continuing in building sector, being changed in structure of building authorities

Our research in the construction sector continues and looks at the net effects of the new model of BA performing their competencies, being prepared currently by the Slovak government.

Conflict of interest: none

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Game Analysis of "Officials and Peasants" – Taking Ephedra Sales License as an Example

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Abstract: China's rural issues are very complex. By introducing game analysis to further simplify the analysis, some problems can be gradually analyzed and studied in depth. Our team discovered some problems and interesting economic phenomena in the process of social research. These are the conventions formed by local residents. There is a game between villages, and there is also a game between farmers and the government. This article starts with a simple example of ephedra sales license. Under the condition of complete information, it is found that the economic scale of the village will affect the result of the static Nash equilibrium analysis. By introducing the proportion of young people in different villages and conducting dynamic analysis, it is found that the villages with a large economic scale are all villages with a high proportion of young people. Suggestions for the design of government mechanisms are given: We should pay attention to the education of young people and the human capital investment of such people.

Keywords: agriculture; game; human capital; proportion of young people

JEL Classification: C72; J24; O18

1. Introduction

China's nationwide system concentrates its efforts on major issues. But how to coordinate the two hands of the government and the market? China's agriculture, rural areas and farmers have always been troubled by the political and economic issues of our country? How to design a reasonable system to unblock information channels so that the Chinese government and farmers can achieve a positive-sum game?

On the occasion of the 100th anniversary of the founding of the party and China has just achieved a complete fight against poverty. In order to gain a deeper understanding of the current situation in China's rural areas, the School of Economics and Management organized a summer survey of the "Three Going to the Countryside". The theme of our team is: Ecological Compensation Mechanism and Rural Revitalization Research.

Our team went to Yanchi County, Ningxia to conduct household surveys. During the survey, some problems and interesting phenomena were indeed found. One of them is the problem in the process of planting and selling ephedra.

Village A in Yanchi County is delineated by the state for returning farmland to forests and ecological compensation. Because of the lack of water in the area, the crops are susceptible to the weather. The so-called farmers said that in the past, growing crops depended on the sky for food. Like this year, it hasn't rained for a long time. If you grow crops, there will be no

harvest. The farmers collectively should plant ephedra. They feel that planting ephedra can escape poverty, because ephedra requires less water than crops and is not affected by drought as much. Moreover, ephedra has a good market as a medicine. So, everyone basically changed to planting ephedra. But ephedra is still a kind of drug, so the sale of ephedra is subject to government control. A license must be issued to sell. I heard from the head of Village A that in the process of selling ephedra from place B to place C, the quality of the ephedra from place B to place C is weighed, and then re-scaled at place C. The quality difference cannot exceed a (the specific figures are forgotten, but the impression is the sale of ephedra is strictly controlled, and it cannot be stolen during the sale to prevent it from being sold as a drug to win huge profits). The government-controlled ephedra can only be used as a pharmaceutical ingredient.

We have learned that farmers, the supply of farmers is more than the amount of license sales. The village chief also hopes that the government can allocate more for them? Is this a problem? The market demand exceeds the quantity supplied by the license? The amount supplied by farmers exceeds the amount sold by license? How to coordinate the government's supervision and the market? How to design an effective system to deal with the differences between the government and farmers? For these problems, establish a game model for in-depth analysis to obtain reasonable results.

The following arrangement is as follows: The second part is a literature review on the application of game theory in institutional economics; the third part abstracts the establishment of game models for analysis; the fourth part draws conclusions based on the results obtained in the third part and puts forward relevant policy recommendations.

2. Literature Review

In order to find the connection point between institutional economics and game theory more clearly, this part first combs the main development process of institutional economics and game theory respectively, and then comprehensively analyzes how game theory is applied to institutional economics, and finally a few examples are reviewed to understand in more detail how game theory is applied to institutional economics.

2.1. The Development of Institutional Economics

System refers to the rules in interpersonal communication and the structure and mechanism of social organizations. Institutional economics studies the impact of institutions on economic behavior and economic development, and how economic development affects the evolution of institutions. Institutional economics originated from the "Leisure Class Theory" by American economist Van Buren, known as the old institutional school, which mainly examines people's behavior from the social culture and social scale of people's lives. Its main research methods adopt historical induction method and historical comparison method.

The explanation of economic phenomena further developed the new institutional economics, which originated in Coase's "The Nature of the Firm", introducing the concept of transaction costs into economic analysis, and pointing out the different roles of firms and markets in economic interactions. Steven N.S. Cheung 's "Tenant Farmer Theory" is regarded as a powerful interpretation and expansion of Coase's institutional economics, critical analysis

of the "rent value" theory, and correction of the previous misjudgment of the share system. Stiglitz's mathematics of Coase's theorem, standardization clearer dissemination and effective promotion of the theory. Among them, Stiglitz is also regarded as an important representative in information economics. In the new institutional economics, one point is very important, and the Coase theorem is the core of it. The simplest Coase theorem is: "When the transaction cost is zero, no matter which party the property rights are defined to, the Pareto effective solution will be obtained through the market transaction." A further promotion of the Coase theorem is that the transaction cost is not zero. How to solve externalities? The economic behavior between people will affect each other, and the participants will make their own optimization and conduct game analysis. Williamson, Demsetz, Hart and others have made important contributions to the new institutional economics.

Coase's pioneering achievements in the research methodology of institutional economics had an important impact on the later studies of economic history by North et al., the discussion of contracts by Zhang Wuchang and others, and the understanding of organizations by Williamson and others. They start from the actual economic situation, test the rationality of the theory, and emphasize that if the theory does not conform to the reality, the theoretical model itself needs to be revised. From the "cost-benefit" analysis, North puts forward the theory of system change only when the expected net benefit of innovation is greater than the expected cost of a new institutional arrangement.

The development and changes of institutions are not mechanical changes, but gradual changes similar to biological evolution. Evolutionary economics further criticizes and develops institutional economics. Representatives of this school include Bolding, Hodgson, Nelson, Winter, Samuels and others.

Of course, there is also a school of comparative institutions represented by Masahiko Aoki. The theoretical explanation of the differences in systems between countries is still very convincing. However, the mainstream of contemporary institutional analysis is still new institutional economics. Other institutional schools provide good supplements to economic explanations.

2.2. The Development of Game Theory

Game theory is an analysis toolkit designed to help us understand the observed phenomena when decision-making agents interact. The basic assumption underlying this theory is that the decision-making body most seeks to determine the external goal (they are rational) and considers their own knowledge or the expectations of the behavior of other decision-making bodies (their reasoning is strategic).

The economics edifice constructed by Adam Smith in The Wealth of Nations, the market is perfectly competitive, prices are regarded as exogenously given, and the interaction between actors is ignored. Obviously, this is not in line with the reality. Nash's equilibrium solution of non-cooperative game analysis between actors first proposed by Nash broke the deadlock and brought changes to microeconomic analysis. In the articles of Borel (1921) and Von Neumann (1928), the concept of abstract strategic game was first proposed. Nash (1950a) formed the concept of Nash equilibrium in the context of this type of game; the basic ideas contained

therein can be traced back at least to Cournot (1838). The Nash equilibrium solution is regarded as the core of game analysis.

Non-cooperative games are mainly divided into static and dynamic games according to whether time is introduced (the order of decision-making by actors); according to whether the information is complete: complete information and incomplete information. The pairwise combination of these two divisions results in four types of non-cooperative games: static games with complete information, static games with incomplete information, dynamic games with complete information, and dynamic games with incomplete information. Static game analysis is also called standard game (strategic game); dynamic game analysis is also called extended game. The above four game equilibrium solutions are: Nash equilibrium, Bayesian Nash equilibrium, subgame refined Nash equilibrium, and refined Bayesian Nash equilibrium. Table 1 below summarizes the four games mentioned above and the corresponding four equilibrium concepts and their development, and also roughly reflects the status of Nobel Prize winners in non-cooperative games.

Table 1. The classification of the game and the corresponding equilibrium concept (own processing according to Zhang (2004))

action equence / information	static	dynamic
complete	static game with complete information; Nash equilibrium; **Representative:** Nash (1950, 1951)	complete information dynamic game; subgame refined Nash equilibrium; **Representative:** Zelten (1965)
incomplete	static game with incomplete information; Bayesian Nash equilibrium; **Representative:** Haysani (1967-1968)	dynamic game with incomplete information; refined Bayesian Nash equilibrium; **Representative:** Zelten (1975), Kreps and Wilson (1982), Fudenberg and Taylor (1991)

2.3. The Application of Game Theory to the Connection Point of Institutional Economics

In the system comparison, according to whether the participants make decisions at the same time or in order, should static game analysis or dynamic game be adopted respectively? A strategic game is a model of a situation in which each participant chooses and only chooses an action plan once, and the decisions of all participants are made at the same time (that is, each participant does not know when choosing an action plan Action plans of other participants). In contrast, the extended game model emphasizes the possible sequence of time: each participant can not only consider his own action plan at the beginning of the game, but also consider his action plan whenever he has to make a decision.

For example: How does the introduction of "transaction costs" change the profit function of participants? For the analysis of institutional economics, the theoretical methods of competitive equilibrium are basically no longer applicable. In order to further clarify the essence of game theory, game theory is compared with the theory of competitive equilibrium. Game theory considers that the decision-making body attempts to obtain information about the behavior of other participants before making a decision, while the assumption given by competition theory is that each participant is only interested in certain environmental

parameters (such as prices), even if these parameters are Determined by the actions of all participants. We illustrate the difference between the two theories by considering the following situation: In this situation, the level of a certain behavior (such as fishing) of each participant depends on the degree of pollution, which in turn depends on all participants. activity. If we use competition theory to analyze, we will look for a pollution level consistent with the actions of all participants. At this time, every participant believes that this degree is a given; if we use game theory to analyze, we require that each participant's actions are optimal, and at this time, each participant and other participants are expected to cause pollution is given.

For the evolutionary economics of the institutional economics school, you can just use a variant of game theory: evolutionary game theory to model and analyze. Game theory has formed an analysis model to find out three or five elements for institutional economics analysis: participant, action set, return function, (state space, corresponding probability).

2.4. Summary of Specific Application Examples

Institutional economic analysis is mainly used in institutional reform and institutional design. For example, the setting of standards: the selection of military logistics service providers from the theory and development of supplier relations, the selection of logistics service provider index systems, and the combination of other methods (Jiang & Wang, 2020). The game between e-commerce vendors, and their mutual competition is not only electricity prices, but also power supply services and power quality; the game between electricity sellers and generators is divided into two situations: cooperation and non-cooperation between electricity sellers and electricity users. Dynamic game (Chen & Zhang, 2019). The demand side under the smart grid and the open power market has given users more choices, and game theory as an important tool for multi-agent decision-making optimization problems is expected to solve many problems in this field (Liu & Gao, 2018). Use game theory and other tools, to study the elimination decision-making behavior of training units under different elimination compensation mechanisms (Song, 2016).

In terms of environmental policy and system formulation: a dynamic game model of bounded rationality between the government and enterprises has been constructed to simulate the impact of three types of policy reforms, including environmental taxation, environmental protection vertical reform, strengthening public supervision, and environmental protection incentives, on the green development behavior of enterprises after the 18th National Congress of the Communist Party of China. Effect (Gu & Li, 2020). Based on game theory, the initial water rights allocation and the current status of water market research, the current status of water resources allocation research, and the current status of water conflict management research are reviewed, and the current problems of water resources research based on game theory are analyzed (Lu & Zhagn, 2020).

Evolutionary Economic Analysis: Research Progress of Social Dilemma Game Model, Evolutionary Game Theory and Equilibrium Analysis Method; Research Progress of Social Dilemma Game and Cooperative Evolution under Reward and Punishment Mechanism and Reputation Mechanism; Research on Social Dilemma Game and Cooperative Evolution with

Separation Strategy and Exploitation Strategy Progress; Research Progress in Social Dilemma Game and Cooperative Evolution under Network Reciprocity (Quan & Zhou, 2020). A review of the dynamics of evolutionary games based on random processes and their cooperation mechanisms in limited populations (Wang & Gu, 2019).

3. Game Analysis

In order to simplify the analysis, we assume that only two villages (A, D) are seeking licenses, and the total number of licenses issued by the government remains the same, that is, the sum of the licenses of Village A and Village D remains the same. We can carry out modeling analysis according to the four types of non-cooperative game classification. This article only conducts a detailed game analysis under the condition of complete information. For incomplete information, considering it is more complicated, we will briefly describe it, and we can continue to analyze and expand it later.

3.1. Under the Condition of Complete Information (That Is, the Government Is Open and Transparent, And the Actions of the Village Are Visible). Static Analysis

1.　Villages A and D are exactly the same. In order to obtain a license, both must spend the same cost. Moreover, both villages are faced with the fact that the license sales volume does not meet the market demand and the farmers' planting supply exceeds the original license supply. Because of the complete information, the government has a certain understanding of these two villages, but it is not clear about their respective demand differences. Therefore, only one village is going to obtain a license, and it will definitely be issued. In this way, the competition between villages faces a prisoner's dilemma. The income matrix of villages A and D is shown in Table 2.

Table 2. Income matrix of A and D villages

D ╲ A	don't strive for	strive for
don't strive for	6，6	0，8
strive for	8，0	2，2

Note: The Model of Prisoner's Dilemma

The government's revenue is the sum of the revenues of the two villages. In fact, the government most hopes that the two villages will not compete and issue licenses according to the village conditions observed by the government. The government's total revenue is 12. The equilibrium point of the prisoner's dilemma is that both villages compete for licenses. If both villages compete for licenses, they will lose costs for rent-seeking. In the end, the government's revenue will be only 4.

2.　Village A is larger than Village D. The government issues licenses in this way: As long as one village obtains a license, it will issue a corresponding proportion of licenses to the two villages according to the size of the village. In this way, the competition between villages is similar to the game of wise pigs. The income matrix of villages A and D is shown in Table 3.

Table 3. Income matrix of A and D villages

D / A	don't strive for	strive for
don't strive for	4，0	3，3
strive for	7，-1	0，0

Note: The Game of Wise Pigs

The government's total revenue is up to 6, which means that only one village can get a license. At the same time, according to the line drawing method, the Nash equilibrium solution is obtained for the village A to obtain the license, and the village D does not fight for the license, and finally the optimization can be achieved.

3.2. Under the Condition of Complete Information (That Is, the Government Is Open and Transparent, and the Actions of the Village Are Visible). Dynamic Analysis

Dynamic analysis, in order to simplify and clarify the analysis ideas, we assume that one factor that causes dynamic changes is the difference in the proportion of adolescents in the population. Assuming that investment in young people is the most efficient, this group of people is the most innovative, and the initial investment will bring high returns in order to realize the fundamental rejuvenation of the village. And suppose that both villages A and D are farsighted (both will actively invest in young people to increase the amount of human capital of this group of people).

1. Except for the high proportion of young people in Village A, Villages A and D are exactly the same. At this time, compared with the previous static analysis, the prisoner's dilemma still exists, and A will definitely fight for it, because the second stage will widen the gap and cause A's economic scale to be larger than D's economic scale, so using the previous static analysis in the second case, it is always a game of wise pigs in the end. If the government does not regulate, the economic scale gap between A and D will diverge.

2. In addition to the high proportion of young people in Village A, Village A is larger than Village D. It has always been a wise pig game. If the government does not regulate, the economic scale gap between A and D will diverge.

3. In addition to the high proportion of young people in Village A, Village A is smaller than Village D. The income of the two villages is the same in the Nash equilibrium in the wise pig game in the previous article. In the early stage, A's strategy was not to fight for a license plate and to free ride. However, due to the high proportion of young people in Village A and great development potential, the economic scale will eventually exceed D. In this way, the latter will reverse to the second situation above. In the later stage, A will actively strive for licenses. In general, the economic scale between A and D will first converge and then diverge.

3.3. Under the Condition of Incomplete Information (The Behavior of the Government and the Village Is Not Transparent)

Combined with the model used by game theory in information economics, there are problems of moral hazard and adverse selection. Therefore, a reasonable mechanism design

must be carried out to select the true category. The two constraints that the mechanism design must meet: participation constraints and incentive compatibility.

4. Conclusions and Recommendations

4.1. Conclusions

In the third part of the game analysis under the condition of complete information, in the static analysis, if two villages are exactly the same, they will fall into a prisoner's dilemma. In the end, the Nash equilibrium is to obtain a license plate, resulting in a loss of efficiency; when the two villages are not the same, will fall into the income matrix similar to the wise pig game. In the end, the Nash Equilibrium is that the village with a large economic scale will fight for the license, and the other village will not fight for the license. The final result is Pareto effective.

By introducing the proportion of young people in each village to conduct a dynamic analysis, it is found that there are three types: except for the different proportions of young people, the two villages are exactly the same. In the first stage, the two villages are in a prisoner's dilemma. Due to the investment in young people, the economic growth of villages with a high proportion of young people will be faster. The second stage is similar to the game of wise pigs. Finally, the economic scale of villages with a high proportion of young people is getting larger and larger than that of another village, and the game behind has always been wise pigs. The village with a high proportion of young people always fights for the license plate, and another village does not fight for the license; the village with a high proportion of youth has a large economy, so the dynamic game has always been similar to the game of wise pigs, and the proportion of young people is high. Villages with a high proportion of youths have small economic scales, so the first situation (a prisoner's dilemma) may appear in the dynamic game process, and the main process is still similar. In the game of wise pigs, a village with a high proportion of young people will not fight for a license if its economic scale is smaller than that of another village, but another village will fight for it. Until the economic scale of a village with a high proportion of youths has been growing more than that of another village, it will actively fight for the license, while the other village will not fight for it.

4.2. Suggestions

Through the above analysis, we can see that under the condition of complete information and static analysis, the government should design a mechanism to prevent the two villages from falling into the prisoner's dilemma and cause efficiency losses; when the economic scales of the two villages are different, the Nash equilibrium solution is Par The government should not intervene if it is an effective solution. In the dynamic analysis, we can see that the final result is that the village with a high proportion of young people will eventually have a larger economic scale, and the economic scale with another village is getting bigger and bigger. The government should pay attention to the education and human capital investment of young people. This is the fundamental way to realize rural revitalization.

Conflict of interest: none

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Digital Finance, E-Commerce Development and Income Gap between Urban and Rural Areas in China

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Abstract: Narrowing the income gap between urban and rural areas is an inevitable requirement for the stable and sustainable development of the national economy. Based on the panel data of 31 provinces in China from 2011 to 2019, this paper empirically tests the effect of digital finance and e-commerce development on the urban-rural income gap by using the adjustment model and the threshold regression model. The research found that: First, digital finance can significantly reduce the income gap between urban and rural areas, and the development of e-commerce plays a positive regulating role; Second, the marginal convergence effect of digital finance on the income gap between urban and rural residents will increase with the development level of e-commerce; Third, the depth of digital finance use and the degree of digitization are conducive to reducing the urban-rural income gap, but the breadth of digital finance coverage will widen the urban-rural income gap. The research results provide policy implications for China to use the synergistic relationship between digital finance and e-commerce to achieve a balance of income for urban and rural residents.

Keywords: digital finance; e-commerce; urban-rural income gap; threshold effect model

JEL Classification: R51; M21; D31

1. Introduction

The balanced income distribution of urban and rural residents is of great value to achieve the goal of high-quality economic development and common prosperity in China. However, China's current urban-rural development is still characterized by a "dual structure", and the problem of unbalanced income gap between urban and rural residents still exists. With the advancement of Internet technology, the rise of digital finance has provided rural residents with payment convenience and financing services, providing them with opportunities to generate income and increase efficiency. In recent years, the close integration of digital finance and e-commerce has promoted the interaction of urban and rural residents, increased the employment of rural population, and changed the industrial structure of rural areas, so that digital finance can directly affect the income of urban and rural residents, thereby affecting the income gap between the two groups. Therefore, this paper will focus on the impact of digital finance and e-commerce development on the income gap between urban and rural residents.

2. Literature Overview

With the continuous penetration of digital finance in various fields of society, scholars have conducted extensive research on the effect and mechanism of digital finance on the urban-rural income gap. Ozili and Peterson (2017) pointed out that digital finance itself has stronger inclusive features and can effectively reduce the income gap between urban and rural residents. Allen et al. (2016) argue that poor, low-income and illiterate individuals cannot fully benefit from the coverage of digital finance. Huang and Zhang (2020) found that the impact of the breadth of digital finance on the income gap between urban and rural residents is heterogeneous in different periods. In the short term, it will widen the urban and rural income gap, but only in the long run can it have a convergence effect on the urban and rural income gap. Agnello et al. (2012) pointed out that digital finance can effectively reduce financial exclusion and improve the uneven distribution of income between urban and rural areas. Dupas and Robinson (2013) found that when digital finance deepens to low-income groups, the income gap can be narrowed as the frequency of use of digital financial accounts continues to increase. In addition, some Chinese scholars have explored the mechanism by which digital finance affects the urban-rural income gap. Wang and Li (2021) explored the convergence effect of digital finance and new urbanization on the urban-rural income gap by constructing a spatial Durbin model. Zhang et al. (2021) analyzed the nonlinear characteristics of digital finance affecting the urban-rural income gap when the digital divide is used as a threshold variable. Ma and Zhang (2022) studied the impact of the breadth and depth of digital finance on the urban-rural development gap from the perspective of the synergistic effect of residents' education.

Both products of the Internet era, e-commerce and digital development have achieved deep integration. Yao (2017) proposed that in the process of e-commerce development, there will be a large number of payment transactions and financing needs, and digital finance can just provide mobile payment and lending convenience for the operation and popularization of e-commerce. Boateng et al. (2008) pointed out that the rise of e-commerce in developing countries has brought economic growth momentum to these countries and contributed to social development. Yang (2019) discussed the poverty alleviation mechanism and effect of e-commerce in rural China, and believed that e-commerce poverty alleviation can provide a historic opportunity for "overtaking on a curve" for traditionally poor areas. Kong and Wang (2022) pointed out that in the early stage of e-commerce development, e-commerce cannot reduce the urban-rural income gap, and only when e-commerce develops maturely can the convergence effect on the urban-rural income gap be manifested.

Existing literature explores the impact of digital finance on the urban-rural income gap from various dimensions, and also confirms that the development of e-commerce is conducive to improving the income of rural residents, but few articles discuss the synergistic effect of digital finance and e-commerce development on narrowing the urban-rural gap. Moreover, as the integration characteristics of digital finance and e-commerce have become more prominent in recent years, it is worth further exploring whether different stages of e-commerce development will affect the convergence effect of digital finance on the urban-

rural income gap. This paper attempts to expand in this area, and the main marginal contributions are as follows: First, it studies the impact of the interaction terms of digital finance, digital finance and e-commerce development on the urban-rural income gap, and analyzes the moderating role of e-commerce development in it. Second, it tests the threshold effect of e-commerce development, and examine the threshold characteristics of digital finance affecting the urban-rural income gap under different e-commerce development levels; Third, explore the heterogeneous impact of digital financial indicators of different sub-dimensions on the urban-rural income gap, in order to enrich existing research results and provide theoretical reference for achieving urban-rural income balance.

3. Methodology

3.1. Model Building

1. Benchmark regression model

In order to verify the impact of digital finance and e-commerce development on the urban-rural income gap, we first analyze the direct impact of digital finance on the urban-rural income gap by constructing model (1). Secondly, on the basis of model (1), the interaction term between digital finance and e-commerce development is introduced into the equation, and model (2) is constructed to further test the moderating effect of e-commerce development on the impact of digital finance on the urban-rural income gap.

$$Gap_{it} = \beta_0 + \beta_1 Index_{it} + \lambda_i Controls_{it} + u_i + v_t + \varepsilon_{it} \tag{1}$$

$$Gap_{it} = \beta_0 + \beta_1 Index_{it} + \beta_2 Index_{it} \times EC_{it} + \lambda_i Controls_{it} + u_i + v_t + \varepsilon_{it} \tag{2}$$

In formula (1) and (2), Gap_{it} is the urban-rural income gap of province i in year t, which is the explained variable of this paper; $Index_{it}$ is the digital financial development index of province i in year t, which is the core interpretation variable of this paper; EC is the e-commerce development index; $Controls$ are other control variables that may affect the urban-rural income gap, u_i is the individual fixed effect, v_t is the time fixed effect, and ε_{it} is the random disturbance term. The coefficient β_1 and the coefficient β_2 are the focus of the model. If the coefficient β_1 is significantly less than 0, it means that digital finance can effectively reduce the urban-rural income gap. Similarly, if the coefficient β_2 is also significantly less than 0, it means that the development of e-commerce has played a positive role in regulating the impact of digital finance on the urban-rural income gap, that is to say, the synergistic effect between the two has a convergence effect on the urban-rural income gap.

2. Panel threshold model

When the development of e-commerce is in different stages, the impact of digital finance on the income of urban and rural residents may show a nonlinear relationship. Therefore, a panel threshold model (3) is constructed to explore the threshold characteristics of the impact of digital finance on the urban-rural income gap when e-commerce development is used as a threshold variable.

$$Gap_{it} = \alpha_0 + \alpha_1 Index_{it} \cdot I(EC_{it} \leq \gamma_1) + \alpha_2 Index_{it} \cdot I(EC_{it} > \gamma_1) + \cdots +$$
$$\alpha_n Index_{it} \cdot I(EC_{it} \leq \gamma_n) + \alpha_{n+1} Index_{it} \cdot I(EC_{it} > \gamma_n) + \lambda_i Controls_{it} + \varepsilon_{it} \quad (3)$$

In formula (3), $I(\cdot)$ is an indicative function, which takes a value of 1 when the conditions in the parentheses are satisfied, and 0 otherwise; γ_n is the nth threshold value of e-commerce development, α_i is a parameter to be estimated, the interpretation of the remaining variables is the same as the previous one.

3.2. Indicator Selection

According to the research needs and the principle of data availability, this paper selects the following indicators:

- Explained variables. The urban-rural income gap (Gap) is measured by the Theil Index, which takes into account both the income of urban and rural residents and changes in population, and can better reflect the income gap of different groups. Its calculation formula is:

$$Gap_{it} = \sum_{j=1}^{2} (\frac{Y_{ij,t}}{Y_{i,t}}) ln(\frac{Y_{ij,t}}{Y_{i,t}} / \frac{P_{ij,t}}{P_{i,t}}) \quad (4)$$

In formula (4), *Gap_{it}* is the Theil Index of province *i* in year *t*, that is the urban-rural income gap; *Y_{ij,t}* is the total income of residents in urban areas (*j*=1) or the total income of residents in rural areas (*j*=2), *Y_{i,t}* is the total resident income of province i in year t; *P_{ij,t}* is the total population in urban areas (*j*=1) or the total population in rural areas (*j*=2), *P_{i,t}* is province *i* in *t* the total population of the year.

- Core explanatory variables. The development level of digital finance (*Index*) is measured by the Digital Inclusive Finance Development Index, which is compiled by the Digital Finance Research Center of Peking University and covers mobile payment, online lending and internet finance in various regions. In addition, in this paper, the raw data of the digital financial index and its sub-dimension indicators are divided by 100, so as to make the model regression coefficient results more readable.

- Adjustment variables. E-commerce development (*EC*) is measured by the regional e-commerce development index, which mainly covers the breadth and depth of residents' use of e-commerce, and can effectively reflect the development trend of e-commerce in China.

- Control variables. In order to ensure the robustness of the estimation results, this paper selects the following control variables: first, the level of economic development (*Rgdp*), which is measured by the logarithm of the per capita GDP of each region; second, the industrial structure (*Str*), which is measured by the increase in the tertiary industry The third is the urbanization level (*Urban*), which is measured by the ratio of the urban population to the total population; the fourth is the education level (*Edu*), which is measured by the number of years of education per capita; the fifth is level of opening (*Open*), which is measured by the proportion of the total import and export trade of each

province in GDP; the sixth is the financial technology support (*Tech*), which is measured by the ratio of government financial science and technology expenditure to the general government budget expenditure.

3.3. Data Sources

The data used in the empirical research in this paper are mainly from the "China Statistical Yearbook" and the websites of local statistical bureaus over the years; the digital financial inclusion index is from the "Peking University Digital Financial Inclusion Index"; the e-commerce development index is from Ali Research Institute "China E-commerce Development Index Report" compiled. In addition, considering the difficulty of obtaining relevant data in Hong Kong, Macao and Taiwan, the data from 2011 to 2019 of 31 provinces (cities and regions) in mainland China was finally selected as the research sample.

4. Empirical Results

4.1. Benchmark Regression Results

By performing Hausman test on the previous benchmark regression model, the statistic result of the test shows that it is significant at the 1% level. Therefore, a fixed effect model is selected to estimate the regression coefficient. Table 1 shows the regression estimation results under the double fixed effects of individual and time.

Table 1. Benchmark regression results

	(1)	(2)	(3)	(4)
Index	-0.2477***	-0.1067*	-0.2308***	-0.1587**
	(-4.06)	(-1.72)	(-3.75)	(-2.59)
Index×EC		-0.0017***		-0.0013***
		(-5.79)		(-4.53)
Lnrgdp			0.1891***	0.1817***
			(5.23)	(5.22)
Str			-0.0646	-0.0264
			(-0.45)	(-0.19)
Urban			1.7911***	1.4947***
			(8.25)	(6.84)
Edu			-0.0323*	-0.0324*
			(-1.78)	(-1.86)
Open			-0.0084	-0.0303
			(-0.28)	(-1.04)
Tech			-0.6000	-0.4314
			(-0.68)	(-0.49)
_Cons	0.2382***	0.2078***	-0.6144***	-0.4796**
	(8.96)	(8.16)	(-2.96)	(-2.38)
Prov_fixed	YES	YES	YES	YES
Year_fixed	YES	YES	YES	YES
N	279	279	279	279
R2	0.0856	0.1985	0.4106	0.4585

Note: *, **, *** are significant at the level of 10%, 5% and 1% respectively, and the t statistic is in parentheses.

Columns (1) and (2) of Table 1 respectively show the impact of the intersection of digital finance (*Index*), digital finance and e-commerce development (*Index×EC*) on the urban-rural income gap without control variables. It can be seen that when no cross term is introduced,

the regression coefficient of digital finance is significantly negative at the 1% significant level, indicating that digital finance has a significant negative convergence effect on the urban-rural income gap. After adding the cross term, the regression coefficient of digital finance is still significantly negative, and the cross term of digital finance and e-commerce development is also negative, and it has passed the 1% significant level test. It shows that the development of digital finance and e-commerce has a positive synergistic effect on reducing the urban-rural income gap. Digital finance provides financing paths and payment convenience for the development of e-commerce, and the development of e-commerce provides more employment opportunities for residents, especially provides a sales platform for agricultural products in remote areas, and promotes the increase of farmers' income. Therefore, with the support of e-commerce, digital finance can better narrow the income gap between urban and rural residents.

Columns (3) and (4) of Table 1 are the regression results after adding a series of control variables. It can be seen that the coefficient of digital finance is still significantly negative, and the coefficient value does not change much. Similarly, the regression coefficient of the intersection of digital finance and e-commerce development is still negative at the significant level of 1%, indicating that the regression results of the benchmark model are relatively stable, and digital finance can effectively reduce the urban-rural income gap. And the development of e-commerce has a significant positive adjustment effect on digital finance to narrow the urban-rural income gap.

As far as the regression results of the control variables are concerned, the regression coefficients of industrial structure, education level, level of opening to the outside world, and financial and technological support are all negative, and the education level has passed the 10% significant level test. It shows that increasing the proportion of the tertiary industry in the industrial structure, strengthening the quality education of the population in various regions, encouraging international trade in various regions, and increasing the government's investment in scientific and technological innovation may narrow the urban-rural income gap to a certain extent. However, the level of economic development and urbanization has a significant positive impact on the urban-rural income gap, which shows that in the process of economic development and urbanization, it is necessary to take into account the income levels of different groups in urban and rural areas.

4.2. Analysis of Threshold Effect

Before analyzing the threshold effect, it is necessary to verify whether the threshold effect exists. This paper uses Stata15.0 to estimate and test the results of the threshold regression model.

Threshold effect test

Through the self-sampling test of the sample, it can be known whether the threshold effect exists, and the number of thresholds and the corresponding threshold value can be determined. When the development of e-commerce is in different stages, the impact of digital finance on the urban-rural income gap may be heterogeneous. Therefore, the development of e-commerce is used as a threshold variable to test the threshold effect. The test results are

shown in Table 2. It can be seen that under the condition that there is no threshold in the null hypothesis, the F statistic is 12.98, and the P value calculated by Bootstrap is 0.048 < 0.05, indicating that the null hypothesis can be rejected at the 5% significant level. In other words, there is a single threshold for the development of e-commerce However, in the double-threshold effect test, the P value is 0.16 2> 0.10, and the F statistic is not significant. Therefore, it is considered that when e-commerce development is used as a threshold variable, there is only a single threshold, and the threshold value is 30.71.

Table 2. The test results of the threshold effect of e-commerce development

Threshold variable	Threshold type	Threshold value	F statistic	P value	10% threshold	5% threshold	1% threshold
EC	Single	30.71	12.98**	0.048	9.6089	12.3157	19.0763
	Double	13.05；30.71	7.87	0.162	9.1648	13.501	18.9392

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively, and the P value and critical value were obtained by repeatedly sampling 500 times using the threshold regression bootstrap sampling method.

Analysis of parameter results

Table 3 shows the difference in the impact of digital finance on the urban-rural income gap when e-commerce development is the threshold variable. When the development level of e-commerce is lower than the threshold value of 30.71, although the impact of digital finance on the urban-rural income gap is significantly negative, the estimated coefficient is small, only -0.0544. The main reason is that when the development level of e-commerce was low, e-commerce had not penetrated into the vast rural areas, and rural residents had limited understanding of e-commerce. It is difficult for digital finance to drive the development of rural industries and generate income for rural residents through e-commerce. In addition, in the early stage of e-commerce development, the network facilities, transportation facilities and residents' educational quality in many rural areas were relatively backward, and there were few e-commerce talents in rural areas, and the acceptance of digital finance was also lower than that of urban residents. Therefore, when the development level of e-commerce is low, the effect of digital finance in reducing the income gap between urban and rural areas is limited. When the development level of e-commerce crosses the threshold value of 30.71, the regression coefficient of digital finance on the urban-rural income gap is -0.0791, and it is significant at the 1% significant level. It shows that the better the development of e-commerce, the stronger the convergence effect of digital finance on the urban-rural income gap. It is not difficult to understand that with the continuous increase of e-commerce platforms, policies such as "e-commerce to the countryside" and "e-commerce poverty alleviation" have made rural areas begin to rapidly develop e-commerce business. Digital finance uses its convenient financing function to ease the capital needs of rural residents to operate e-commerce business. At the same time, the fast online payment function of digital finance also allows rural residents to sell goods and obtain income without leaving home. Therefore, the rapid development of e-commerce can promote digital finance to reduce the urban-rural income gap more effectively.

Table 3. The test results of the threshold effect of e-commerce development

Variable name	Coef.	Std.	t value	P value
Index(EC≤30.71）	-0.0544	0.0105	-5.16	0.0000
Index(EC>30.71）	-0.0791	0.0101	-7.80	0.0000
Lnrgdp	0.1266	0.0300	4.22	0.0000
Str	-0.2537	0.0975	-2.60	0.0100
Urban	1.5664	0.2150	7.28	0.0000
Edu	-0.0338	0.0171	-1.98	0.0490
Open	-0.0182	0.0273	-0.67	0.5050
Tech	-0.4466	0.8239	-0.54	0.5880
_Cons	-0.3838	0.1778	-2.16	0.0320

Heterogeneity analysis of digital finance sub-dimension

In order to further explore the structural characteristics of the impact of digital finance on the urban-rural income gap, the secondary indicators of the digital finance index were selected to estimate the benchmark regression model. The secondary indicators include: digital finance coverage breadth index (*Cover*), digital finance usage depth (*Depth*) and digitalization degree (*Digit*). Columns (1), (3) and (5) of Table 4 respectively show the estimated results of the impact of the three sub-dimension indicators of digital finance on the urban-rural income gap. The results show that the influence coefficients of digital finance coverage, depth of use and digitalization on the urban-rural income gap are all significantly negative. Among them, the regression coefficient of coverage breadth is significantly positive at the significant level of 5%, indicating that simply opening digital accounts for residents to increase the coverage breadth of digital finance not only fails to narrow the urban-rural income gap, but instead widens it to a certain extent income gap between the two groups. The possible reason is that although digital finance has effectively filled the service blind spots that traditional financial institutions cannot cover, it cannot play the true inclusive function of digital finance by only allowing residents to open digital accounts. The regression coefficients of the depth of use and the degree of digitization are significantly negative, indicating that the depth of use and digitization of digital finance can truly broaden borrowing channels for rural residents. By providing convenient services such as financing, wealth management and payment, digital finance has provided help for their employment and income growth. Column (2), column (3) and column (5) of Table 4 are the regression results after adding the interaction terms of each sub-dimension index of digital finance and e-commerce development. The results show that the estimated results of the regression coefficients of each interaction term are not significantly different from the coefficient values and significance of the previous benchmark regression model. It shows that after the dimensionality reduction and decomposition of the digital financial index, the previous research conclusions still hold, and the results of the benchmark regression model have good robustness.

Table 4. Regression results of digital finance sub-dimension

	(1)	(2)	(3)	(4)	(5)	(6)
Cover	0.1739** (2.06)	0.1757** (2.21)				
Cover×EC		-0.0015*** (-5.38)				
Depth			-0.1778*** (-5.98)	-0.1382*** (-4.45)		
Depth×EC				-0.0010*** (-3.60)		
Digit					-0.0395** (-2.14)	-0.0315* (-1.80)
Digit×EC						-0.0014*** (-5.17)
_Cons	-0.6606*** (-3.13)	-0.4799** (-2.37)	-0.6957*** (-3.51)	-0.5682*** (-2.89)	-0.5885*** (-2.73)	-0.4332** (-2.10)
Controls	YES	YES	YES	YES	YES	YES
Prov_fixed	YES	YES	YES	YES	YES	YES
Year_fixed	YES	YES	YES	YES	YES	YES
N	279	279	279	279	279	279
R^2	0.3863	0.4543	0.4581	0.4868	0.3871	0.4505

Note: *, **, *** are significant at the level of 10%, 5% and 1% respectively, and the t statistic is in parentheses.

Conclusions

This paper first empirically tests the effect of digital finance on the urban-rural income gap. Then, it analyzes the moderating effect and threshold effect of e-commerce development on the impact of digital finance on the urban-rural income gap. Finally, it explores the structural differences in the impact of digital finance on the urban-rural income gap from the three sub-dimensions of digital finance coverage, depth of use and degree of digitalization. The main research conclusions are as follows: First, digital finance can significantly reduce the urban-rural income gap, and the development of e-commerce has a significant positive moderating effect on the impact of digital finance on the urban-rural income gap; Second, the marginal convergence effect of digital finance on the urban-rural income gap will increase with the growth of e-commerce development level. In the stage of high e-commerce development level, the effect of digital finance in reducing the urban-rural income gap is stronger; Third, the heterogeneity analysis shows that the depth of the use of digital finance and the degree of digitization can significantly reduce the urban-rural income gap, but the breadth of coverage will widen the urban-rural income gap to a certain extent. The research conclusions suggest that in the promotion of digital finance, attention should be paid to the synergistic effect of e-commerce development on digital finance in reducing the income of urban and rural residents, and the use of digital financial products and services by rural residents should be strengthened to make digital accounts "live", so as to achieve the purpose of reducing the urban-rural income gap.

Conflict of interest: none

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Time-Varying Shocks to Loan Defaults from Monetary Policy Uncertainty

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Abstract: Based on the economic policy uncertainty data constructed by Baker et al. (2016) from 2011 to 2020, this paper then empirically examines the time-varying shocks of economic as well as monetary policy uncertainty indices on loan default risk using a TVP--VAR model, with a view to stabilizing leverage in China and resolving. The results of the study show that the economy and the monetary policy uncertainty index have a time-varying impact on loan default risk. The results show that: (1) the rise in economic and monetary policy uncertainty leads to the rise in loan default risk, and the long-term effect is stronger than the short-term effect. (2) The impact of economic and monetary policy uncertainty on loan defaults is influenced by specific economic events. (3) Policy uncertainty is also heterogeneous, with economic policy uncertainty presenting positive shocks in the short and medium term and negative shocks in the long term, while monetary policy uncertainty is positive in the short and long term and negative in the medium term.

Keywords: economic policy uncertainty; monetary policy uncertainty; loan default; TVP-VAR; impulse response

JEL Classification: E52

1. Introduction

Loan default risk is a representative indicator of a bank's credit rating, a reflection of the credit quality of a country's banks, and also affects the good functioning of a country's financial market. Since 2012, financial market reform has been promoted, various banks have further improved their credit management systems for SMEs, and while the speed and volume of loans have grown, the quality of banks' loans has declined. The 2016 Central Economic Work Conference clearly required that prevention and control of financial risks be placed in a prominent position in banks. At the same time, Xing and Wang (2021) pointed that with the government's innovation in economic and monetary policies in banking and financial markets, economic and monetary policy regulation tools are gradually diversified, and the role of monetary policy as the main instrument for adjusting the banking market is crucial in macroeconomic and financial operations. The two financial crises that swept the world in the 1920s and 1930s and the beginning of the 21st century gave all countries and governments a wake-up call to pay attention to economic policy uncertainty on the banking sector, the financial industry, and the macroeconomy. Therefore, this paper uses time-varying parametric vector autoregressive models to study the degree of impact of economic policy uncertainty and

monetary policy uncertainty on banks' loan defaults in different periods of banking industry development, as well as time-varying characteristics, and to make policy recommendations for credit management and risk prevention in China's banking market.

Monetary policy uncertainty mainly arises from the central bank's trade-off between using the money supply model or the Phillips curve model with open market operations as the main policy instrument, including uncertainty within the operating model, uncertainty in the transmission mechanism of action, uncertainty in the operating strategy and uncertainty in the choice between the two models. Wang and Wang (2020) pointed out that rising monetary policy uncertainty can lead to economic cyclical fluctuations, which have implications for both macroeconomic and microeconomic agents. When monetary policy uncertainty rises, the central bank or the bank in the development of loan default policy against, cannot determine the true relationship between the economic operation, coupled with the existence of data in the bank management process, measurement techniques are not perfect, which in turn leads to the frequency of bank loan defaults. For the direct impact of monetary policy uncertainty on loan default, the current research method is still mainly through non-time-varying parameters for empirical research, while there is little research on building dynamic time-varying models, therefore, this paper analyzes the impulse response of monetary policy uncertainty at different time points and equally spaced time points facing different shocks by analyzing the TVP-VAR model of economic policy uncertainty and monetary policy time-varying shocks of uncertainty on loan defaults.

Theories related to monetary policy were first proposed by Keynes on the interest rate transmission channel of monetary policy, focusing on the transmission mechanism of monetary policy, which refers to the intermediate objectives and changes in socio-economic life caused when various monetary instruments are applied in macroeconomic operations. In the West, theoretical analysis of the transmission mechanism has focused on the Keynesian school and the monetary school. The Keynesian school's idea of the transmission of monetary policy can be summarized as the influence of interest rates, and hence investment and output, through an increase or decrease in the money supply M. The Keynesian school places importance on the role of the interest rate. The monetary school, on the other hand, differs from the Keynesian school in that the monetary school places no emphasis on the role of the interest rate and emphasizes the role of the money supply and the real money balance. Bernanke and Blinder (1988) stated that the channel of monetary policy transmission is mainly through the monetary channel and the credit channel, which includes balance sheets and bank loans.

Regarding theories related to economic policy uncertainty, previous scholarly research has focused on discussing the causes of economic policy uncertainty. The time lag theory of policy argues that uncertainty arises from intrinsic and extrinsic time lags of policy. The intrinsic time lag refers to the time required between when an economic shock occurs, when the policymaker identifies the economic shock, and when the policymaker begins to act. The extrinsic time lag refers to the period after the policy is implemented until it actually has an impact on economic agents. The theory of government discretionary policy suggests that there is temporal inconsistency in policy, when policy makers prefer to announce policies in advance, which affects

the expectations of economic agents, and when economic agents adjust their behavior according to their expectations, the policy makers exercise discretion and contradict the announced policy, which leads to the discredited policy (Guo et al.,2018; Xu,2021).

With regard to the theory of monetary policy uncertainty, Cook and Korn (1991) first proposed the "policy expectations hypothesis" on monetary policy uncertainty, which argues that monetary policy uncertainty affects asset prices in financial markets mainly through the guidance of public expectations of future policies. This implies that when monetary policy uncertainty rises, public expectations will be inconsistent with actual expectations, which in turn will affect changes in financial markets, and monetary policy uncertainty will affect the degree of price response in the market, so that there will be deviations between the actual realized and expected values of macroeconomic indicators.

In recent years, one of the great challenges facing the banking industry is non-performing loans of banks and the quality of their credit assets has gradually deteriorated, and it is crucial to dispose of non-performing loans to prevent large-scale credit risk or credit risk of banks. Non-performing loans are loans where the borrower is unable to return the interest or even the principal as per the agreed contractual date. Reducing the level of non-performing loans in commercial banks requires efforts from all sides. Jin (2017) found that the current balance of non-performing loans in China's banking sector is still in an upward trend, but the year-on-year increase in the balance has entered a decline since 2016, and the industry-wide non-performing loan ratio is stabilizing, but the quality of loans is still low.

Focusing on two perspectives of monetary policy uncertainty and loan default risk, and starting from the direct impact of monetary policy uncertainty on loan default, the literature covering such topics has been little studied by scholars. From the direct impact perspective, Wang and Li (2019) first measured the default risk factor and build the impulse response function of monetary uncertainty shocks and default risk factor by constructing a nonlinear DSGE model with stochastic volatility The results of the study show that when monetary policy uncertainty rises leads to a rise in default risk. Christiano et al. (2014) through BGG model to construct default risk factor and similarly conclude that default risk rises when monetary policy volatility increases. When the volatility of monetary policy increases, the greater the uncertainty of financial market operations, and the resulting interbank credit risk from monetary policy uncertainty is bound to rise. Bank credit risk includes individual, corporate long and short-term deposit and loan risk, various types of bond term spread risk, etc. Wang (2021) and Deng et al. (2021) investigated the long-term and short-term effects of economic policy uncertainty on bank credit allocation and financing constraints using monthly data on bank credit and economic policy uncertainty index, and the results show that economic policy uncertainty suppresses the scale of bank loans and strengthens the financing constraints of enterprises. Chi et al. (2017) showed that there is a significant positive correlation between economic policy uncertainty and bank non-performing loan ratio. But some scholars hold different views. Bordo et al. (2016) found that based on risk avoidance, banks will limit the scale of loans. Therefore, when economic uncertainty increases, banks' non-performing loans will decline.

2. Methodology

2.1. Time-Varying Parametric Vector Autoregressive Model (TVP-VAR)

Vector autoregressive model (VAR) is proposed to overcome the disadvantages of multiple regression models to describe the relationship between variables only in terms of economic theory, it is an unstructured model, mainly through economic data to determine the impact of economic dynamics, often used to analyze the dynamic impact of each stochastic fluctuations between economic variables on the system of variables, to explain the impact of shocks and uncertainty on the formation of economic variables. The main application is in the field of monetary policy. In practice, the var model is not easily interpreted in the var model for the estimates of individual parameters due to the consistency of the estimated quantities, therefore, generally var model by observing the impulse response function of the system. The impulse response function approach (IRF) is to analyze the dynamic impact on the system when the VAR model is subjected to some shock, which describes the impact on the current and future values of all endogenous variables after a shock of a standard deviation size is applied to the random error term of an endogenous variable. The vector autoregressive model has the same explanatory variables wrapped in each equation, and the explanatory variables are the lagged terms of the explanatory variables. TVP-VAR model treats all variables included in the equation as endogenous, thus avoiding the division between endogenous and exogenous variables, so that only *c* is exogenous and *mpu*, *epu*, and *default* are all endogenous.

Consider the following expression for the VAR model:

$$Y_t = \mu + A_1 Y_{t-1} + \ldots + A_P Y_{t-p} + \varepsilon_t, t = 1,2,3\ldots, T \tag{1}$$

where Y_t is the endogenous variable of the VAR model, Y_t = {epu,mpu,default}, *epu* stands for the index of economic policy uncertainty, *mpu* stands for the index of monetary policy uncertainty, *default* stands for the index of loan default risk, and *P* is the lagged order, ε_t is the K-dimensional perturbation term, and the individual components are not correlated with their own lagged values.

An important issue in estimating VAR models is the determination of the optimal lag order (p) of the model. Unconstrained VAR models are suitable for dealing with multivariate analysis and forecasting, and are also widely used in the study of economic and financial problems, while the limitation of VAR models is that they cannot examine the contemporaneous effects between multiple variables, so subsequent economists have tried to introduce structure into VAR models and consider the contemporaneous effects of multiple variables, i.e., SVAR models (Structural VAR). The most basic SVAR model is set up as follows:

$$AY_t = F_1 Y_t + \ldots + F_P Y_{t-p} + \delta_t, t = p + 1,\ldots, n \tag{2}$$

whereY_t is a k*1 dimensional observable vector, *A* is a k*k matrix of associative parameters, and $F_1 \ldots F_p$ is the k*1-dimensional coefficient matrix, and$\delta_t$is the k*1-dimensional structural shock variable. When the joint parameter matrix is a triangular matrix, i.e.

$$A = \begin{pmatrix} 1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ a_{k1} & \cdots & 1 \end{pmatrix}_{k*K} \tag{3}$$

The above equation can be rewritten as:

$$Y_t = B_1 Y_t + \ldots + B_p Y_{t-p} + A^{-1} \sum \varepsilon_t, t = p + 1, \ldots, n \tag{4}$$

$$B_i = A^{-1} F_i \tag{5}$$

Then by the Kronecker product:

$$X_t = I_s \otimes (Y_{t-1}, \ldots Y_{t-p}) \tag{6}$$

Simplifying gives the simplified SVAR equation:

$$Y_t = X_t \beta + A^{-1} \sum \varepsilon_t \tag{7}$$

TVP-VAR model is a multivariate time series model that introduces stochastic fluctuations and time-varying parameter features based on traditional VAR and SVAR models, which can explain the dynamic relationship between endogenous variables in the economy. TVP-VAR model treats all system variables as endogenous variables and analyzes the impact of shocks to each endogenous variable on other variables, and also fully takes into account individual and time effects. So the above equation can again be rewritten as:

$$Y_t = X_t \beta_t + v_t, \ t = p + 1, \ldots, n \tag{8}$$

where t = 2011, 2012, ... , 2020 denotes the year, Yt denotes the three endogenous variables of economic policy uncertainty, monetary policy uncertainty and loan default risk, and the coefficient β_t, the random disturbance termsv_t all vary over time and with:

$$v_t = A_t^{-1} \sum_t \varepsilon_t \tag{9}$$

Primiceri (2005; 2013) assumed that the parameter matrix is a lower triangular matrix:

$$A_t \Omega_t A_t^T = \Sigma_t \Sigma_t^T \tag{10}$$

The parameter matrix A$_t$ can also be written as:

$$A_t = \begin{pmatrix} 1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ a_{k1,t} & \cdots & 1 \end{pmatrix}_{k*K} \tag{11}$$

Order:

$$a_t = (a_{21}, a_{31}, a_{41}, \ldots a_{k,k-1}).h_t = (h_{1t}, .., h_{kt}). \quad h_{it} = log\sigma_{it}^2 \tag{12}$$

The logarithmic stochastic volatility matrix. Assume that the parameters in the TVP-VAR equation obey a random wandering process and obey the following distribution.

$$\beta_{t+1} = \beta_t + \mu_{\beta t} \tag{13}$$
$$a_{t+1} = a_t + u_{at} \tag{14}$$
$$h_{t+1} = h_t + u_{at} \tag{15}$$

Since all parameters in the TVPVAR model are time-varying, it is not possible to estimate the parameters by least squares and great likelihood methods, Nakajima (2011) refers to Bayesian estimation and uses Gibbs sampling method in Markov Monte Carlo model (MCMC) for parameter estimation, which overcomes the shortcomings of traditional estimation methods and provides time-varying parameter estimation for TVPVAR model provides an accurate estimation method.

2.2. Data Sources and Variable Selection

The monthly data used in this paper are obtained from the official website of economic policy uncertainty, the Guotaian database and the China Stock Bond Information Network, and the time span is from January 2011 to December 2020. The economic policy uncertainty index and the monetary policy uncertainty index are referenced from Baker et al. (2016) by extracting newspaper articles such as the South China Morning Post that contain information on "monetary policy", "uncertainty". then Husted et al. (2020) used this to construct the economic policy uncertainty index. Regarding the construction of the overall bank default risk index, this paper extracts eight indicators from the bond market and bank level that can reflect loan default risk including TED spread, the ratio of credit to GDP gap of financial institutions and corporate bond spread, and extracts the main influencing factors through principal component analysis to obtain the main indicator of bank loan default. which refers to Gilchrist et al. (2009) take TED spread as an important indicator for loan default risk construction, which can focus on reflecting credit default in financial market.

3. Results

In this paper, by studying the direct impact of economic policy uncertainty and monetary policy uncertainty index on loan default risk, the data sample interval is from January 2011 to December 2020, and the data frequency is monthly, firstly, we need to determine the optimal lag order of TVP-VAR model, which is the same as the lag order of conventional VAR model. Therefore, we select three variables, economic policy uncertainty index epu and

monetary policy uncertainty index mpu and loan default index default, for empirical analysis, and use the monthly data from January 2011 to January 2020 as the sample to construct a loan default risk index to measure the loan default risk in China, and establish a TVP-VAR model to study through impulse response function The impact of monetary policy uncertainty shocks on loan default risk in China.

3.1. Smoothness Test

Since there is a seasonal trend in the monetary policy uncertainty index and the loan default risk index, seasonal adjustment is performed. Adf test is first performed on the three variables, and the results show that the economic policy uncertainty index, the monetary policy uncertainty index is smooth at the 5% level of significance, and the loan default risk index has a unit root. therefore, the loan default risk index is differenced and tested, smooth after second order differencing and the optimal lag order is 5. The results are shown in Table 1.

Table 1. ADF test results

variable	ADF statistics	5% threshold	conclude	variable	ADF statistics	5% threshold	conclude
mpu	-4.188447	-2.885863	smoothly				
default	2.372568	-2.886959	unstable	D(default,2)	-10.98144	-2.886959	smoothly
epu	-5.904088	-2.885863	smoothly				

3.2. Selection of the Lag Order

The AIC and SC criterion is generally used, and the final lag order is the order where AIC, SC, and HQIC take the minimum value, and when AIC and SC do not take the minimum value at the same time, the LR value is used to make the judgment of the optimal lag order. As shown in the table below, when AIC and HQIC and LR take the fourth lag order, the value is the smallest, so the optimal lag order is determined to be the fourth order.

Table 2. Hysteresis orders

Lag	Logl	LR	FPE	AIC	SC	HQIC
0	-904.3662	NA	2,933.462	16.49757	16.57122	16.52744
1	-841.5999	120.9678	1,103.745	15.52000	15.81460*	15.63949
2	-826.4046	28.45682	986.5767	15.40736	15.92290	15.61646
3	-808.9059	31.81567	846.1649	15.25284	15.98933	15.55156
4	-794.7359	24.99087*	771.6506*	15.15883*	16.11628	15.54718*
5	-786.5159	14.04872	784.9489	15.17302	16.35141	15.65098
6	-777.3819	15.11252	786.3832	15.17058	16.56992	15.73816
7	-769.5154	12.58649	807.5077	15.19119	16.81148	15.84839
8	-764.8897	7.148796	881.2350	15.27072	17.11196	16.01754

Note: The superscript ***, **, *, are significant at the level of 1%, 5% and 10%, respectively. The t-statistic is in brackets.

3.3. Results of Parameter Estimation

After determining the form of the model variables and the optimal lag order, the empirical operation of the TVP-VAR model can be carried out below. In this paper, we use the Matlab code package written by Nakajima, and for the sake of empirical convenience, we

do not change the names of the variables in the code, and set economic policy uncertainty as p, monetary policy uncertainty as x, and loan default index as i. After the model is set up, the MCMC function can be used for parameter estimation, with the function "MCMC(10000)" represents MCMC iteration 10,000 times, and discard the first 1,000 times as the "pre-burn value", MCMC function will output 4 graphs, respectively for MCMC parameter estimation results, posterior estimates of stochastic volatility, posterior estimates of time-varying parameters (2). In this paper, the input sample size is 120*3, the lag length is 5, the running time of the program is 687.58 seconds, and the parameter estimation results (table + graph) are as follows.
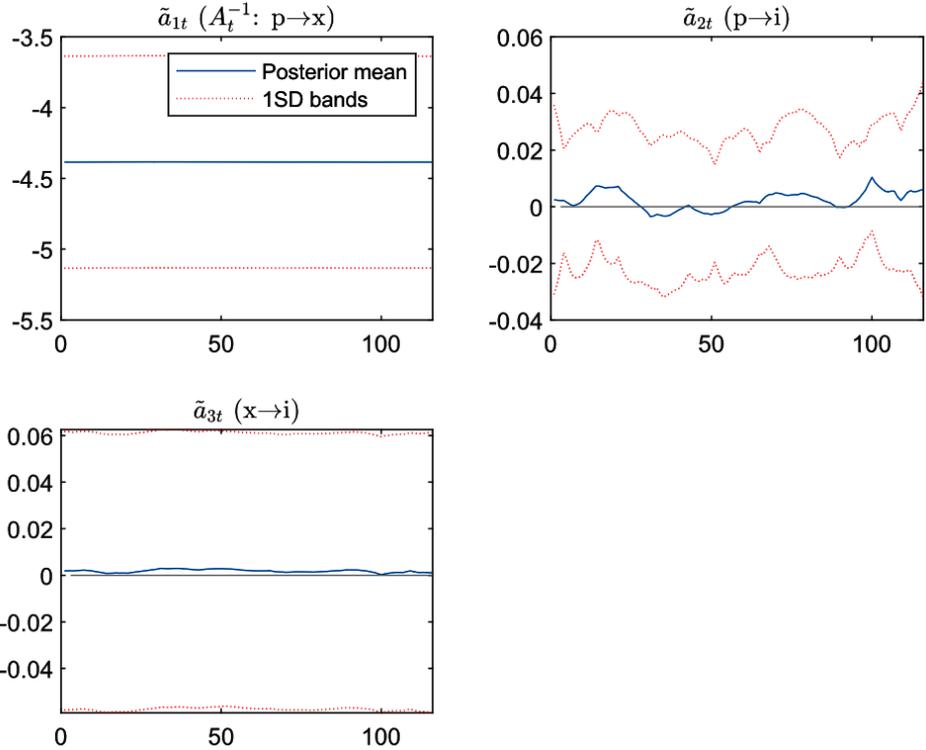
Figure 1. Parameter estimation

Table 3. TVP-VAR model parameter estimation results

Parameter	Mean	Stdev	95% U	95% L	Geweke	Inef.
sb1	0.0023	0.0003	0.0018	0.0029	0.194	6.98
sb2	0.0023	0.0003	0.0018	0.0028	0.197	7.01
sa1	0.0056	0.0018	0.0034	0.0101	0.942	34.97
sa2	0.0050	0.0012	0.0033	0.0078	0.000	19.54
sh1	0.0057	0.0017	0.0034	0.0101	0.553	35.77
sh2	0.0056	0.0016	0.0034	0.00098	0.241	26.47

Since we are examining the impact of economic policy uncertainty and monetary policy uncertainty on loan defaults, we only need to analyze the response of loan default risk to economic policy uncertainty and monetary policy uncertainty, so we only need to focus on the latter two plots. The Geweke convergence diagnostic is used to determine whether the Markov chain obtained from the pre-simulation converges to the posterior distribution, while the invalid influence factor is the ratio of the variance of the posterior sample mean to the

variance of the uncorrelated serial sample mean. The parameters of the model are estimated by the MCMC algorithm, and it is clear from the results that the convergence statistic cannot reject the original hypothesis of the posterior distribution at the 5% significance level, and therefore the results are convergent, and the MCMC test results are convergent, except that the Geweke values sa1 and sh1 are greater than 0.5 and the null factors are both less than 120, which indicates that at least 120 valid samples were obtained in 10,000 MCMC samples, the posterior distribution sampling is good, and the model parameter estimation results are robust.

3.4. Impulse Response Results
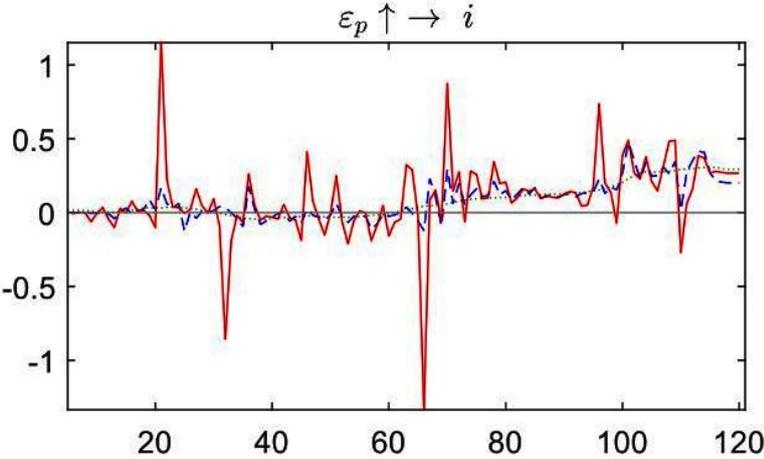
Figure 2. Isometric impulse response plot of economic policy uncertainty and loan defaults
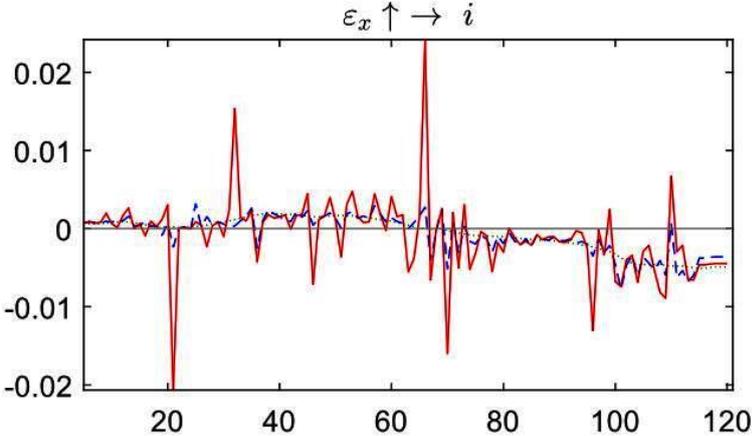
Figure 3. Equally spaced impulse response plots of monetary policy uncertainty and loan defaults

Equally spaced impulse responses are impulse response functions of variables induced by shocks of different time horizons (lags). Unlike the two-dimensional impulse response under the VAR model, the TVP-VAR model can apply variable parameters to calculate impulse response plots for each variable at all time points at different lags. Considering the comparability of impulse responses across periods, the size of the shock term is set equal to the mean of the random fluctuations in the sample period. The graphs depict the dynamics of the shocks to the economic policy uncertainty index, the monetary policy uncertainty

index, and the loan default index for lags 4, 8, and 12.$\varepsilon_p \uparrow \rightarrow$ i; $\varepsilon_x \uparrow \rightarrow$ i. The results of equally spaced impulse responses of the economic policy uncertainty as well as the monetary policy uncertainty index to the loan default index are indicated.

First, observing the effect of economic policy uncertainty on loan defaults, there is little variation across time intervals between period 0 and 80, with coefficients ranging between 0 and 0.2, but between periods 80-120, shocks rise with lags 4 and 8, ranging between 0.2-0.4, while the volatility range for lag 12 has exceeded 0.4 and rises rapidly, indicating that economic policy uncertainty has a greater impact on the long-term effects of loan defaults, with rising economic policy uncertainty rapidly leading to higher loan default risk as time progresses.

Second, observing the effect of monetary policy uncertainty on loan defaults, there is little difference across time intervals in the period 0-90, with coefficients close to 0. This indicates that the effect of monetary policy uncertainty on loan defaults is insignificant, but starts to turn negative in the period 90-120, with the volatility range of loan defaults for lags 4 and 8 lying roughly at -0.05-0, while the volatility for lag 12 range lies roughly at -0.1-0, so that the long-term effect of loan defaults due to monetary policy uncertainty is more pronounced. This suggests that monetary policy uncertainty brings increasing volatility to loan defaults as time progresses, and that in the long run, rising monetary policy uncertainty
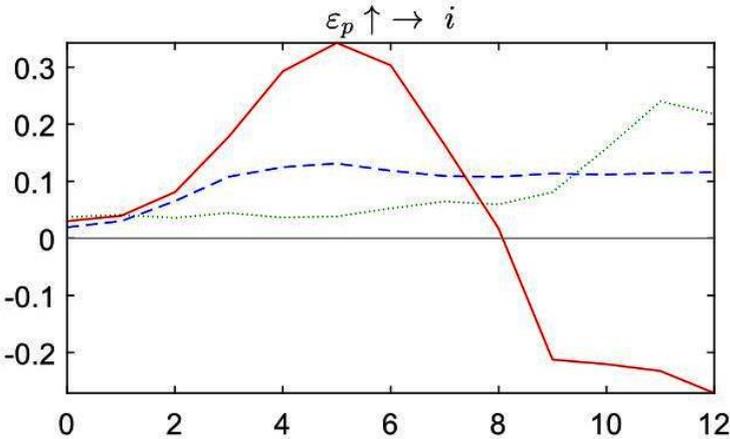
Figure 4. Impulse response plot of economic policy uncertainty and loan defaults at different points in time
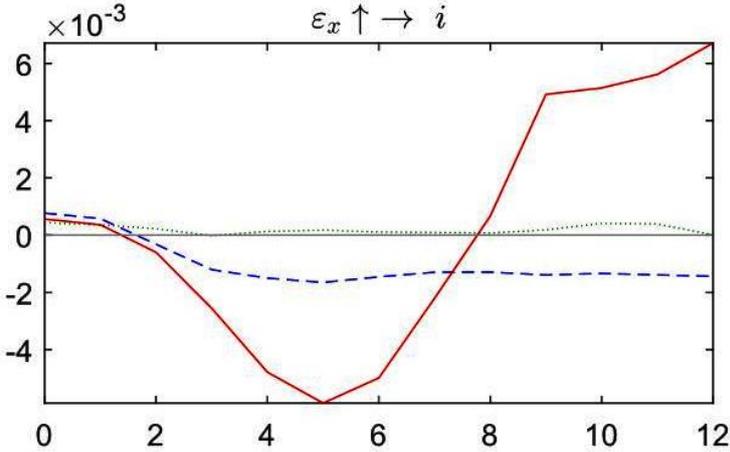
Figure 5. Impulse response plot of monetary policy uncertainty and loan defaults at different points in time

ultimately leads to lower loan default risk. When uncertainty increases in the current year, it becomes more difficult for banks to assess firms' performance, and with the incentive of risk aversion, banks will reduce risk-based loans and lower the amount of non-performing bank loans, which helps prevent loan defaults by firms.

The split-point impulse response is the impulse response function at different identified points in time. To further examine the time-varying pattern of the monetary policy uncertainty index on loan default shocks, three representative observations are selected in Figure 4, October 2012, March 2018, and December 2019. The results of the time-pointed impulse responses of monetary policy uncertainty as well as economic policy uncertainty on the loan default index are examined, so it is only necessary to look at.

First, looking at the impact of economic policy uncertainty on loan defaults, the shock to the loan default index is positive in both October 2012 and March 2018, with a smaller impact in the current period. In particular, the shock in December 2019 rises sharply after about period 2, peaks in about period 5, then the shock declines and becomes negative in about period 8, continues to fall sharply, and levels off in about period 9 when the fluctuations level off. This suggests that rising economic policy uncertainty exacerbates loan defaults in the first eight periods and that there is a time lag in this effect, while in the long run it appears that economic policy uncertainty curbs loan default risk to some extent. The impact of the impulse response function is stronger in 2019 compared to 2012 and 2018, with positive shocks rising rapidly in the short run and such shocks turning negative and remaining high in the long run. The possible reasons for this are the sudden outbreak of the epidemic, the implementation of economic policies that do not take into account the unexpected situation, the more conservative business decisions of enterprises and banks, the uncertainty of the future business direction of enterprises, and the unpredictability of conventional business decisions in the case of repeated epidemics, which may lead to unpredictable defaults of enterprises and exacerbate loan defaults. However, since the epidemic, China has adopted prudent economic and monetary policies to effectively prevent and control financial risks by lowering the reserve requirement ratio for financial institutions, expanding the amount of refinancing and establishing a long-term management mechanism, so in the long run, it seems that the risk of loan defaults by banks tends to decline.

Second, examining the impact of monetary policy uncertainty on loan defaults again, the impact of monetary policy uncertainty on loan defaults is positive at this point in time in October 2012, with a smaller impact in the current period, and then tends to converge. This suggests that rising monetary policy uncertainty exacerbates loan defaults. At this point in March 2018, after about the second period, the direction of the shock is negative, with a smaller impact in the current period and in the long run. In particular, December 2019 shows a negative shock overall, a positive shock in the current period, a negative shock in about period 2, then keeps falling, reaches a minimum in period 5, starts rising again from period 6, and becomes positive in about period 8, suggesting that the impact of monetary policy uncertainty on loan defaults is positive in the current period, negative in the medium term, and becomes positive again in the long-term shocks. In the long run, when monetary policy uncertainty rises, loan defaults rise. The reason for this may be that, on the one hand,

when monetary policy uncertainty rises under the epidemic, the volatility of corporate loan costs increases, the performance and investment of both sales-oriented and investment-oriented firms are hit, and the sunk costs of corporate investments in infrastructure are difficult to recover, which can exacerbate corporate loan defaults. On the other hand, due to the global public health emergencies, banks have difficulty in assessing the performance of enterprises, and with the incentive of risk aversion, they will reduce risky loans to banks and reduce the amount of non-performing loans to banks, which will help prevent loan defaults by enterprises, and therefore the data show that loan defaults by banks will decrease.

4. Discussion and Conclusions

This article introduces the impact of economic policy uncertainty and monetary policy uncertainty on loan default. According to the empirical conclusion, generally speaking, the impact of uncertainty on loan default is positive. However, economic policy uncertainty presents a positive impact in the short and medium term and a negative impact in the long term, while monetary policy uncertainty presents a positive impact in the short and long term and a negative impact in the medium term. Therefore, based on the empirical results, we need to consider the following situations when dealing with the relationship between uncertainty and loan default: (1) When formulating economic policies, specifically monetary policies, the government should maintain openness and consistency in policy information, take into account the long-term goals of economic operation, not just immediate interests, and reduce the negative impact of policy uncertainty.(2) For enterprises and banks, the government should strengthen its support for enterprise investment, stimulate enterprise vitality, improve banks' risk management and prevention and control mechanisms, reduce enterprises' non-performing loan rate in banks, and create a good environment for win-win cooperation between banks and enterprises.(3) Banks should continuously improve the quality of credit assets, improve bank management structure, personnel management structure, internal management structure, including talents, loan review mechanism, enterprise lending mechanism, institutional operation mechanism, which is conducive to curbing banks' loan default risk behavior and reducing default risk in the financial market.

Conflict of interest: none

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Research on the Indirect Impact of Monetary Policy Uncertainty and Loan Default – Based on Two Channels of Banks and Enterprises

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Abstract: Based on the financial data of 15 listed banks from 2011 to 2020, this paper makes an empirical analysis of the panel model, examines the indirect impact mechanism between the uncertainty index of monetary policy and the non-performing loan ratio of banks, and verifies the intermediary effect of bank risk-taking and enterprise loan cost between the uncertainty of monetary policy and the non-performing loan ratio of banks, In addition, it also tests the heterogeneity of the equity nature of listed banks in order to make a comprehensive analysis of the indirect impact channels of monetary policy uncertainty on loan default. The results show that: (1) there are some intermediary effects between loan cost and bank risk-taking on loan default when the uncertainty of monetary policy increases. (2) The impact of monetary policy uncertainty on the non-performing loan ratio of state-owned banks and joint-stock banks is significantly positive, and the impact coefficient on the non-performing loan ratio of state-owned banks is greater than that of joint-stock banks.

Keywords: monetary policy uncertainty; loan default; risk bearing of banks; non-performing loan ratio; loan cost

JEL Classification: E52

1. Introduction

Since 2016, China has steadily promoted the supply side structural reform. The central bank's active monetary policy innovation and expected fine-tuning will inevitably lead to an increase in policy uncertainty. The flexibility advantage of monetary policy is that it can deal with the contradictions of China's internal economic structure adjustment, but it also brings uncertainty. The government flexibly uses various monetary policies to adjust the macro-economy. However, the camera of monetary policy and the inconsistency between policies will bring uncertainty. The Sixth Plenary Session of the 19th CPC Central Committee pointed out: "in terms of economic construction, the balance, coordination and sustainability of China's economic development have been significantly enhanced, the country's economic strength, scientific and technological strength and comprehensive national strength have leapt to a new level, and China's economy has embarked on a higher quality, more efficient, more equitable, more sustainable and safer development path." Therefore, in order to stabilize monetary policy, ensure the stability, continuity and sustainability of monetary policy implementation, and reduce the uncertainty of monetary policy, we must pay attention to the impact of monetary

policy uncertainty. At the same time, the financial stability report of China's central bank in 2021 pointed out: "at present, the changes of the century and the epidemic situation of the century are intertwined and superimposed... The instability and uncertainty at home and abroad have increased significantly. Domestic financial risks are still many and wide, regional financial risks still exist, the breach risk of some enterprises has increased, and the risk of individual small and medium-sized banks is more prominent...". At present, under the normalization of the epidemic and the complex international environment, it is very important to continue to maintain financial stability, maintain the continuity and stability of financial policies, reduce the risk of bank loan default and promote the improvement of financial development level. Based on this background, an in-depth study of the impact of monetary policy uncertainty on bank loan default risk is not only conducive to the stability and sustainable development of the policy, but also effectively prevent and control financial risks. The two global financial crises in the 1920s and 1930s and the early 21st century have alerted all countries and governments to the impact of economic policy uncertainty on banking, finance and macro-economy. Both financial crises were the result of excessive monetary expansion. The direct cause of the great depression was insufficient investment, loan default and credit contraction. Therefore, we must pay attention to the relationship between monetary policy uncertainty and bank risk-taking, and it is necessary to consider the mechanism of government monetary policy uncertainty on loan default. As for the uncertainty of monetary policy, there is no unified conceptual expression at present. Due to the low degree of marketization of interest rate in China, the uncertainty of China's monetary policy mainly comes from the uncertainty generated in the operation of AD-AS model under the monetary model and Phillips curve model when the central bank realizes the goal of price stability. The uncertainty in the monetary model comes from the regulation of monetary policy objectives, money stock and money circulation speed. The uncertainty in the Phillips curve model comes from the relationship between the expected rate of change of price and actual output. Western economists examine uncertainty under the complete model of Phillips curve. At present, most scholars believe that the uncertainty of monetary policy is the uncertainty in the implementation and transmission of monetary policy caused by the variability of monetary policy tools and the uncertainty of macroeconomic situation (Wang & Wang, 2020; Li, 2016). Apergis and Miller (2007) distinguished the two concepts of the impact of monetary policy level and the impact of monetary policy uncertainty are easy to be confused. The difference between the two lies in the different transmission mechanism. The former is on the aggregate demand side and the latter is on the aggregate supply side. Cook and Corn (1991) as well as Kurov and Stan (2017) first put forward the "policy expectation hypothesis" about the uncertainty of monetary policy. They believe that the uncertainty of monetary policy mainly affects the asset price of the financial market through the guidance of the public's future policy expectation, which means that the increase of monetary policy uncertainty will lead to the deviation between the actual price and the expected price. Cogley et al. (2011) found that the uncertainty of monetary policy comes from the uncertainty of models and parameters, and Bayesian estimation should be used to evaluate the uncertainty. Other scholars have examined the relationship between monetary policy and uncertainty. Bekaert et al. (2013) believes that loose

monetary policy reduces risk aversion and uncertainty. Due to expansionary money, the central bank provides sufficient liquidity. The uncertainty of monetary policy has a tightening effect on the macro economy. The tightening effect can restrain consumption, investment and labor employment through the addition of Preventive Savings, sticky prices and endogenous marginal costs (Wu et al., 2021; Nam et al., 2021; Zhou et al., 2021). Husted et al. (2019) pointed out that the uncertainty of monetary policy will lead to the decline of enterprise investment through financial channels such as real option effect and financial friction effect.

As for the research on the impact of monetary policy uncertainty on loan default, the previous literature research has a variety of perspectives. Through extensive collection of literature, it focuses on the two factors of monetary policy uncertainty and loan default, and makes a literature review from the aspect of indirect impact. The indirect influence literature can be summarized into the following three perspectives. The first is to study the relationship between indicators that can reflect the fluctuation of monetary policy, such as loan interest rate, money supply and non-performing loan rate, but this study lacks the overall grasp of monetary policy. Christiano et al. (2016) constructed the default risk factor through BGG model and concluded that when the fluctuation of monetary policy intensifies, the default risk increases. The second is to study the relationship between economic policy uncertainty and enterprise loan cost, enterprise credit scale and enterprise investment from the enterprise level. The third is to study the relationship between economic policy uncertainty and bank risk-taking from the bank level.

From the perspective of indirect impact, for the specific indicators of monetary policy, some scholars have studied the impact of short-term loan interest rate and money supply on non-performing loans by building models (Xie, 2009; Lu, 2012; Fernández-Villaverde et al., 2015; Ma & Shen, 2017). Therefore, the research on non-performing loans from this perspective mainly focuses on the impact of a specific indicator in monetary policy, which is lack of comprehensiveness and analysis of indicators that can reflect the overall monetary policy. For the level of enterprise loan cost, the increase of monetary policy uncertainty will lead to the increase of enterprise loan cost (Song et al., 2019; Francis et al., 2014). It is generally believed that when the uncertainty of monetary policy increases, the loan cost of enterprises increases, and the profitability of enterprises decreases. Due to the failure to repay the principal and interest on time, the non-performing loan rate of banks increases. Tan and Zhang (2017) pointed out that when the economic uncertainty rises, the factor price and asset price of the enterprise will fluctuate, the profitability of the enterprise's investment projects will be affected, and the solvency cannot be judged. Therefore, the bank will strengthen the review of the enterprise's loan projects, increasing the loan cost of the enterprise. Bolton et al. (2019) found that the uncertainty risk leads to the increase of enterprise financing cost, and the financing decision of the enterprise depends on the profitability and liquidity of the enterprise. When the policy uncertainty increases, the risk borne by the enterprise increases, and the enterprise financing requires higher risk compensation, so the agency cost and financing cost will increase. For the level of bank risk-taking, there are few studies on the analysis of monetary policy uncertainty and bank risk-taking mechanism. Liu & Hou (2020) pointed out that monetary policy uncertainty will increase the bank's ex ante risk-taking level through loan scale and liquidity,

but will reduce the bank's ex ante risk-taking level through the change of asset return. Uncertainty is inversely proportional to the bank's subsequent risk-taking. Based on the DSGE model, Li and Huang (2021) concluded that the increase of monetary policy uncertainty will increase the bank's non-performing loan ratio and inhibit the bank's credit activities, so as to increase the bank's risk-taking level. In addition, other scholars study how economic policy uncertainty affects bank risk-taking from the perspective of monetary policy. Brana et al. (2019) as well as Matthys et al. (2020) analyzed that the loose monetary environment may stimulate banks to increase their risk appetite by issuing loans with lower spreads to higher risk companies. Most scholars have investigated the relationship between economic policy uncertainty and bank risk-taking. They believe that economic policy uncertainty and bank risk-taking are positive. Bank risks come from all aspects, including operation risk, liquidity risk, financing risk, profit risk and credit default risk. Due to the infectious risk, the risks of banks affect each other. When the uncertainty of economic policies increases and the risk of credit default increases, banks will issue more short-term loans and guaranteed loans and recover long-term loans, Reduce the loss of non-performing loans, but banks sometimes fail to correctly understand the situation and make mistakes in operation and management, resulting in the wrong issuance of credit structure, which leads to the rise of bank credit risk and the rise of non-performing loan rate. It can be seen from the previous literature that the research on bank risk-taking mainly focuses on the uncertainty of economic policy and the choice of two monetary policy tools. In addition, the previous literature has inconsistent directions in discussing the relationship between monetary policy uncertainty and bank risk-taking level. Therefore, the relationship between specific monetary policy uncertainty and bank risk-taking is still unclear and needs to be further studied.

Generally speaking, the previous literature focuses on the direct impact of economic policy uncertainty, and there is little research on the indirect impact between monetary policy uncertainty and loan default. Therefore, this paper aims to deeply analyze the impact of monetary policy uncertainty in the face of the impact of monetary policy uncertainty through the Chinese monetary policy uncertainty index constructed by Baker et al. (2016), How the two channels of loan cost and bank risk-taking affect loan default provides new ideas for preventing greater systemic financial risk.

2. Methodology

This paper comprehensively analyzes the indirect impact mechanism of monetary policy uncertainty on bank non-performing loan ratio, and verifies how monetary policy uncertainty affects bank non-performing loan ratio through two indirect impact mechanisms: loan cost and bank risk-taking through empirical regression results.

2.1. Fixed Panel Model

In order to estimate the total effect of monetary policy uncertainty on loan default, the following benchmark model is set:

$$npl_{it} = \beta_0 + \beta_1 lnmpu_t + \beta_2 X_{it} + \beta_3 M_t + a_i + u_{it} \tag{1}$$

NPL represents the non-performing loan ratio of banks, lnmpu represents the uncertainty of monetary policy, and the annual index is taken as logarithm, β_0 is intercept term, coefficient β_1 represents the impact of the uncertainty index of monetary policy on the non-performing loan ratio. X_{it} is a bank level control variable that changes with time, M_t controls a series of macro level factors, and a_i is a bank fixed effect that controls the individual characteristics that do not change with time. u_{it} is a random error term.

2.2. Intermediary Effect

In order to analyze how the uncertainty of monetary policy affects loan default through the two channels of bank risk-taking and loan cost, we need to expand the benchmark model of panel data and analyze the intermediary effect of intermediary variables. The intermediary effect can effectively test the role of intermediary variables. We need to test whether the intermediary effects of bank risk-taking and loan cost exist and their proportion in the total effect. We can judge whether the intermediary effect exists by gradually testing the regression coefficient. The extended model is as follows:

$$r_{it} = \varphi_0 + \varphi_1 lnmpu_t + \varphi_2 X_{it} + \varphi_3 M_t + a_i + u_{it} \tag{2}$$

$$Z_{it} = \alpha_0 + \alpha_1 lnmpu_t + \alpha_2 X_{it} + \alpha_3 M_t + a_i + u_{it} \tag{3}$$

$$npl_{it} = \omega_0 + \omega_1 lnmpu_{it} + \omega_2 r_{it} + \omega_3 X_{it} + \omega_4 M_t + a_i + u_{it} \tag{4}$$

$$npl_{it} = \gamma_0 + \gamma_1 lnmpu_{it} + \gamma_2 Z_{it} + \gamma_3 X_{it} + \gamma_4 M_t + a_i + u_{it} \tag{5}$$

"R" represents the floating range of loan interest rate, "Z" represents the bank's risk-taking level, and other variables have the same meaning as those in the benchmark model. Consider two intermediary effects, namely indirect effects. The first intermediary effect considers the cost of enterprise loans, that is, the uncertainty of monetary policy increases the cost of enterprise loans, which in turn leads to the default of enterprise loans. Models (1), (2) and (4) are used to test the uncertainty of monetary policy - loan cost - loan default. Firstly, we test the effect of monetary policy uncertainty on loan default β_1 in the total effect model (1). Then test the impact of monetary policy uncertainty on loan cost, and investigate φ_1 in model (2). Finally, test the influence of monetary policy uncertainty, loan default and loan interest rate and cost at the same time, and investigate the coefficients ω_1 and ω_2 in model (4). The second intermediary effect considers bank risk-taking. Firstly, it examines the impact of monetary policy uncertainty on loan default, then examines the impact of monetary policy uncertainty on bank risk-taking, and finally tests the impact of monetary policy uncertainty and bank risk-taking on loan default at the same time. Here, models (1), (3) and (5) are used to test the transmission mechanism of monetary policy uncertainty - bank risk-taking - loan default. First, test the total impact of monetary policy uncertainty on loan default, and investigate β_1 in model (1). Then test the impact of monetary policy uncertainty on bank risk-taking, and investigate the effect of α_1 in model (3). Finally, test the impact of monetary policy uncertainty, bank risk-taking and bank loan default at the same time, and investigate the impact of γ_1 and γ_2 in model (5).

2.3. Data Source and Variable Selection

Huang and Luk (2020) measured the monthly data of the monetary policy uncertainty index in China. They can be found from the official website of the economic policy uncertainty index. The macro level data involved in the construction of loan default indicators comes from guotai'an database, and the enterprise level data comes from China bond information network and Dongfang wealth network. The data of listed banks comes from guotai'an database. Combined with the required data of listed banks, excluding other lack of listed banks, 15 listed banks with complete data range are finally obtained including 10 joint-stock banks and 5 large state-owned commercial banks, and finally obtained the balanced panel data of 15 listed banks from 2011 to 2020. Compared with the previous literature, this data covers a wide range of data and involves many types of data at all business levels of banks. Therefore, this paper uses the data of 15 listed commercial banks from 2011 to 2020 as samples for empirical analysis.

The dependent variable is the bank's non-performing loan rate. The proxy variable of monetary policy is generally the market interest rate, but China's market interest rate is not perfect. At the same time, China mostly uses quantitative monetary policy to regulate the economy, such as the growth rate of broad money supply, the deposit reserve ratio and the benchmark interest rate of one-year loan. Here, we refer to most literatures and select the monetary policy uncertainty index obtained from the official website for empirical analysis. It is made by extracting key words about monetary policy and uncertainty from well-known newspapers and periodicals. It is calculated by comprehensively considering many indicators of monetary policy, including macro-control, monetary policy means of the central bank, open market operation, deposit reserve ratio, benchmark interest rate, money liquidity, interest rate, interest, money supply, lending tools, inflation rate, quantitative easing and tightening, etc. We average the monthly data to obtain the annual data, which is used as the main explanatory variable for empirical analysis. The control variables at the bank level include the ROA of listed banks, deposit loan ratio, total asset turnover rate, net profit growth rate, sustainable development rate, total asset growth rate, banking profitability and banking prosperity, which in turn represent the development ability, operation ability and profitability of banks. As for the indicators of bank risk-taking, we refer to Xu and Chen (2012) to measure the overall risk of the bank with Z-value. It is a direct measure of the bank's bankruptcy probability, taking into account the bank's operating status, profitability, financial status, etc. For the enterprise loan cost index, the floating range of loan interest rate is selected as the index. The classification of bank nature refers to the classification of listed banks in guotai'an database, which is divided into two categories: large state-owned commercial banks and joint-stock commercial banks.

3. Results

We usually assume that the mean value of the disturbance term is independent of all explanatory variables and is not affected by internal factors. There is no problem of missing variables in the model, but if there is a problem of missing variables, the estimated value of variables will be too high or too low. Therefore, we need to test the robustness of the model

and variables before empirical analysis. In order to test the role of the two intermediary variables, bank risk-taking and loan cost, between the uncertainty of monetary policy and loan default, we need to test the intermediary effect and judge the proportion of the intermediary effect in the total effect. In addition, in order to investigate the different impact of banks with different property rights on loan default in the face of monetary policy uncertainty, we distinguish between state-owned banks and joint-stock banks to test bank heterogeneity.

3.1. Model Robust Test

Instrumental variable method is a common method to solve endogenous problems. It introduces an exogenous variable, which is independent of random disturbance term and related to endogenous variable. In fact, the over identification test is to test the exogenous nature of instrumental variables, that is, instrumental variables are not related to disturbance terms. Weak instrumental variable test is to test the correlation between instrumental variables and endogenous explanatory variables.

Table 1. Instrumental variable method

variable	npl
lnmpu	1.030746 *** （5.25）
adjusted R^2	0.7695
sample size	150
over identification test	3.402(0.0651)
weak instrumental variable test	0.9303(0.0000)

The superscript ***,**,* are significant at the level of 1%, 5% and 10%, respectively. The t-statistic is in brackets.

There are many methods of robustness test, including missing variables, changing dependent variables, core independent variables, instrumental variables, etc. Referring to the practice of Wang (2014), this paper selects the U.S. monetary policy uncertainty index and Monetary Policy Perception Index as instrumental variables, and uses the method of replacing the core explanatory variables to test the robustness of panel data. Through two-stage least squares regression, the results show that the instrumental variables we selected are effective. The panel model has good robustness.

3.2. Intermediary Effect Test

Firstly, hosman test is used to determine whether the panel model is suitable for fixed effect or random effect. The results show that the panel model in this paper is suitable for fixed effect. The hosman test results are omitted here. Then the total effect of monetary policy uncertainty and loan default is tested by Stata software. Model 1 is the regression result of the total effect. The results in Table 2 show that the value of the test statistics of the core explanatory variable lnmpu is less than the critical value, and the p value is 0. Therefore, the uncertainty of monetary policy after taking logarithm is significant at the significance level of 0.05. Therefore, the uncertainty of monetary policy has a significant impact on loan default, and the total effect is significant. The positive coefficient indicates that when the uncertainty of monetary policy increases, the loan default behavior of banks increases. It also controls the

bank level and macro level variables, including bank deposit loan ratio, ROA, total asset growth rate, net profit growth rate, sustainable development rate, total asset turnover rate, M0 growth rate and CPI growth rate.

Table 2. Total effect regression results

npl	Model (1)	
	fixed effect	random effect
lnmpu	0.78700***(5.56)	0.6334818***(4.15)
deposit loan ratio	-1.07687***(-6.05)	-0.670975***(-4.55)
Roa	-155.6282***(-7.03)	-124.3342***(-5.84)
Growth rate of total assets	-0.70727***(-2.72)	-0.952839***(-3.31)
Net profit growth rate	-0.04549(-0.45)	-0.0281298(-0.29)
Sustainable development rate	-1.66787*(-1.85)	-2.831056***(-3.30)
Total asset turnover	12.82201(1.21)	21.10358**(2.17)
M0 growth rate	-0.05840***(-7.09)	-0.0510332***(-5.66)
Consumer retail price index growth	-0.01231**(-2.15)	-0.0138502**(-2.17)
Constant	0.91502*(1.86)	0.7314408(1.35)
Observations	150	150
R^2	0.5222	0.6098

The superscript ***,**,* are significant at the level of 1%, 5% and10%, respectively. The t-statistic is in brackets.

The method of stepwise testing regression coefficient is divided into three steps. First, test the total effect of independent variable x on dependent variable y, and the coefficient is a. Second, test the relationship between independent variable x and intermediary variable m, and the coefficient is B. Third, after controlling the intermediate variable m, test the coefficient C of the core explanatory variable and the coefficient D of the intermediate variable. When the coefficients a, B and D are significant, the mediating effect is significant. When the coefficient C is not significant, it is a complete intermediary. When C is less than a, it is partial mediation.

Dependent variable R, core explanatory variable lnmpu, control variable deposit loan ratio, M0 growth rate, M1 growth rate, M2 growth rate, CPI growth rate, banking prosperity and bank profit index constitute model 2.

Table 3. Regression results of lnmpu and loan cost

r	Model (2)	
	fixed effect	random effect
Lnmpu	14.68339*** (9.36)	14.74255*** (9.91)
deposit loan ratio	-0.1761649 (-0.68)	-.0431235 (-0.35)
M0 growth rate	-1.437453*** (-9.65)	-1.443444*** (-10.22)
M1 growth rate	0.1082267*** (3.52)	0.1094503*** (3.76)
M2 growth rate	0.6246675*** (14.54)	0.6241975*** (15.29)
Consumer retail price index growth	-0.1623461*** (-7.66)	-0.1608086*** (-8.04)
Prosperity banking index	1.70574*** (7.63)	1.719066*** (8.14)
Bank profit index	-1.079227*** (-6.33)	-1.090572*** (-6.78)
Constant	-94.10628*** (-8.73)	-94.68211*** (-9.28)
Observation	150	150
R^2	0.9872	0.9873

The superscript ***,**,*,are significant at the level of 1%, 5% and 10%, respectively. The t-statistic is in brackets.

Dependent variable Z, core explanatory variable lnmpu, control variable deposit loan ratio, ROA, total asset growth rate, net profit growth rate, sustainable development rate, total asset turnover rate, M0 growth rate, CPI growth rate, banking prosperity and bank profit index constitute model 3.

Table 4. Regression results of lnmpu and Z

Z	Model (3)	
	fixed effect	**random effect**
lnmpu	0.0615389* (1.93)	0.0495106 (1.49)
deposit loan ratio	-0.0107933 (-0.66)	-0.0132385 (-0.82)
Roa	-23.82271*** (-10.80)	-23.02328*** (-10.27)
growth rate of total assets	-0.045203* (-1.92)	-0.0409833* (-1.67)
net profit growth rate	0.0165214* (1.79)	0.023647* (2.50)
sustainable development rate	-0.1288618 (-1.46)	-0.1390081 (-1.54)
total asset turnover	-0.8137681 (-0.83)	-0.1683032 (-0.17)
M0 growth rate	-0.003772* (-1.74)	-0.0029327 (-1.30)
consumer retail price index growth	-0.0024034*** (-2.87)	-0.0020059* (-2.31)
prosperity banking index	0.0005043 (0.17)	0.0002299 (0.07)
bank profit index	0.001598 (0.62)	0.0015954 (0.59)
Constant	0.0388958 (0.23)	0.0869708 (0.50)
Observations	150	150
R^2	0.3024	0.3371

The superscript***,**,*,are significant at the level of 1%,5%and10%, respectively. The t-statistic is in brackets.

Dependent variable NPL, core explanatory variable lnmpu, control variable R, deposit loan ratio, ROA, total asset growth rate, net profit growth rate, sustainable development rate, total asset turnover rate, M0 growth rate and CPI growth rate constitute model 4.

Table 5. Test of intermediary effect of loan cost

npl	Model (4)	
	fixed effect	**random effect**
lnmpu	0.5698241*** (4.31)	0.5052124*** (3.80)
r	-0.0679363*** (-5.73)	-0.0758525*** (-6.67)
Deposit loan ratio	-1.050897*** (-6.60)	-0.6937231*** (-5.27)
Roa	-98.74781*** (-4.46)	-79.03743 *** (-3.95)
Growth rate of total assets	-0.4664896* (-1.97)	-0.6586843*** (-2.64)
Net profit growth rate	0.0441789 (0.48)	0.0550549 (0.64)
Sustainable development rate	-0.2474846 (-0.29)	-1.094317 (-1.39)
Total asset turnover	29.74063*** (3.01)	31.1346 *** (3.56)
Consumer retail price index growth	-0.009584* (-1.86)	-0.0097352* (-1.77)
M0 growth rate	-0.0413281*** (-5.21)	-0.0370297*** (-4.59)
Constant	1.732409*** (3.75)	1.578605*** (3.28)
Observations	150	150
R^2	0.6364	0.6997

The superscript ***,**,* are significant at the level of 1%, 5%and 10%, respectively. The t-statistic is in brackets.

Dependent variable NPL, core explanatory variable lnmpu, control variable Z, deposit loan ratio, ROA, total asset growth rate, net profit growth rate, sustainable development rate, total asset turnover rate, M0 growth rate and CPI growth rate constitute model 5.

Table 6. Intermediary effect test of bank risk taking

npl	Model (5)	
	fixed effect	random effect
Lnmpu	0.8070487*** (5.84)	0.6361135*** (4.19)
z	-2.524276*** (-2.76)	-0.6982436 (-0.98)
Deposit loan ratio	-1.087181*** (-6.26)	-0.7042696*** (-4.71)
Roa	-205.6704*** (-7.30)	-138.8544*** (-5.53)
Growth rate of total assets	-0.8015908*** (-3.13)	-0.9466838*** (-3.32)
Net profit growth rate	0.0131696 (0.13)	0.0148919 (0.14)
Sustainable development rate	-1.657554* (-1.89)	-2.897372*** (-3.34)
Total asset turnover	13.56764 (1.32)	22.414** (2.25)
M0 growth rate	-0.0560069*** (-6.94)	-0.0503604*** (-5.58)
Consumer retail price index growth	-0.0117763** (-2.10)	-0.0131003** (-2.06)
Constant	1.659577*** (3.02)	0.9721898* (1.65)
Observations	150	150
R^2	0.4699	0.6016

The superscript ***,**,* are significant at the level of 1%, 5% and 10%, respectively. The t-statistic is in brackets.

First, we examine the relationship between the uncertainty of monetary policy and the non-performing loan ratio of banks, as shown in Table 2, β_1 significant. Then through the regression results of monetary policy uncertainty and loan cost, as shown in Table 3, the uncertainty of monetary policy is significant at the 95% significance level, and the coefficient is significant φ_1 is positive, which indicates that when the uncertainty of monetary policy increases, the floating range of loan interest rate becomes larger and the loan cost increases. When considering both monetary policy uncertainty and loan cost, as shown in Table 5, the coefficient φ_1 and ω_2 were significant at 95% significance level, and ω_1 less than β_1. Therefore, there are some intermediary effects $\frac{\varphi_1\omega_2}{\beta_1}$. Similarly, the relationship between bank risk-taking and monetary policy uncertainty is investigated. As shown in Table 4, the uncertainty of monetary policy is at the significance level of 90% α_1 is significant, and the coefficient is positive. It shows that when the uncertainty of monetary policy increases, the risk of bank bankruptcy increases and the Z value becomes larger. When considering the uncertainty of monetary policy and bank risk-taking at the same time, it can be seen from the results of empirical analysis that, as shown in Table 6, the p value is still significant at the 95% level, α_1 and γ_2 are significant, and γ_1 not less than β_1. So, there are some mediating effects $\frac{\alpha_1\gamma_2}{\beta_1}$.

Through the intermediary effect results, it can be seen that the loan cost and bank risk-taking have some intermediary effects on loan default when the uncertainty of monetary policy increases. Therefore, when considering the impact of monetary policy uncertainty on bank loan default, we need to pay attention to the two default risk transmission channels of enterprise loan cost fluctuation and bank risk-taking. For the enterprise loan cost channel, when the uncertainty of monetary policy rises, we should pay attention to how the uncertainty affects the enterprise loan cost and control the sunk cost. Generally, enterprises have policy lag and lag in cost adjustment. Therefore, we need to focus on the renewal of cost control means to prevent the loan default caused by the rise of loan cost. For the risk-taking

channels of banks, when the uncertainty of monetary policy rises, the adjustment of uncertainty also lags behind. Therefore, it is necessary to prevent the risk of loan default caused by the rise of the overall risk of banks. We should reduce the default risk of credit loans by controlling other risks, such as liquidity risk, management risk and policy risk

3.3. Bank Heterogeneity Test

Table 7. Bank heterogeneity test

npl	Joint stock bank		state-owned bank	
	Fixed effect	**Random effect**	**Fixed effect**	**Random effect**
Lnmpu	0.65236***	0.4986255***	1.4361***	1.048157***
	(3.51)	(2.76)	(7.28)	(4.75)
Deposit loan ratio	-1.201761***	-0.9588634***	1.176877	0.7092313**
	(-6.21)	(-6.96)	(1.92)	(2.02)
Roa	-149.6731***	-128.8045***	-251.73***	-106.6937***
	(-6.26)	(-5.94)	(-4.05)	(-2.69)
Growth rate of total assets	-0.4802444*	-0.4039017	-2.822009**	-1.850375
	(-1.79)	(-1.46)	(-2.65)	(-1.46)
Net profit growth rate	-0.0421021	0.1037302	-0.2921297	-0.648162***
	(-0.38)	(1.13)	(-1.03)	(-3.17)
Sustainable development rate	-1.432817	-2.132364***	0.2957409	-2.891566
	(-1.50)	(-2.60)	(0.12)	(-1.08)
Total asset turnover	19.23747	22.45357**	-19.10937	-5.835748
	(1.62)	(2.46)	(-0.87)	(-0.24)
M0 growth rate	-0.064852***	-0.0594472***	-0.0799793***	-0.0488822***
	(-6.10)	(-5.63)	(-5.01)	(-3.10)
Consumer retail price index growth	-0.0097125	-0.0100577	-0.0390256***	-0.0463385***
	(-1.38)	(-1.40)	(-3.24)	(-4.26)
Constant	1.339463**	1.550186**	-2.791941***	-2.146565**
	(2.12)	(2.41)	(-2.80)	(-2.53)
Observations	100	100	50	50
R²	0.7771	0.8036	0.5831	0.7374

The superscript ***,**,* are significant at the level of 1%, 5% and 10%, respectively. The t-statistic is in brackets.

Through the analysis of 15 listed banks divided into two types of banks with different properties, we can see from the empirical results, as shown in Table 7. The impact of monetary policy uncertainty on the non-performing loan ratio of state-owned banks and joint-stock banks is significantly positive, and the impact coefficient on the non-performing loan ratio of state-owned banks is greater than that of joint-stock banks, indicating that when the uncertainty of monetary policy increases, compared with joint-stock banks, the uncertainty of monetary policy has a greater impact on state-owned banks. As the equity nature of state-owned banks belongs to state-owned holding, the influence of government policies is more direct, comprehensive and profound, so the coefficient is large. At the same time, other control variables, bank deposit loan ratio, ROA level, total asset growth rate, M0 growth rate and consumer price index growth rate are also significant. Comparing the development ability, operation ability and profitability of state-owned banks and joint-stock banks, it is concluded that the coefficients of state-owned banks are greater than joint-stock banks. It shows that the non-performing loan rate of state-owned banks with strong

profitability and development ability is lower than that of joint-stock banks. Therefore, the problem of non-performing loan ratio of joint-stock banks cannot be ignored.

4. Discussion and Conclusions

This paper studies the relationship between monetary policy uncertainty and loan default, and comprehensively analyzes how the two intermediary variables of loan cost and bank risk-taking transfer uncertainty and then affect loan default. Based on the panel data of 15 listed banks in China from 2011 to 2020, three conclusions can be drawn: (1) when other variables are controlled unchanged, monetary policy uncertainty significantly affects bank loan default, and when monetary policy uncertainty increases, loan default will increase. (2) Considering the intermediary effect, we find that there are some intermediary effects in both loan cost and bank risk-taking. Therefore, when the uncertainty of monetary policy increases, we should focus on how the uncertainty will affect loan default through the two transmission channels of loan cost and bank risk. (3) Considering the heterogeneity of banks with different equity properties, we find that the impact of monetary policy uncertainty on the non-performing loan ratio of state-owned banks is greater than that of joint-stock banks.

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Research on the Risk of Default on Farm-Related Loans and the Identification of Default Motives

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Abstract: Based on the data from 2017 Financial Household Survey, this paper presents an empirical analysis of questionnaire data from 5,390 farming households, using logit and probit binary choice models to derive the factors that significantly affect farming households' loan default. The study found that the factors significantly affected farmers' loan default behavior including internet, credit cards, phone type, smart phone, online shopping, father's education, debt, trust and attention to financial information. Other factors including mother's education, parents' political status, farm income, happiness, choice of return, risk of investment project, total household assets, total household income and total household consumption have no significant impact on farmers' loan default. Among these factors, total farm income, trust and family happiness were found to be passive factors and the remaining variables were found to be active factors. Besides, household network infrastructure including internet, credit card, phone type, smart phone and online shopping were found to have a greater impact on loan default based on marginal effects. Through the analysis of factors that affect loan default, we can better propose corresponding measures to deal with the frequent default of farmers, which is conducive to understanding farmers' loan needs and improving the quality of banks' loans.

Keywords: farm loans; default risk; active default; passive default

JEL Classification: D12

1. Introduction

The issue of rural farmers' development has always been the most fundamental challenge for Chinese society, and financial support for rural areas is indispensable for achieving leapfrog development of rural areas and farmers. Due to the innate vulnerability and sensitivity of farm households, their resistance to natural and market risks is very weak. These underlying risks have dealt a huge blow to financial risks in rural areas, already leading to a huge gap between rural areas and urban residents at all times. Therefore, exploring the internal and external constraints faced by farm households in rural areas is crucial to the sustainability of financial development in rural areas.

According to the China Rural Household Finance Development Report (2016) "*the balance of loans to rural households at the end of 2016 was 70,846 billion yuan, accounting for 6.6% of all loans, an increase of 15.2% over the balance of loans at the beginning of the year and an increase of about 20.4% since 2007. In addition, the amount of non-performing loans related to agriculture by*

rural credit cooperatives amounted to RMB 2,161 billion." The agricultural non-performing loan rate of rural credit cooperatives has remained high for years and the frequency of loan defaults by farmers has led financial institutions to become increasingly stringent in rationing loans to farmers, who have been denied access to loans. The production and consumption level of farmers has decreased. Generally speaking, financial institutions judge the occurrence of default by farmers built on two aspects. On the one hand, it is based on farmers' subjective efforts to repay loans. Farmers with different subjective consciousness characteristics choose to default on loans or keep the contract. On the other hand, farmers face various natural and investment risks, and are unable to repay their loans due to numerous risks. Farmers' loan default can be divided into Farmers' active default and farmers' passive default according to various risks faced by different farmers and willingness to repay. Farmers' active default refers to the default of farmers' subjective will. It refers to that farmers are unwilling to repay even if they have the ability to repay. Farmers' passive default refers to farmers' default caused by facing various uncertain risks. The loan transactions between financial institutions and farm-related enterprises or farmers are based on profit maximization for both parties. When financial institutions are unable to fully grasp the household's economic conditions, they generally assume that the farmer will actively default on the loan, concluding that the worst-case scenario is that the farmer will not be able to repay the loan. The farmer will not repay the loan even if he or she has the income funds to do so. The financial lending institution will screen the loan based on this behavior strategy which ignores the fact that the farmer passively defaults. Failure in loan rationing policies can greatly increase the probability of loan default by farmers.

The literature on farm lending can be discussed from three perspectives. The basis for the delineation is based on differences in survey data. The first perspective is based on enterprise loan data from state-owned banks to show the impact of factors such as farm-related enterprise characteristics and loan contracts on loan default. Yin et al. (2014) showed that the relationship between agriculture-related loan contracts, benchmark interest rates and loan default. It concluded that loan amount and loan duration all had significant effects. Others used corporate loan data from state-owned banks to analyse loan default caused by information asymmetry problems between bank lenders and enterprises (Liang & Wen, 2019; Yin & Gan, 2011; Duan, 2020; Li et al., 2013). He et al. (2015) explained the influence of the internal equity structure of rural commercial banks on their operational risk and performance. Allen and Gregory (2002) as well as Thomas et al. (2011) explained the internal operation of relationship-based lending and explored the loan default caused by the principal-agent problem of credit officers.

The second perspective is based on the level of development of rural areas and macroeconomic policies, showing that the level of urbanization is inversely related to loan default. The higher the level of regional economic development, the lower the loan default. It is mainly from theoretical analysis. Empirical studies are scarce. The level of provincial financial competition has a significant impact on credit risk (Zhou, 2017; Lin & Xie, 2017). Wang and Lu (2011) showed that relationship between the level of rural financial development and the urban-rural income gap. Zhang and Du (2017) proved that its impact

on credit risk of farm loans mainly from macroeconomic indicators. Andrew et al. (2017) showed that the impact of firm characteristics, regional sector and macroeconomic variables on credit risk default.

The third perspective is based on the household farming questionnaire, discussing the impact of various factors on loan default, such as the credit limit of farm households, the loan supply of financial institutions, the household demographic characteristics of farm households and the economic status of households. Some scholars showed that the financing situation of Chinese farmers was facing serious credit constraints (Ding & Qin, 2014; Zhu & Li, 2006). Some scholars analyzed the relationship between the size of farmers' credit and loan interest rates, and advocated interest rate marketization and diversification of farmers' income. Besides, some scholars also concluded that financial institutions should strengthen the review of farmers' eligibility before borrowing based on the records of maturing small loans from rural credit cooperatives (Zhang & Jian, 2017; Yao & Wang, 2018; Adeniyi & Olufemi, 1982). Wu and Song (2016), Amare and Bekabil (2008) as well as Chen et al. (2021) showed that most farmers have higher demand for informal institutional borrowing and insufficient demand for effective formal credit. Ron and Oliver (2012) showed that some differences in the size of credit rationing and the degree of loan default among farmers compared to non-farm entrepreneurs. Shoaib (2019) as well as María et al. (2019) studied credit default delete maize cultivation in agricultural production and compared the benefits of non-agricultural income diversification and agricultural credit management risk.

Overall, the first perspective focuses on the information asymmetry among financial lenders, farm-related enterprises and farmers. Financial institutions are unable to detect that farm-related enterprises do have active defaults. However, it ignores the passive default behavior of farmers. The second perspective focuses on indicators including the overall level of regional economic development. The level of financial development in rural areas reduces the likelihood of passive default by farmers and compensates for the natural financial vulnerability of farmers in rural areas. However, this type of indicator ignores the motivation of farmers to actively default. The third perspective focuses on the impact of influencing factors including farmers' personal characteristics, family network infrastructure and economic characteristics of farm households on loan defaults through empirical research from specific farm household loan defaults, but they do not distinguish between the active and passive nature of factors that influence farm household loan defaults.

2. Methodology

2.1. Independent Samples T-test and Hypothesis Testing

Farmers engaged in agricultural activities depend on the weather and are thus subject to extreme weather conditions, while those engaged in non-agricultural activities are also exposed to investment risks due to market competition and policy changes. Farmers therefore adjust their consumption expenditure and loan repayment expectations in line with the various risks they face. As for the distinction between active and passive motivational attributes of farmers' default, Su and Hu (2014) argued that investment risk is a non-controllable factor for farmers and

financial institutions, and that effort is a controllable factor for farmers and non-controllable for financial institutions. They therefore found exposure to investment risk as a passive cause of farm household default and effort as an active factor of farm household default. Among the 17 influencing factors selected, for each influencing factor is divided into active and passive. However, the active and passive nature of each influencing factor is artificially divided, so its basic description of the variable is not objective. Here, we can use the sample data of the difference between farmers influenced by this factor to make default and non-default decision, and use the idea of hypothesis testing, to derive the general the final decision of the farmer under the influence of this factor. If the overall mean of defaulting farmers under the influence of a factor is greater than the overall mean of non-defaulting farmers, we can infer that the factor is an active default factor. This is because under the influence of this factor, farmers can choose to default or not to default, but the sample can verify the overall behavior. Most farmers choose to default under the influence of this factor, so we can objectively consider this factor as the active factor influencing farmers to default. This method of distinguishing between active and passive default factors is more scientific and objective than artificial subjective division. In addition, the remaining variables reflect the passive motivation of farmers to default.

After the SPSS analysis was completed, the study used independent sample t-test to determine the influence of various independent variables on farmers' default behavior, and the results showed that the sample mean of the defaulted farmer variable was greater than the sample mean of the non-defaulted farmer variable including internet, credit card, phone type, smart phone, online shopping, education(mother), education(father), status(mother), status(father), debt, trust, finance information, choice on investment, lnasset, lnincome, lnconsump. while the sample mean of the defaulted farmer for farm income and happiness was not greater than the sample mean of the non-defaulted farmer, so we can make the original assumptions about all variables based on the basic information of the sample data hypotheses and alternative hypotheses, where the hypotheses for all variables except for farm income and happiness. Let denote μ_{1i} represents the overall mean of the independent variable among defaulting farmers and μ_{2i} represents the overall mean of the independent variable among non-defaulting farmers, thus the original hypothesis is:

$$H_0: \mu_{1i} \leq \mu_{2i} \tag{1}$$

and the alternative hypothesis is:

$$H_1: \mu_{1i} > \mu_{2i}(i = 1,2,3,4,5,6,7,8,9,10,12,14,15,16,17,18) \tag{2}$$

As for farm income and happiness, the original and alternative hypotheses are:

$$H_0: \mu_{1i} \geq \mu_{2i} \tag{3}$$

$$H_1: \mu_{1i} < \mu_{2i}(i = 11,13) \tag{4}$$

Based on the Levene's variance equivalence test, the hypothesis test from Table 1 shows that internet, credit card, phone type, online shopping, education(mother), education(father), status(mother), status (father), debt, farm income, finance information, choice on investment, lnasset, lnincome, lnconsump differences are presented at the 0.01 level of significance. Factors including smart phone and happiness are at the 0.05 level of significance; and trust is presented at the 0.05 level of significance. Only the original hypothesis of trust cannot be rejected and the overall mean of trust among defaulting farmers is not greater than the overall

Variable	Number	Mean	Significant Two-Tailed	Significant
internet(x_1)	729	0.8861	0.000	0.000
	4,661	0.6413	0.000	
credit card(x_2)	729	0.5542	0.000	0.000
	4,661	0.2678	0.000	
phone type(x_3)	729	0.9973	0.007	0.000
	4,661	0.9850	0.000	
smartphone(x_4)	729	0.1920	0.017	0.000
	4,661	0.1442	0.028	
online shopping(x_5)	729	0.8162	0.000	0.000
	4,661	0.5372	0.000	
education(mother)(x_6)	729	0.2126	0.000	0.000
	4,661	0.1068	0.000	
education(father)(x_7)	729	0.3278	0.000	0.000
	4,661	0.1927	0.000	
status(mother)(x_8)	729	0.0960	0.000	0.000
	4,661	0.0571	0.001	
status(father)(x_9)	729	0.2565	0.001	0.000
	4,661	0.2038	0.002	
debt(x_{10})	729	12.3539	0.000	0.000
	4,661	3.0965	0.000	
farm income(x_{11})	729	1.0658	0.000	0.000
	4,661	2.4040	0.000	
trust(x_{12})	729	0.0658	0.180	0.008
	4,661	0.0536	0.212	
happiness(x_{13})	729	0.1454	0.040	0.000
	4,661	0.1764	0.030	
finance information(x_{14})	729	0.1385	0.000	0.000
	4,661	0.0931	0.001	
choice on investment(x_{15})	729	0.1742	0.000	0.000
	4,661	0.1212	0.000	
lnasset(x_{16})	729	14.0974	0.000	0.000
	4,661	13.1740	0.000	
lnincome(x_{17})	729	11.2593	0.000	0.703
	4,661	10.8352	0.000	
lnconsump(x_{18})	729	11.3004	0.000	0.007
	4,661	10.5411	0.000	

mean of trust among non-defaulting farmers. Therefore, farm income, trust and happiness are passive default factors and the remaining variables are active factors.

2.2. Logit and Probit Model

We investigate the status of farm-related loan default based on the household finance survey data of Southwest University of Finance and Economics, using binary discrete variables as the dependent variable. In this paper, we use the latest survey data in 2017 and visit farmers' households and local financial institutions to find that farmers are reluctant to mention their household financial default. In order to examine the various influencing factors behind farmers' loan default, we select various variables that can reflect farmers' default behaviour for empirical analysis. In order to study the various influences behind the default behaviour of farmers, we selected various variables that reflect farmers' default behaviour for empirical analysis. Therefore, the following basic least squares regression model (5) is built.

$$y = \beta_0 + \beta_1 internet + \beta_2 credit\ card + \beta_3 phone\ type + \beta_4 smartphone + \beta_5 online\ shopping + \beta_6 edu(mother) + \beta_7 edu(father) + \beta_8 status(mother) + \beta_9 status(father) + \beta_{10} debt + \beta_{11} farm\ income + \beta_{12} trust + \beta_{13} happiness + \beta_{14} finance + \beta_{15} choice + \beta_{16} lnasset + \beta_{17} lnincome + \beta_{18} lnconsump \qquad (5)$$

Before the empirical test of variables, we first predict the coefficient symbol of each variable. Through the previous knowledge and the distinction criteria between the initiative and passivity of factors affecting farmers' loan default determined in Table 1, we can predict the coefficient symbol direction of each variable, and then test the correctness of the symbol direction through the empirical results. Indicators related to the family's network and communication infrastructure include the number of smart phones, online shopping, the Internet and the type of mobile phones, which reflect the openness of family members. At the same time, there are a large amount of financial knowledge and financial opportunities on the Internet, and farmers can make small loans through access to the Internet. Meet the loan needs of farmers in order to better carry out production and consumption, which is conducive to the increase of farmers' family income. Therefore, the coefficient sign is expected to be negative. The education level of the father or mother will affect the family's loan choice. Generally speaking, the higher the education level, the more comprehensive the understanding of loan knowledge. Therefore, the family's income and expenditure will be reasonably distributed, and the loan default will not occur. Therefore, the education level is inversely proportional to the loan default expectation. Generally speaking, the political status of parents is that the political consciousness of Party members and cadres is relatively high, and the probability of loan default is reduced. Farmers' trust in strangers can affect farmers' choice of loan institutions. There are more and more informal loan institutions. Farmers who are easy to trust others are easy to borrow from informal loan institutions for production and consumption. However, informal institutions have high loan interest rate and immature loan operation, which is higher than the loan default rate of formal institutions. Happiness means that farmers will not repay the loan by reducing the current consumption level, which is called the habit effect of consumption. Therefore, the coefficient symbol is expected to be positive. The higher the farmers' attention to financial information, the greater the probability

of investment and financial management. However, various financial information is good or bad, farmers' financial knowledge is weak, and they are easy to be cheated. Therefore, the coefficient symbol is expected to be positive. The coefficient directions of household assets, liabilities, income and other indicators are similar to previous studies and will not be explained.

Table 2. Variable expected symbol

Variable	Coefficient Expected Sign
a default loan	-
internet	negative
credit card	negative
phone type	negative
smart phone	negative
online shopping	negative
education(mother)	negative
education(father)	negative
status(mother)	negative
status(father)	negative
debt	positive
farm income	negative
trust	positive
happiness	positive
finance information	positive
choice on investment	negative
lnasset	negative
lnincome	negative
lnconsump	positive

This paper is based on the questionnaire data of farm households in rural areas, and the dependent variable is the existence of outstanding bank loans of farm households, so the actual data obtained are binary discrete variables, and the general linear probability model cannot explain the binary discrete variables, so here we choose logit and probit models for analysis, in the general linear probability model.

$$y_i = \begin{cases} 1 \ there \ is \ a \ default \ loan \\ 0 \ there \ is \ no \ default \ loan \end{cases} \tag{6}$$

$$E(y_i) = p_i \tag{7}$$

Among them, it is only true when the value of p_i is between (0,1), otherwise there will be a contradiction, so we assume that there is an unobserved latent variable y_i^*, which has a linear relationship with x_i, that is:

$$y_i = \begin{cases} 1, y_i^* > 0 \\ 0, y_i^* \leq 0 \end{cases} \tag{8}$$

$$y_i = 1 - F(-x_i'\beta) + \mu_i \tag{9}$$

The type of F distribution function determines the type of binary selection model. When the distribution function obeys the logical distribution, the corresponding binary selection model is the Logit model. When the distribution function obeys the standard normal distribution, the corresponding binary selection model is a Probit model. In addition, we also considered the marginal effect of x_i and $p(y = 1|x)$.

2.3. Data Source and Variable Selection

The data used in this paper come from the 2017 China Household Finance Survey data set, which contains three data sets, namely the household part, the individual part and the regional part. In this paper, the household and individual datasets are selected and combined, from which areas with rural household registration are selected to analyse the loan default problem of rural households in household finance. The selected indicators relate to individual and household characteristics, household borrowing and debt status, asset status, income status, household expenditure status, financial risk knowledge, and internet infrastructure. As the household and individual data set contained a large number of invalid questionnaires, 5,390 valid questionnaires were obtained after eliminating invalid questionnaires. This paper focus on the descriptive statistics of the 5,390 valid questionnaires. Table 3 shows the specific meaning of each variable, which is from the household financial data set. The data set used in this article contains many variables. The sample statistical description of a single variable is omitted here. It is easy to understand the meaning of the indicators of household network and communication infrastructure, assets, income and consumption, but the following indicators need to be explained here. For example, parents' education level and parents' political outlook are ordered variables. The classification order of education level is: 1 - no school, 2 - primary school, 3 - junior high school, 4 - senior high school, 5 - technical secondary school, 6 - Junior College, 7 - undergraduate, 8 - Master, 9 - doctor. The order of political outlook is: 1 - members of the Communist Youth League, 2 - members of the Communist Party of China, 3 - democratic parties and other parties, and 4 - the masses. Other ordered variables also include the type of mobile phones and the number of smart phones. The classification order of attention to economic and financial information is: 1 - very concerned, 2 - very concerned, 3 - general, 4 - little concerned, 5 - never concerned. The selection and classification order of investment project risk and return is: 1 - high risk and high return projects, 2 - slightly high risk and slightly high return projects, etc. Due to limited space, only the first few items are listed here. Farmers' trust in strangers is measured by investigating farmers' answers to five different questions: "very trust", "comparative trust", "general trust", "distrust" and "very distrust". Similarly, the investment choice of farmers is measured by investigating the income and risk choice of farmers for investment projects from high to low. Farmers' attention to financial information is measured from high to low. The above indicators have an impact on Farmers' loan default.

Table 3. Variable meaning – Part 1

Variable	Variable Meaning
internet	whether to use the internet (Yes=1,No=0)
credit card	whether to use a credit card(Yes=1,No=0)
phone type	phone type 1-smart phone, 2-non smart phone, 3-no mobile phone
smart phone	number of smartphones 0-5, 6-10, 11-15, 16-20
online shopping	whether to shop online (Yes=1,No=0)
education(mother)	mother's education (1-9) 1 - no school, 2 - primary school, 3 - junior high school, 4 - senior high school, 5 - technical secondary school, 6 - Junior College, 7 - undergraduate, 8 - Master, 9 - doctor
education(father)	father's education 1 - no school, 2 - primary school, 3 - junior high school, 4 - senior high school, 5 - technical secondary school, 6 - Junior College, 7 - undergraduate, 8 - Master, 9 - doctor
status(mother)	mother's political outlook 1 - members of the Communist Youth League, 2 - members of the Communist Party of China, 3 - democratic parties and other parties, 4 - the masses
status(father)	father's political outlook 1 - members of the Communist Youth League, 2 - members of the Communist Party of China, 3 - democratic parties and other parties, 4 - the masses
debt	total liability
farm income	total agricultural income
trust	trust in people you don't know 1 - very trust, 2 - relatively trust, 3 - general trust, 4 - not very trust, 5 - very distrust
happiness	Happiness 1 - very happy, 2 - happy, 3 - generally happy, 4 - unhappy, 5 - very unhappy
finance information	attention to financial information 1 - very concerned, 2 - more concerned, 3 - general, 4 - little concerned, 5 - never concerned

Table 3. Variable meaning – Part 2

Variable	Variable Meaning
choice on investment	choice of return and risk of investment project 1 - high risk and high return projects, 2 - slightly high risk and slightly high return projects, 3 - average risk and average return projects, 4 - slightly low risk and slightly low return projects, 5 - unwilling to take any risk, 6 - don't know
lnasset	logarithm of total assets
lnincome	log total income
lnconsump	log total consumption

3. Results

3.1. Logit and Probit Model Estimation Results for Each Variable

Table 4 shows the estimation results of all variables. It has advantages in estimating the influence of binary discrete variables on dependent variables in binary selection model.

Table 4. The binary regression analysis of farmers' default probability – Part 1

A default loan	Dependent variable: (1 = yes, 0 = no)	
	Logit model	Probit model
finance information	0.0828*	0.0403*
	(1.890)	(1.740)
return on investment	-0.0243	-0.0123
	(-0.670)	(-0.640)
credit card	0.444***	0.264***
	(4.310)	(4.780)
internet	0.454***	0.217***
	(2.840)	(2.790)
phone type	-0.440**	-0.196**
	(-2.180)	(-2.080)
smartphone	-0.0938**	-0.0577**
	(-2.160)	(-2.500)
online shopping	0.508***	0.265***
	(3.910)	(4.070)
education(mother)	0.0192	0.0124
	(0.430)	(0.510)
education(father)	0.0977**	0.0539**
	(2.460)	(2.500)
status(mother)	-0.0895	-0.0398
	(-1.120)	(-0.910)

The superscript ***, **, * are significant at the level of 1%, 5% and 10%, respectively. The t-statistic is in brackets.

Table 4. The binary regression analysis of farmers' default probability – Part 2

| A default loan | Dependent variable: (1 = yes, 0 = no) | |
	Logit model	Probit model
status(father)	0.0909	0.0510*
	(1.570)	(1.670)
trust	-0.0986*	-0.0507*
	(-1.840)	(-1.800)
happiness	0.0137	0.00633
	(0.420)	(0.370)
lnincome	0.0215	0.0135
	(0.910)	(1.110)
farm income	-2.02e-06	-1.00e-06
	(-1.450)	(-1.580)
lnasset	-0.00680	0.0123
	(-0.170)	(0.580)
lnconsump	0.0172	0.0186
	(0.230)	(0.470)
debt	2.78e-06***	1.07e-06***
	(15.24)	(17.58)

The superscript ***, **, * are significant at the level of 1%, 5% and 10%, respectively. The t-statistic is in brackets.

3.2. Binary Regression Analysis of Farmers' Default Probabilities

From the logit and probit regression results of the binary regression analysis of farmers' default probability in Table 4, it can be seen that the factors that significantly affect farmers' bank loan default behavior include internet, credit cards, phone type, smart phone, online shopping, father's education, debt, trust and financial information. In contrast, mother's education, parents' political affiliation, farm income, happiness, choice on investment, total household assets, total household income and total household consumption are not significant for farm loan default. The opposite sign of the coefficients is found in the graph for internet, credit cards, online shopping, parents' education, mother's political affiliation, trust, and total household income. Next, we delve into the analysis of the effects of the individual independent variables.

According to personal characteristics, the higher the father's education level, the higher the probability of default, which is contrary to common sense and existing research. According to the statistical data, the education level of fathers in rural areas accounts for the largest proportion of primary school and junior middle school education, and only two of them have master's degree. Therefore, the overall education level in rural areas is very low. The probability of loan default in rural areas is generally higher. This is a relative indicator. The education level of mothers was not significant. Those whose parents are party members usually have greater social influence in rural areas. Therefore, they will reduce the default of loans because of their face and leader status. As for indicators of trust, rural people have conservative ideas and

traditions. They are less likely to trust others outside their family, and therefore less likely to be deceived by people they do not know, and less likely to engage in risky activities. The indicator of farmers' happiness is not significant. It is classified as an active default factor, where it is generally difficult for farmers' happiness to be expressed in household economic decisions, and therefore the factor of farmers' happiness is not significant.

According to household financial characteristics, there is a negative correlation between total household assets and loan default, while there is a positive correlation between total household income and loan default. It is because that the total income of farm households includes total agricultural income, household income from wages and business income, etc. Households with diverse income sources are also more exposed to income fluctuations. Therefore, when the total household income of farmers increases, the loan default behavior will increase. The more total household assets, the more funds can be used to repay the loan, so loan default will decline. The higher the aggregate household consumption, the higher the probability of default. When the total household income remains unchanged, the more the household's existing consumption expenditures are, the less household residual income will be. For the indicator of aggregate farm income, we can learn from the descriptive statistics that in the modernization process, urbanization in rural areas has accelerated. Farm income in farm households is becoming less and less and household business income and wage income are becoming more and more, therefore, the factor of total farm income is not significant.

According to level of household risk knowledge, for financial information concern, the empirical results show that the less concerned farmers are about financial information, the higher the probability of default. For the indicator of investment risk-return choice is not significant, it is because that farmers lack professional investment financial knowledge about investment risk-return choice, and therefore knowledge about risk and return is also deficient. The indicator of whether or not to use credit cards reflects credit evaluation of financial institutions for serving customers. The empirical results show that farmers who use credit cards have a higher probability of default. Farmers who use credit cards for large consumption, the pressure to repay the loan when due is great.

According to network infrastructure characteristics, all four independent variables on network infrastructure are significant, specifically, the regression coefficient of 0.454 for the indicator of whether or not to use the Internet, which indicates that farmers' loan defaults are more influenced by whether or not farmers' households use the internet. This goes against common sense and some existing studies. In this regard, It is because that farmers have easy access to novel investment and financial management methods on the internet, and will increase their household investment and financial projects such as stocks, funds, bonds, etc. However, there are greater risks in online investment and financial projects, so there is a greater probability of default.

3.2. Analysis of Marginal Effects

The marginal effects of the independent variables were further plotted to determine which type of characteristics of the independent variables dominated the effect on the dependent variable in influencing farm loan default. As shown in Figure 1, the marginal

utility of default for the sample of farmers, the marginal effects of the independent variables show that the use of credit cards, online shopping and internet access have the largest marginal effects on the dependent variable, and all three indicators reflect the level of internet infrastructure in rural areas, so the level of digital financial services in rural areas dominates the dependent variable in this empirical analysis. The dominant effect is therefore on the dependent variable in this empirical analysis. This provides ideas on the concentrate on the development of digital financial infrastructure in rural areas in the adoption of supportive policies for rural areas. Here we use x1 to x18 to represent the above variables.
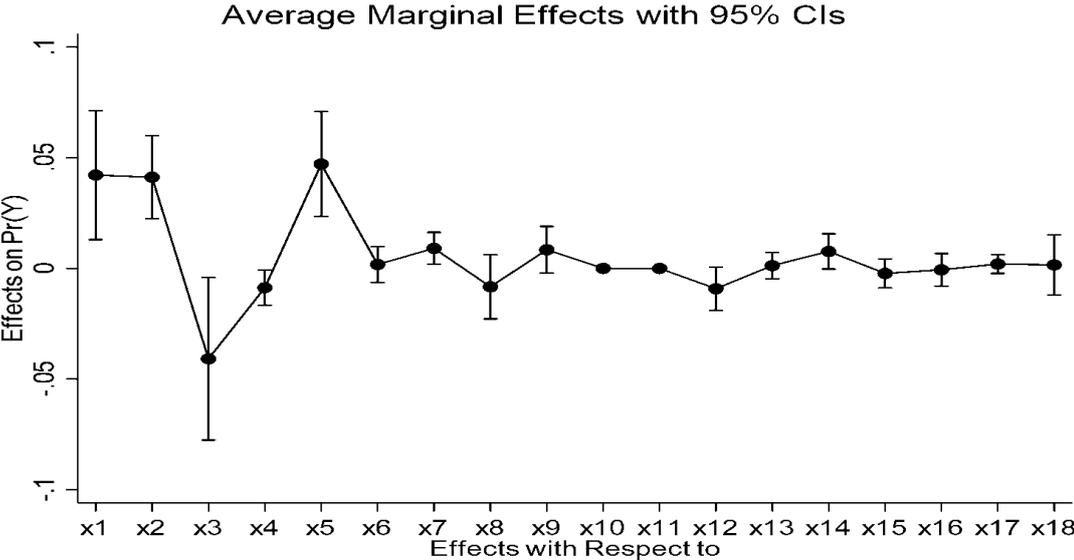
Figure 1. Average marginal effects

4. Discussion and Conclusions

Based on the household financial survey data set released in 2017, this article uses the independent sample t-test method to distinguish the active factors and passive factors affecting farmers' default, and uses logit and probit model to test the significance and marginal effect analysis of all independent variables affecting farmers' loan default. From this, we can draw three conclusions: (1) the impact of active and passive factors on Farmers' default is obviously different. Therefore, it is necessary to divide the active and passive attributes of factors affecting farmers' default, which is conducive to formulating differentiated strategies to reduce farmers' default. (2) In the empirical test of significance, among the personal characteristic factors of farmers, only the variable of father's education is significant, and the other independent variables are not significant. Among the family financial characteristic factors of farmers, only the total household debt is significant, and the other variables are not significant. As for the level of household risk knowledge of farmers, only the attention of financial information is significant. As for the characteristics of home network infrastructure, it is an independent variable, which is significant. (3) The marginal effect results show that in the impact of farmers' loan default behavior, whether farmers use credit card, online shopping and Internet have the greatest marginal impact on the dependent variable and occupy the leading role. For farmers affected by active default, psychological

care can be provided to enhance their sense of well-being and trust. For farmers affected by passive default, policy subsidies, network infrastructure development and risk education in rural areas can be provided. The government should promote the digitization of financial loan services in rural areas. Besides, Promoting the supply side structural reform and information transparency of rural credit cooperatives. The means of asset quality management should be innovated at all times, and online real-time dynamic monitoring should be implemented to reduce the occurrence of breach of contract. Farmers' cognitive ability about risk and the depth of financial knowledge affect farmers' loan default behavior. Therefore, we should promote financial liberalization in rural areas, and update the financial knowledge system and strengthen farmers' understanding of risk expectations. Educational attainment in rural areas is still low. We need to continue to implement compulsory education, especially in rural areas. It is generally accepted that the stronger the farmer's sense of well-being, the greater the level of satisfaction for themselves, the less likely they are to engage in active default. Therefore, while supporting farmers with industrial financing, it is also important to increase the happiness of farmers and the trust between them. This requires the coordination role of village cadres and the implementation of national policies. Financial policies need to be based on ensuring the basic living standards of farmers and constantly enriching the cultural and social life of farmers. It is important to ensure that all aspects of food, clothing, housing and transport are protected.

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Management Methods for Global Virtual Teams - A Review of Current Literature and Directions for Future Research

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Abstract: Global virtual teams, whose members are geographically dispersed across time, space and cultures have become increasingly prevalent as an organizational form in the modern industrial development, especially fueled by the unprecedented COVID pandemic conditions. To understand how to manage this unique organizational form to sustain and excel in the challenging business environment becomes extremely relevant and imperative. This paper conducted a systematic review of published literature on the findings from virtual team research in the past two decades (from 2001 to 2021) in an effort to shed light on the understanding of the management methods for global virtual teams. The review is organized around the variables repeatedly examined and verified by researchers in pursuit of the knowledge, then it classified the literature into different themes according to how to manage those variables on the purpose of understanding the methods to deal with them. Based upon the review, suggestions for further research that can guide future inquiry are proposed.

Keywords: virtual teams; management methods; systematic literature review

JEL Classification: M16; L23

1. Introduction

Globalization has been leading an accelerating path towards connectivity across geographical and time-zone boundaries. Commercial activities of today have no longer clear national hallmarks in all areas spanning from designing, developing, shipping, marketing, and sales. One of the building blocks of the success along the path is virtual team which has prevailed as a preferred form of organization due to its nature of less bond to physical proximity. The emergent need of this form was made prominent under the unprecedented COVID pandemic situation which made it an obligation rather than choice for many organizations (Kniffin et al., 2021). All these make the understanding of global virtual team and ways to optimize its operation imperative to researchers.

Global virtual teams

While existing studies on general teams may account for some of the description for a virtual team, however, there are essential differences that emphasize the need for a definition of its own. Driskell et al. defines virtual team as "a team or group whose members are mediated by time, distance, or technology." (2003, p. 297) A virtual team doesn't need to be a global one

when team members are from the same country, city, or even same building but with no or only limited physical contacts. Examples nowadays can be easily found under the COVID triggered workspace change when people who used to be working in the same office must work from home. Traditionally to collaborate with each other, members need to constantly communicate to exchange information and hinge upon all the work parts to form a whole. This need persists in global virtual teams but posts new challenges such as cultural differences, lack of collaboration history, time-zone differences etc. In addition, virtual setup on the one hand makes it possible to engage bigger variety of contributors holding particular skills, expertise, or information despite distance (Nydegger & Nydegger, 2010), but on the other hands limits the media for communications due to the absence of physical proximity. All of them add up to the complexity of global virtual teams that have drawn a large body of research.

Managing global virtual teams

As referred earlier, global virtual teams bring about significant challenges for companies and organizations. Many known challenges in traditional teams will be magnified in the virtual team context due to the organizational and process complexities. Management method is one of biggest (Malhotra et al., 2007). Existing studies suggest that teams with properly equipped skills in virtual setting is vital for business success. It necessitates a fresh inquiry into the role and nature of management methods in virtual settings (Hoch, 2014). Empirical studies revealed that management failure can cause team attrition, under-performing team members, lack of team spirit and crash of team goals (Malhotra et al., 2007).

One of the main challenges that leaders encounter in managing virtual teams is how to integrate business and information technology systems within organizations to fully leverage the potential of virtual teams. Global virtual team members face added complexity such as managing from distance, integrating members from different cultures, increasing flexibility to meet rapid technological changes, and particular facilitation skills with the help of technical tools. Transformational leadership is hypothesized to be the most suitable for managing virtual teams given the fast-changing environment and limited possibility of close task monitoring for traditional management transactions (Avolio et al., 2000; Bell & Kozlowski, 2002).

Given the goal to better understand management methods for global virtual teams, the research is structured as follows. The first chapter provides an overview of the primary subjects in question to form the conceptual basis for the study. Then I present an overview of the research methodology applied for conducting the systematic literature review, followed by sections that organize the selected literature centered around management methods for global virtual teams. Lastly, I summarize and discuss the findings and propose future studies that can advance our understanding of management methods for global virtual teams.

2. Methods

This study adopts the method for systematic literature review proposed by Kitchenham (2004) which can be summarized in three major steps:

Planning, during which researcher defines the research questions, laying out search strategy and determining the review protocol including inclusion and exclusion criteria.

Conducting, during which researcher applies the review protocol to find and review articles that can potentially answer the pre-defined research questions.

Reporting, during which researcher codes, validates and reports the review results.

The first two steps will be discussed in the current chapter in details, while the reporting step will be undertaken in the next chapter which codes the results by several themes.

2.1. Research Questions

This study aims to understand the examined management methods for virtual teams reported by empirical studies in the field or laboratory settings to address the following questions:

1. What are the main factors that can impact the performance of a global virtual team?
2. What are the management methods for the known factors in order to improve global virtual team performance?
3. What are the factors that are less studied which can be subjects for future research?

2.2. Literature Search Process

Multiple term-based searches were conducted based on the research questions to identify and in the attempt to exhaust potentially relevant publications. Google Scholar was used as the sole basis to look for articles that are relevant to selected terms since this search engine uses meta-search algorithm that returns results from all major scientific publication repositories. The first 10 pages of the research result were scanned to identify targeted articles. In addition, relevant keywords, citations, and bibliography in the collected articles were used to generate additional results. In the meanwhile, authors that have been prolific in writing about concerned subjects are further searched for collecting more articles. This results in 'snowballing' effect (Budgen et al., 2011) that can lead to the saturation of publications.

2.3. Inclusion and Exclusion Criteria

The following inclusion and exclusion criteria are applied to all the retrieved studies for selecting relevant primary studies to answer the research questions:

- Only publications between 2001 and 2021 are included.
- Only empirical studies that use methods such as case studies, surveys, experiments, and ethnographical studies are included.
- Studies which do not have implications that are relevant to management methods are excluded.
- Extended papers that are about the same topic but published in different journals are excluded.

Based on the inclusion and exclusion criteria as describe, 17 articles were excluded from the search results, leaving 39 articles for data synthesis and analysis.

2.4. Data Synthesis and Analysis

In order to answer the research questions, relevant content with sufficient details is extracted from the included search results including Author, Year, Title, Research Method, Independent and Dependent Variables, Finding, and Theory.

From the extraction, data is classified into several themes based on which the papers are matched accordingly.

Table 1. Previous research organized by themes

Themes	Publication
Temporal distance	Montoya-Weiss et al., 2001; Sarker & Sahay, 2002; Espinosa & Carmel, 2003; Holmstrom et al., 2006; Espinosa & Pickering, 2006; Lee & Sankey, 2007; Munkvold & Zigurs, 2007; Cummings et al., 2009
Spatial separation	Herbsleb et al., 2001; Sarker & Sahay, 2002; Gibson & Gibbs, 2006; Holmstrom et al., 2006; Espinosa et al., 2007; Nguyen et al., 2008; Cummings et al., 2009; Espinosa et al., 2014; Herbsleb, 2016
Communication technology	Lurey & Raisinghani, 2001; Kirkman et al., 2004; Gibson & Gibbs, 2006; Munkvold & Zigurs, 2007; Shachaf, 2008; Cummings et al., 2009; Pinjani & Palvia, 2013; Dossick et al., 2015; Brown et al., 2016; Zhu & Smith, 2019
Coordination and conflict management	Maznevski & Chudoba, 2000; Herbsleb et al., 2001; Lurey & Raisinghani, 2001; Montoya-Weiss et al., 2001; Ramesh & Dennis, 2002; Sarker & Sahay, 2002; Yates et al., 2003; Espinosa & Pickering, 2006; Espinosa et al., 2007; Herbsleb, 2016; Sánchez et al., 2018; Nordbäck & Espinosa, 2019
Trust	Jarvenpaa et al., 2004; Kotlarski & Oshri, 2005; Oertig & Buergi, 2006; Munkvold & Zigurs, 2007; Altschuller & Benbunan-Fich, 2010; Peñarroja et al., 2015; Lippert & Dulewicz, 2018; Davidavičienė et al., 2020
Cultural differences	Gibson & Gibbs, 2006; Holmstrom et al., 2006; Oertig & Buergi, 2006; Lee & Sankey, 2007; Munkvold & Zigurs, 2007; Shachaf, 2008; Lippert & Dulewicz, 2018; Davidavičienė et al., 2020; Kiely et al., 2021
Task (process, content, and distribution)	Munkvold & Zigurs, 2007; Sarker & Sarker, 2009; Bhat et al., 2017
Knowledge sharing	Hinds & Mortensen, 2005; Kotlarsky & Oshri, 2005; Espinosa et al., 2007; Draghici & Draghici, 2008; Xue et al., 2012; Pinjani & Palvia, 2013; Bhat et al., 2017

3. Results

3.1. Managing Temporal Distance

In terms of temporal distance or time difference as a key variable for determining the global virtual team performance, articles selected in the review spanned across 9 years. Temporal distance entails the form of asynchronous communication which greatly differs from the traditional synchronous communication wherein verbal and nonverbal can help regulate the flow of conversation. Lacking temporal coordination mechanism to clarify doubts and resolve misunderstandings can lead to severe conflicts. Montoya-Weiss et al. (2001) broke down the conflict management behaviors into 5 dimensions: Avoidance, Accommodation,

Competition, Collaboration and Compromise. They argued that temporal coordination mechanism could significantly weaken the negative effect of Avoidance and Compromise behaviors on virtual performance while having no moderation effect upon Accommodation, Competition and Collaboration (Montoya-Weiss et al., 2001). More of the negative effects of temporal distance was studied by Espinosa and Carmel (2003). They empirically found that time separation could affect planning of team interactions especially from the fact that timing mattered in time-separated contexts but not in only distance separation. Temporal boundaries are more difficult to cross with communication technologies than spatial boundaries (Cummings et al., 2009). Espinosa and Carmel (2003) proposed a mathematical model to calculate the vulnerability costs based on the degree of time separation which contributed to the quantification of the impact of temporal distance. From the aspect of managing the impact of temporal distance, Saker and Sahay (2002) argued that reducing friction of temporal distance required special attention to technical and social components, meanwhile, systematically developing a shared frame of reference and sense of mutuality could help deal with the communication complications. Holmstrom et al. (2006) revealed the same conclusion that temporal distance could be mitigated by deliberate planning of time overlaps, such as making time zone differences manageable by dividing work among a limited number of sites. Given all these challenges, can we state that virtual teams will be less efficient? Kelly and Sankey (2007) gave negative answer in their study and empirically showed that time, budget, and value delivery was evidently successful through virtual teams if effective coordination mechanism was in place. And such mechanism was summarized by Munkvold and Zigurs that "Swift-starting virtual teams need to structure their interaction from the onset, including introducing team members' background and discussing project goals and deliverables, defining roles and responsibilities, and setting milestones." (2007, p. 298)

3.2. Managing Spatial Separation

Spatial separation is the defining characteristic of virtual teams. Herbsleb et al. (2001) found that compared to same-site work, cross-site work took much longer, and required more people for work of equal size and complexity. They also revealed that delay in cross-site work and degree to which remote colleagues were perceived to help out when workloads were heavy were strongly related. Sarker and Sahay (2002) argued that reducing the friction of locational distance required attention to technical and social components in the form of a systematically developed framework of reference and sense of mutuality. In another empirical research (Gibson & Gibbs, 2006), creating a psychologically safe communication climate was shown effective in mitigating negative impact of spatial separation. Such climate as an organizational culture factor can be achieved by several means. Holmstrom et al. (2006) showed in their field case study that occasional face-to-face meetings for virtual teams could greatly contribute to it. Apart from it, Espinosa and colleagues (2007) in their in-depth interview-based field study noted that shared team knowledge in comparison to shared task knowledge could significantly alleviate the negative impact of geographic distance to coordination. Several studies (Nguyen et al., 2008; Herbsleb, 2016; Majchrzak et al., 2009)

have led us to believe that computer-mediated technology for synchronous and asynchronous communication plays a key role in achieving so.

3.3. Managing Communication Technology

The nature of virtual team determines that face-to-face communication is rare or even impossible which leads to the inevitable probing for alternative communication media and opens the gate of multitude of research on communication technology. Lurey and Raisinghani (2001) and Gibson and Gibbs's (2006) study showed similar stress on such internal group dynamics. Given all the computer-mediated communication media including e-mails, instant messaging applications, teleconferencing combined with audio and video e-meetings etc. (Shachaf, 2008), researchers still recommend occasional face-to-face meetings (Kirkman et al., 2004; Munkvold & Zigurs, 2007) when feasible as an effective means to compensate the negative side of virtuality. Pinjani and Palvia (2013) stressed the importance of the collaborative character of chosen technology, urging managers to select technology that promotes transparency and instant interactions. And Dossick et al. (2015) dissected and proved that the Messy talk communication style could satisfy the collaborative needs in virtual environment due to its flexible, informal and active characteristics. Furthermore, Brown et al. (2016) added into the technology profile the enablement of perceived identity communication which facilitates sense of continuity, coherence and mutual understanding. In 2019, Zhu and Smith (2019) examined the polychronic values with its moderating effect between communication technology and job satisfaction which further complete the epitome of ideal technology support for virtual teams.

3.4. Managing Coordination and Conflicts and Building Trust

The same as for traditional face-to-face teams, virtual teams won't be exempted from conflicts within team members, therefore it's important to understand how to coordinate the work in order to reduce clashes and build trust. Herbsleb et al. (2001) revealed that virtual teamwork took much longer time and requires more people for work of equal size and complexity compared with face-to-face work. And number of people involved in multi-site work remains a powerful predictor of delay (Herbsleb, 2016). This intertwined effect of size and complexity renders the difficulty of coordination and building trust. It was stronger in the early phase which effected one's trust in perception of team cohesiveness and later moderated relationships between communication and perceptual outcomes (Jarvenpaa et al., 2004). Altschuller and Benbunan-Fich (2010) argued that trust also mediated relation between virtual copresence and performance. In response to the challenge for establishing trust, Jarvenpaa et al. (2014) in their study promoted behaviors that conveyed enthusiasm, individual initiative, predictable communication patterns, substantive and timely response, and task-oriented leadership style to facilitate trust. Those promoted behaviors resonate with studies and suggestions from other researchers (Lurey & Raisinghani, 2001; Ramesh & Dennis, 2002) on strengthening social ties and relations while forming object-oriented team to avoid interpersonal clashes. Kotlarsky and Oshri (2005) stressed that human-related issues such as social ties and knowledge sharing were key to successful virtual teams especially

through rapport and transactive memory. Especially to swift-starting virtual teams, Munkvold and Zigurs (2007) recommended that the team needed to structure interaction from beginning, including introducing team members' background and competence, discussing project goals and deliverables, defining roles and responsibilities and setting milestones. Sánchez et al. (2018) suggested from their empirical study that team cross feedback was an effective intervention that guided members to reflect and learn, hence forming a stronger bond that fosters better cooperation. When it comes to intervention by leadership, Nordbäck and Espinosa (2019) suggested shared leadership through implicit and behavioral interventions to improve team effectiveness. And when intervention of feedback happens in a high climate of trust environment, team information process will be enhanced thus better learnings and cooperation effectiveness (Peñarroja et al., 2015).

3.5. Managing Cultural Differences

As a complex construct, culture has been studied broadly on many levels: international, national, regional, business, and organizational (Shachaf, 2008). But in the context of global virtual teams, what stands out from those levels as the most prominent is heterogeneity of national cultures of team members. Gibson and Gibbs (2006) concluded from their study that creating a psychologically safe communication climate served a powerful means to mitigate possible national cultural clashes. Another line of thoughts was examined by Holmstrom et al. (2006) that they postulated socio-cultural distance could be mitigated by formal and informal information sharing between participants. This conclusion was supported by Oertig and Buergi (2006) with additional emphasis that investment in language and intercultural training were also important for virtual team performance. Lee and Sankey (2007) revealed from their field interviews that there were doubts in real virtual teams whether ability of training could change inherent cultural style, however, the effect of simply being sensitive and build the cultural awareness were fundamental for successful virtual teams. An in-depth study by Lippert and Dulewicz (2018) showed that cultural differences in virtual teams would be dampened by the high-context and low-context communication styles which rendered different climate in teams such as directness and precision of information. This urges virtual team partitioners to adopt versatile methods in response to the high and low context members. Davidavičienė et al. (2020) took communication technology selection in the context of cultural differences and suggested media richness to adapt for different cultures, such as using content anonymity for collectivistic cultures. Kiely et al. (2021) postulated in their studies which were empirically verified that cultural differences negatively impact effectiveness of plans, formal and information mutual adjustments. This provides meaningful implications for better adaptation for team processes and tasks.

3.6. Managing Task and Knowledge Sharing

Among all the reviewed literature, two minor themes emerged in a few of the articles which are worth attention: task and knowledge sharing. The extent to which they have been studied seems to be much less than the other variables. Doubtlessly any type of focus will still

entail conflicts, but there are solutions provided. Hinds and Mortensen (2005) argued that shared context could moderate effect of distribution on task conflict while spontaneous communication would mitigate the distribution effect of both interpersonal and task conflicts.

When it comes to knowledge sharing, Espinosa et al. (2007) stated that virtual team members coordinated through team knowledge. Having shared team knowledge could fulfill the three distinct types of coordination needs – technical, temporal, and process and mitigated negative effect on coordination. Draghici and Draghici (2008) concluded similarly through their case study that knowledge sharing culture was crucial for virtual organizations. They went on to define phases for creating such culture: planning, organizing, leading and controlling. In specific, organization needs to generate knowledge through planning, to structure it through organizing, to encourage collaborative work through leading and to identify the increase in individual and organizational knowledge through controlling. In a study conducted by Bhat et al. (2017), empirical method was used to confirm the positive relation between team member task dependability, information sharing and virtual team effectiveness.

4. Discussion

The objective of this study is to understand how to manage global virtual teams. For the first two question it posted: what are the main factors that can impact the performance of a global virtual team? And what are the management methods for the known factors in order to improve global virtual team performance? They were answered through themes identified from the reviewed literature in Results chapter. One interesting finding is that several researches chose Adaptive structuration theory (DeSanctis & Poole, 1994) as basis for its adequate portrayal of the process by which technologies are adapted via structures, appropriations, and decision outcomes (Sarker & Sahay, 2002; Brown et al., 2016). Another prevalently used theory in the study of virtual teams is Media Richness theory (Daft & Lengel, 1986). The theory postulates that matching media characteristics with tasks can improve the information richness therefore is popularly cited in the context of coordination for time separation, spatial distance, and technology mediation (Ramesh & Dennis, 2002; Espinosa & Carmel, 2003; Shachaf, 2008). From the reviewed articles, many useful counteractions in the face of virtual team challenges were derived as described in the previous chapter. They offer valuable guidance to organizations especially under the acute COVID-19 circumstances.

The literature to date has successfully captured many variables that are related to virtual teams when each was examined extensively through empirical studies. Time distance, spatial separation and communication technology are the mostly discussed while cultural differences, task content and knowledge sharing seemed to still have vacancy to be filled (Cumming et al., 2009; Gibson & Gibbs, 2006). This provides answer to the third research question that future research is encouraged to explore more in these variables, furthermore, to design empirical methods that can incorporate more of the variables into the study model in order to provide a systematic view on global virtual teams.

5. Conclusion

This paper reviewed the literature on management methods for global virtual teams. When analyzing the literature, it is apparent that the research questions have been addressed by different researchers, setups, and aspects. The original aim of this article has been fulfilled, that is, to verify how much we know about managing virtual teams. The study is rigorously structured which first specify the concepts, then present a comprehensive list of issues that have been examined by research to date. The literature reviewed was categorized and synthesized into themes so as to provide easy reference and analysis of previous findings. Using themed methods illustrates well which variables play critical roles in managing virtual teams. These seven themes, which have good saturation of the subject in question are comprehensive. But through the systematic review and comparison, we could suggest gaps which are suitable for further exploration. I believe addressing these gaps has the potential to fill the void in our understanding of managing global virtual teams and spur both research and practice. It brings new opportunities to understand global virtual teams and the way to manage them better.

To summarize, global virtual team emerge as a new form of organization that offers unprecedented levels of flexibility and responsiveness which can potentially revolutionize our workplace. However, not being able to manage it properly to benefit from such advantages can cause more harm. Although this paper has made effort to systematically understand what we have known about it, extensive research is needed further to better the management of this unique form.

Conflict of interest: none

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A Study on Carbon Emission Peak Forecast of China's Industrial Sector and Carbon-intensive Industries

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Abstract: The industrial sector is China's pillar industry and a major carbon dioxide emitter. Predicting the time and peak value of China's industrial sector carbon emissions under different scenarios has important reference value for China's 2030 carbon emissions peak target. This article is based on the STIRPAT model, using industry-level energy consumption and economic development data from 2000 to 2018, to analyze the overall performance of China's industrial sector and four carbon-intensive industries under five scenarios: low carbon, baseline, high energy consumption, scale adjustment, and technical energy conservation. The peak time and peak value were predicted. The study found that under the baseline scenario, neither the industrial sector nor the various carbon-intensive industries can achieve a carbon emission peak in 2030. However, under the low-carbon scenario, the industrial sector and all carbon-intensive industries can achieve a carbon emission peak in 2030. At the same time, compared with the baseline scenario, the scale adjustment and technical energy conservation scenarios can also advance the carbon emission peak time of the industrial sector. In order to fulfill the carbon emission peak commitment on time, the government should formulate appropriate emission reduction policies based on the specific conditions of each industry to ensure high-quality economic development.

Keywords: industry; carbon emission peak; STIRPAT; scenario analysis

JEL Classification: C51; O14; Q56

1. Introduction

The latest report issued by the United Nations Intergovernmental Panel on Climate Change (IPCC) shows that even in the best case of substantial emission reductions, the global temperature increase may temporarily reach 1.5℃ within 20 years. Scientists say that if carbon emissions are not "immediately, rapidly and massively reduced", the goal of controlling global temperature rise to 1.5℃ or even 2℃ higher than pre-industrial levels by 2100 will be "unachievable." In order to cope with the increasingly severe climate problem, countries around the world have successively proposed the goal of achieving "net zero emissions" by the middle of this century. As the world's largest carbon emitter, China is actively making its own contribution to combating global climate change. On September 22, 2020, China's President Xi Jinping announced at the General Debate of the Seventy-fifth United Nations General Assembly: "*China will increase its nationally determined contributions, adopt more powerful policies and measures, and commit to reaching the carbon emission peak by 2030.*

Meanwhile, China will strive to achieve carbon neutrality by 2060." Although China's "dual carbon goal" commitment has received widespread attention and appreciation from the international community, at the same time, the carbon emission peak goal will also impose strict standards for China's energy conservation and emission reduction. In order to reach the goal of carbon emission peak and carbon neutrality on schedule, the government urgently needs to introduce various emission reduction policies. However, the construction of the government policy system needs to be based on science. The achievement of the peak goal not only depends on the application and promotion of various emission reduction technologies, but more importantly, the establishment of scientific and reasonable guidance plans for emission reduction paths (Shi et al., 2021). The industrial sector has been playing the dominant role in China's carbon emission, the annual carbon emissions of the industrial sector account for more than 70% of the country's total carbon emission (Yuan et al., 2020). Whether the industrial sector can achieve carbon emission peak is significance to the realization of China's overall carbon emission peak. Therefore, it is important to explore the peak time and peak value of China's industrial sector by setting different peak scenarios. This will not only help various industries to formulate countermeasures in advance, but also improve the governance capacity of the government to promote the high-quality development of China's economy (Li et al., 2021).

At present, scholars mainly use environmental Kuznets curve, IPAC model, STIRPAT model, grey measurement method when predicting the peak of carbon emissions. Zhu Yongbin et al. (2009) improved on the Moon-Sonn endogenous economic growth model and substituted the energy intensity under technological progress obtained from the input-output analysis into the model. They believed that at the current rate of technological progress, China will reach the peak of energy consumption and carbon emission in 2043 and 2040, respectively; Ma et al. (2016) based on the energy system optimization model, and set up scenarios according to the target of 2030 carbon emission peak, and researched that China will achieve the peak of carbon emission in 2030; Jiang et al. (2009) used the IPAC model to analyze China's future energy and greenhouse gas emission scenarios, and the results showed that under the baseline scenario, China's carbon emission from burning fossil energy will reach its peak in 2040; Qu et al. (2010) used the STIRPAT model to predict the peak of China's carbon emission in the future. It is believed that if China keeps its carbon emission intensity declining while economic and social development, the peak time for carbon emissions should be between 2020 and 2045; Lin et al. (2011) used the GM (1,1) gray forecast model to predict the trend and peak time of carbon emission in Taiwan, China. Regarding the research scale of carbon emission peak, scholars generally conduct research from the level of countries, regions, and industries. At the national level, through model prediction and scenario analysis, Lin (2015) believe that China will achieve a carbon emission peak before 2030, while Li and Liu et al. (2018) analyzed a variety of scenarios and believed that China's goal of carbon peaking by 2030 is very challenging; At the regional level, Pan et al. (2021) set up different scenarios for 11 provinces in eastern China. The study found that the overall carbon emissions in the eastern region can reach a peak around 2030; Deng et al. (2016) used the STIRPAT model to forecast carbon emission peak of the five northwestern provinces. It

is believed that if the carbon emission intensity is maintained at a reasonable decline, the five northwestern provinces will be able to reach the peak before 2030; At the industry level, Yuan et al. (2020) have predicted the peak carbon emissions of China's industrial sector and eight major sub-sectors. Under the low-carbon scenario, each industry can reach its peak before 2030; Wang et al. (2017) conducted scenario predictions on 9 major sub-sectors of China's industrial sector and the peak scenarios are quite different.

In summary, scholars started from different levels and used various forecasting models to get a lot of prediction results on the peak and time of China's carbon emissions. However, in the industry-level prediction, the peaking scenarios set in the existing literature are relatively simple and general, failing to accurately identify the emission reduction effects of influencing factors such as scale and technology. Moreover, previous studies have not studied the peaking of emission in carbon-intensive industries. Therefore, on the one hand, this article has effectively identified the effects of scale and technical factors on China's industrial sector by refining the low, medium, and high scenario settings at the industry level in previous studies; on the other hand, this article has filled the gap in the research on the peak of carbon in China's carbon-intensive industries.

2. Methodology

2.1. Model Buliding

IPAT model was first proposed by Ehrlich and Holden in 1971, which is widely used to test the impact of human activities on the environment. The basic expression is:

$$I = P \times A \times T \tag{1}$$

where, I represents environmental pressure, which is generally expressed in terms of resource and energy consumption or greenhouse gas emission. P is population size; A is the degree of affluence, represented by the level of economic development; T stands for technical level. However, this equation is only a simplified form of measuring environmental pressure, which has some limitations. It assumes that different factors have the same contribution to environmental pressure, which is inconsistent with the hypothesis of environmental Kuznets curve. In order to overcome the limitations of this model, Dietz and Rosa (1997) proposed STIRPAT model based on IPAT model, whose expression is:

$$I = aP^b A^c T^d e \tag{2}$$

In order to facilitate empirical research, logarithms of both sides of the model are generally taken to obtain:

$$lnI = lna + blnP + clnA + dlnT + e \tag{3}$$

where, I represents environmental pressure, P represents population size, A represents affluence, and T represents technology level. a is the model coefficient, b, c and d are the elastic coefficients of P, A and T respectively, and e is the error term.

In addition to population size, economic development level and technological level, environmental pressure is also influenced by many social factors. In view of this, many

scholars have extended STIRPAT model by adding factors such as urbanization rate, industrial structure, energy structure and energy intensity into the model. Therefore, referring to previous studies, this paper selected total industrial output value, year-end population, industrial energy consumption structure and industrial energy intensity, to predict the peak carbon emissions of China's industrial sector. When forecasting the carbon emission peak of different industries, four variables were selected: total industry output value, total population at the end of the year, industry energy consumption structure, and industry energy intensity. At the same time, in order to verify the nonlinear relationship between carbon dioxide emissions and economic growth, The quadratic term of GDP per capita is added to the model, and the final STIRPAT model expression is:

$$lnI_i = lna + blnIGDP_i + clnPOP + d(lnperGDP)^2 + flnES_i + glnEI_i + lne \qquad (4)$$

where, I_i represents the carbon emission of i industry, $IGDP_i$ is the total industrial output value of i industry, POP is the total national population at the end of the year, $perGDP_i$ is the per capita GDP , ES_i is the energy consumption structure of i industry, EI_i is the energy intensity of i industry, a is the model coefficient, b, c, d, f and g are the elastic coefficients of each variable, and e is the random error term.

2.2. Scenario Settings

In order to study the carbon emission path of China's industrial sector, this article uses scenario analysis to predict the future carbon emissions of China's industrial sector.

Baseline scenario: In the baseline scenario, the rate of change of each influencing factor is set at the median level, and the specific setting of the rate of change of each influencing factor refers to the development goals set in the "14th Five-Year Plan". For example, since policymakers have shifted from simply pursuing economic growth to pursuing high-quality economic development, the annual economic growth rate is set to float around 5%. In terms of population, China has begun to implement the three-child policy, and it is expected that the population growth rate will increase.

Low carbon scenario: In the low-carbon scenario, the rate of change of each influencing factor is set at a low level.   Under this scenario, the government implements a relatively strict low-carbon development policy, it will reduce energy intensity and at the same time increase the proportion of clean energy in energy consumption, so energy intensity and energy structure are both set to low values, and lower energy intensity will influence economic growth to a certain extent, so per capita GDP is also set to low value.

High energy consumption scenario: In the high energy consumption scenario, the change rate of each influencing factor is set at a high value level. Due to the huge impact of the epidemic in 2020, in order to stimulate economic development, the government may adopt a more extensive economic development model and relax restrictions on the development of the energy and resources industry.

Scale adjustment scenario: Under the scale adjustment scenario, the population size and the total output value of the industry are set at the low level, and other factors are kept at the median level. In this scenario, although the government has implemented the three-child

policy, the population size is at a low value due to the increase in living costs, which has not stimulated residents' willingness to have children.

Technical energy conservation scenario: In the technology improvement scenario, the energy intensity and energy structure are set at a low level, and other influencing factors are kept at a medium level. In this scenario，the government actively supports the development and utilization of technologies related to renewable energy, therefore, energy intensity and energy structure are at low value.

Table 1. Scenario setup for China's industrial sector

Scenarios	Variation trend				
	POP	IGDP	PerGDP	EI	ES
BAU	Medium	Medium	Medium	Medium	Medium
Low-carbon (S1)	Low	Low	Low	Low	Low
high energy consumption (S2)	High	High	High	High	High
Scale adjustment (S3)	Low	Low	Medium	Medium	Medium
Technical energy conservation (S4)	Medium	Medium	Medium	Low	Low

2.3. Data Sources

In this paper, the data of China's industrial sector from 2000 to 2018 are taken as samples. The total industrial output value, population size, per capita GDP and other data come from China Statistical Yearbook. The energy consumption data were derived from the China Energy Statistical Yearbook, and were used to measure industry-level CO2 emissions from 2000 to 2018.

In order to calculate the carbon emissions of China's industrial sectors, this paper divides the carbon emissions generated by energy consumption into two parts, one is the direct carbon emissions generated by the combustion of coal, coke, crude oil, gasoline, kerosene, diesel, fuel oil and natural gas, and the other is the indirect carbon emissions generated by electricity consumption. According to the calculation method in IPCC Guidelines for National Greenhouse Gas Inventory 2006, the carbon emission coefficient of various energy sources is used to calculate the carbon emission generated by energy consumption in China's industrial sector. The specific calculation formula is as follows:

$$C_i = 44/12 \times \sum_{i=1}^{8} \sum_{j=1}^{8} E_{ij} \times F_j \times W_j \tag{5}$$

where, C_i is the carbon emission of i industry; 44/12 represents the mass fraction of carbon element in CO2; E_{ij} is the consumption of the j energy in i industry; F_j is the standard coal coefficient of j energy; W_j is the carbon emission coefficient of the j energy.

3. Results

3.1. Results of STIRPAT Model

Taking into account the multicollinearity existing between the various influencing factors in the STIRPAT model, this paper uses ridge regression to fit the model. Ridge regression improves the algorithm based on the least squares method. The factor K is added

to eliminate the collinearity between the factors, thereby effectively improving the stability of the estimation. Using SPSS26 to regress the above model, the K value and model related parameters of the industry as a whole and each industry are obtained. As shown in Table 2.

Table 2. Results of ridge regression and STIRPAT analyses for China's industry

Sectors	K	POP	IGDP	PerGDP	EI	ES	a	R^2
Industry	0.01	6.2294	0.3029	0.0309	0.0950	3.0052	-25.1983	0.99
Oil industry	0.2	4.5386	0.1403	0.1004	0.0846	0.5236	-10.8524	0.98
Chemical industry	0.1	2.9940	0.1132	0.0694	0.0701	1.3725	-11.3868	0.98
Steel industry	0	7.3246	0.4630	-1.1161	0.0395	0.3498	-18.2842	0.99
Power industry	0.1	3.3840	0.1212	0.0732	0.1099	7.3360	-38.9658	0.99

Through regression, it is found that population has the greatest impact on the carbon emissions of China's industrial sectors, and the impacts of the industry sector's total output value and per capita GDP are also in line with expectations; in different industries, the impact of energy intensity on carbon emissions is not the same. It may be related to the characteristics of various industries; the impact of energy structure on carbon emissions is in line with expectations, that is, a reduction in the proportion of coal in fossil energy consumption can significantly reduce carbon emissions.

3.2. Results of China's Industrial Sector Carbon Emission Forecasts

Based on the ridge regression equation of the China's industrial sector and different industries, combined with the previous five scenarios (baseline scenario, low-carbon scenario, high energy consumption scenario, scale adjustment scenario and technical energy conservation scenario), the carbon emissions of China's industrial sector from 2020 to 2040 is predicted, and the specific results are described. See Figure 1 and Figure 2.
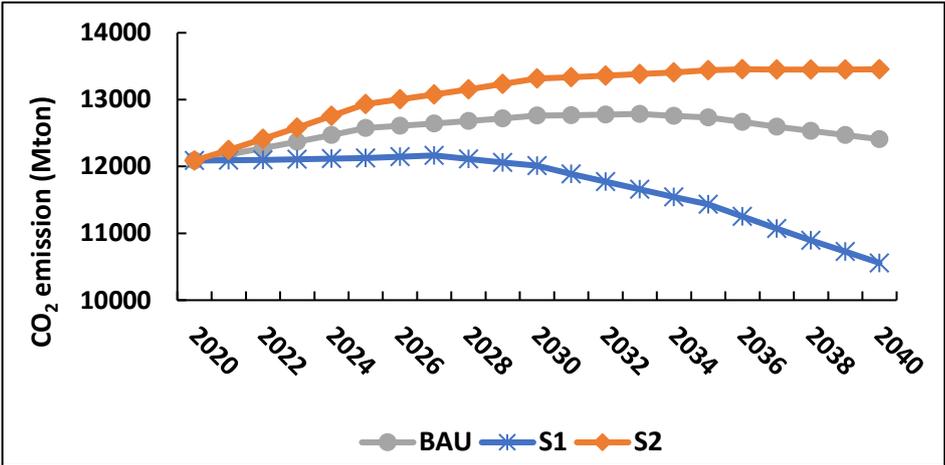
Figure 1. The carbon emission trend of China's industrial sector in BAU-S1-S2 scenarios

It can be seen from Figure 1 that the gap between the peak value and the peak year of China's industrial sector's overall carbon emissions is relatively obvious under different emission reduction efforts. Among them, in the baseline scenario, the overall carbon emission peak of China's industrial sector is 12.786 billion tons, which will reach the peak in 2033, and the carbon emission peak time will be later than 2030; in the low-carbon scenario, the carbon

emission peak will be 12.166 billion tons in 2027, the carbon emission peak time is slightly earlier than 2030, and the set goal of carbon emission peak can be achieved; and under the high energy consumption scenario, the carbon emission peak will not be achieved before 2040. This result shows that under the current established emission reduction efforts, it is difficult for China's industrial sector to achieve carbon emission peak on time. Only by strengthening emission reduction efforts can carbon emission peak be achieved before 2030.
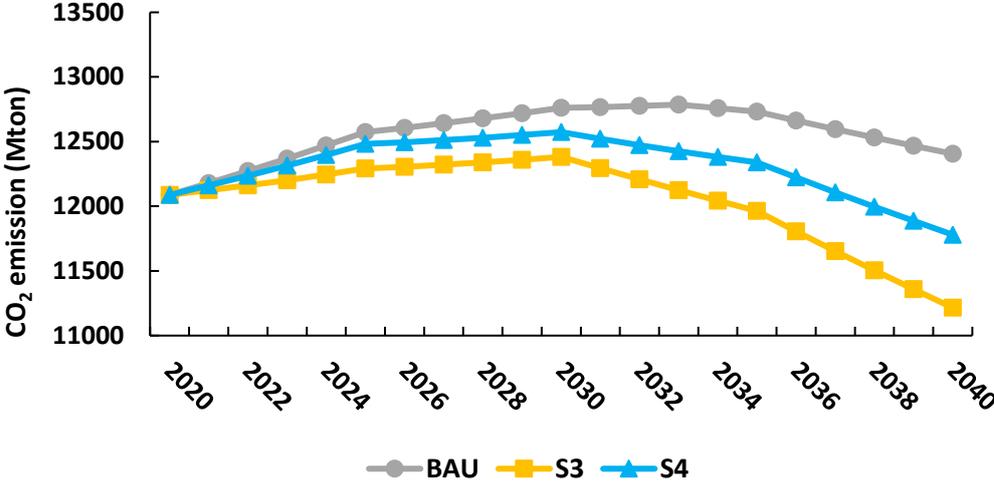
Figure 2. The carbon emission trend of industrial sector in BAU-S3-S4 scenarios

According to the analysis of the previous content, we found that the goal of carbon emission peak in 2030 can only be achieved by strengthening the reduction of emissions. Therefore, in this section, we adjust the scale and the influence of technical factors according to the baseline scenario. It can be seen from Figure 2 that both in the scale adjustment scenario or in the technical energy conservation scenario, the carbon emission peak can be effectively reduced and the goal of reaching the carbon emission peak in 2030 can be achieved. However, the difference between the two scenarios lies in the amount of emission reductions value. In the scale adjustment scenario, the peak value of carbon emission is 12.382 billion tons, and in the technical energy conservation scenario, the peak value of carbon emission is 12.573 billion tons. Compared with technical energy conservation scenario, scale adjustment can achieve more carbon emission reduction. The reason for this performance may be that China's population size and economic aggregate have a large volume. In the future emission reduction process, we need to adopt both scale adjustment and technical energy conservation methods. Only by taking a two-pronged approach can emission reduction be achieved more efficiently. In addition, considering the size of China's population and economic aggregate, scale adjustment may not be easy. Therefore, the way of technical energy conservation is worthier of our attention.

3.3. Results of China's Carbon-intensive Industries' Carbon Emission Forecasts

In order to further explore the carbon emission peak of different industries, four different carbon intensive industries' carbon peak situation are forecasted, and the five scenarios (baseline scenario, low-carbon scenario, high energy consumption scenario, scale adjustment

scenario and technical energy conservation scenario) of the oil industry, chemical industry, steel and power industry are compared.

- The analysis of oil industry carbon emission trend

  As an energy industry sector that extracts oil (including oil, oil shale and natural gas) and refines it, the oil industry produces a large amount of carbon dioxide emissions. As shown in Figure 3, in the five scenarios, the oil industry cannot reach the carbon emission peak before 2030; in the high energy consumption scenario, it cannot reach the carbon peak before 2040; in the baseline scenario, low carbon scenario, scale adjustment scenario and technical energy conservation scenario, it can reach the carbon emission peak before 2040. Due to the characteristics of oil industry, its carbon dioxide emission reduction needs to rely on the development of new energy and the raise of energy efficiency.
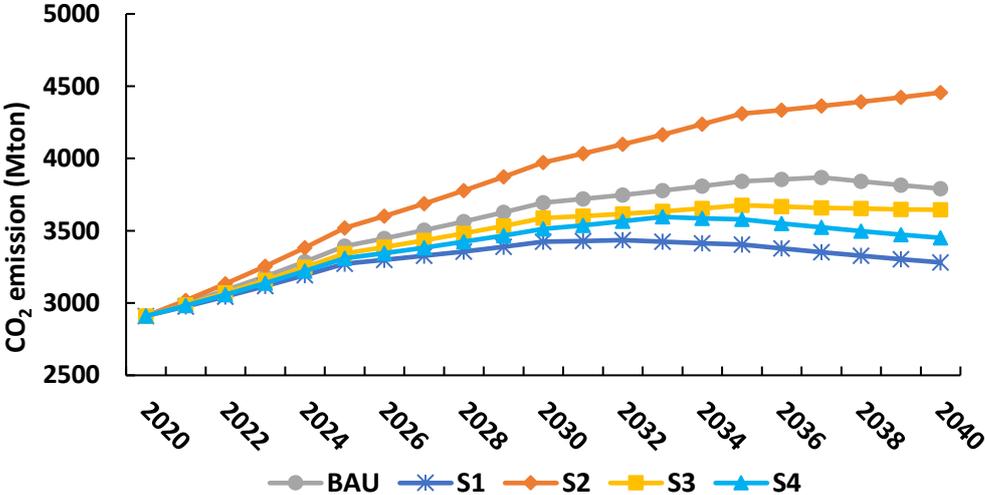
Figure 3. The carbon emission trend of oil industry in BAU-S1-S2-S3-S4 scenarios

- The analysis of chemical industry carbon emission trend

  The chemical industry is the country's basic industry. The development speed and scale of the chemical industry have a direct impact on all sectors of the society and economy. Due to the diverse categories and product of the chemical industry, it emits various and toxic gas. Therefore, the chemical industry is a big emitter. The sustainable development of the chemical industry has important practical significance for human economic and social development. As shown in Figure 4, The chemical industry can achieve a carbon emission peak in 2030 under the low-carbon scenario, and achieve the carbon peak target by 2040 under the baseline scenario, scale adjustment scenario, and technical energy conservation scenario, and under the high energy consumption scenario, it failed to achieve carbon emission peak before 2040. The chemical industry's carbon emission reduction is under great pressure. Although it produces less carbon emissions compared to the oil industry, due to the complexity of the industry and the special status of the industry, it is necessary to consider a variety of emission reductions in order to achieve carbon emission reduction.
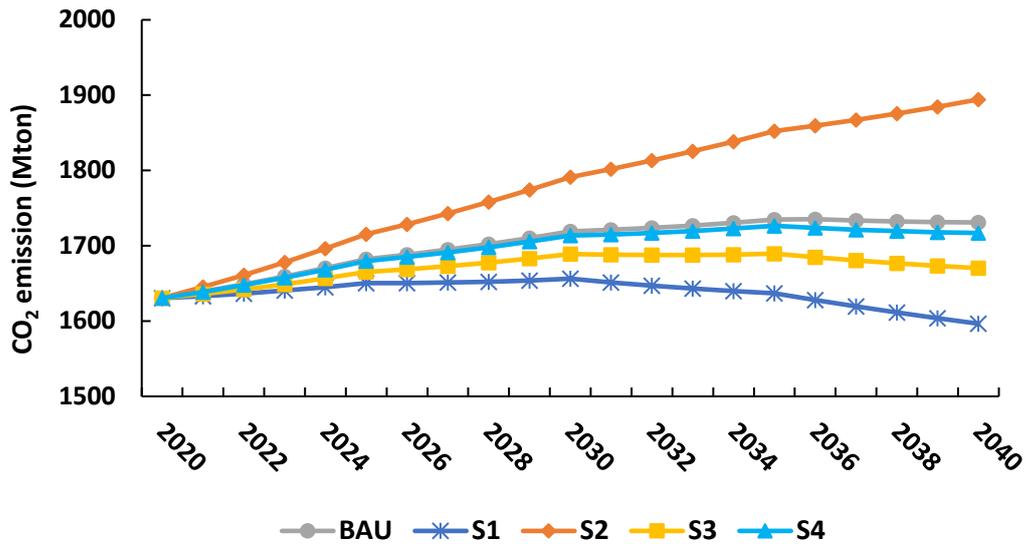
Figure 4. The carbon emission trend of chemical industry in BAU-S1-S2-S3-S4 scenarios

- The analysis of steel industry carbon emission trend

  The steel industry is an industry that is mainly engaged in industrial production activities such as ferrous metal mineral mining and ferrous metal smelting and processing, including mineral mining and dressing of metallic iron, chromium, manganese, ironmaking, steelmaking, and steel processing industries. Ferroalloy smelting industry, steel wire and its products industry and other sub-sectors, is one of the country's important raw material industries.
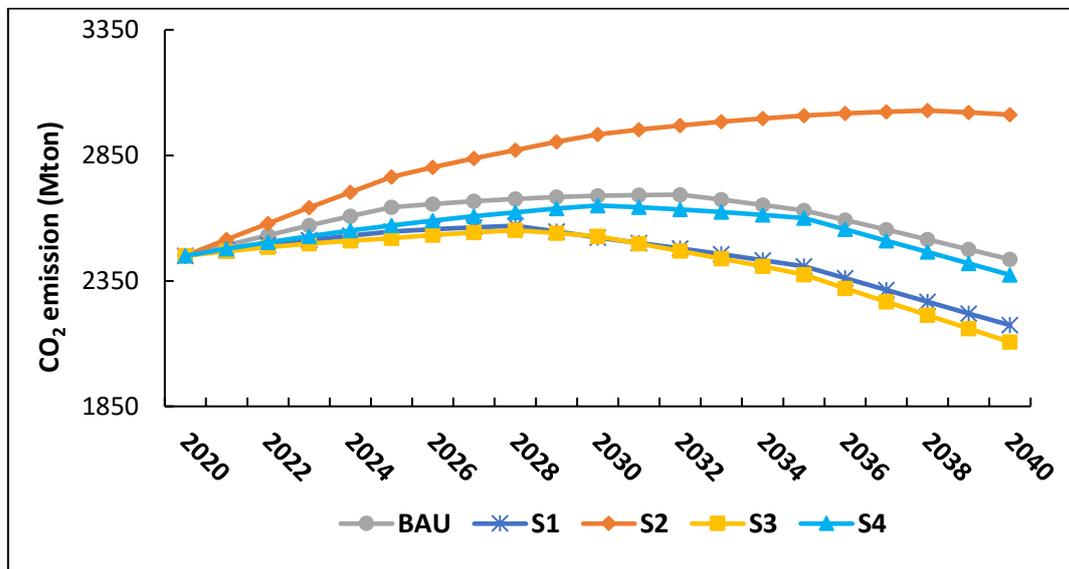
Figure 5. The carbon emission trend of steel industry in BAU-S1-S2-S3-S4 scenarios

As show in Figure 5, according to carbon emission trend forecasts, the steel industry can achieve carbon emission peak before 2030 under low-carbon scenarios, scale adjustment scenarios, and technical energy conservation scenarios, and achieve carbon emission peak before 2040 under baseline scenarios and high energy consumption scenarios. Since China's steel industry has been developing under a situation of overcapacity and weak

demand since 2013, the reduction of emissions in the steel industry should consider methods such as resolving overcapacity, carrying out structural restructuring, increasing product innovation, and promoting green development.

- The analysis of power industry carbon emission trend
  As an industry that produces, transmits and distributes electric energy, the power industry mainly relies on coal, oil, natural gas and other fossil energy sources for its raw materials. Therefore, this industry will produce a large amount of carbon dioxide emissions, which leads to great pressure on emission reduction. As show in Figure 6, the power industry can only achieve the carbon peak goal in 2030 under the low carbon scenario, and can achieve the carbon peak goal in the near time after 2030 under the baseline scenario, scale adjustment scenario and technical energy conservation scenario, and can't achieve the carbon emission peak goal before 2040 under the high energy consumption scenario. As the power industry directly consumes fossil energy, its carbon dioxide emission reduction should increase the consumption proportion of clean energy, reduce the consumption proportion of fossil energy, and improve the energy utilization mode to produce, transport and distribute electric energy by comprehensively utilizing various energy sources and methods.
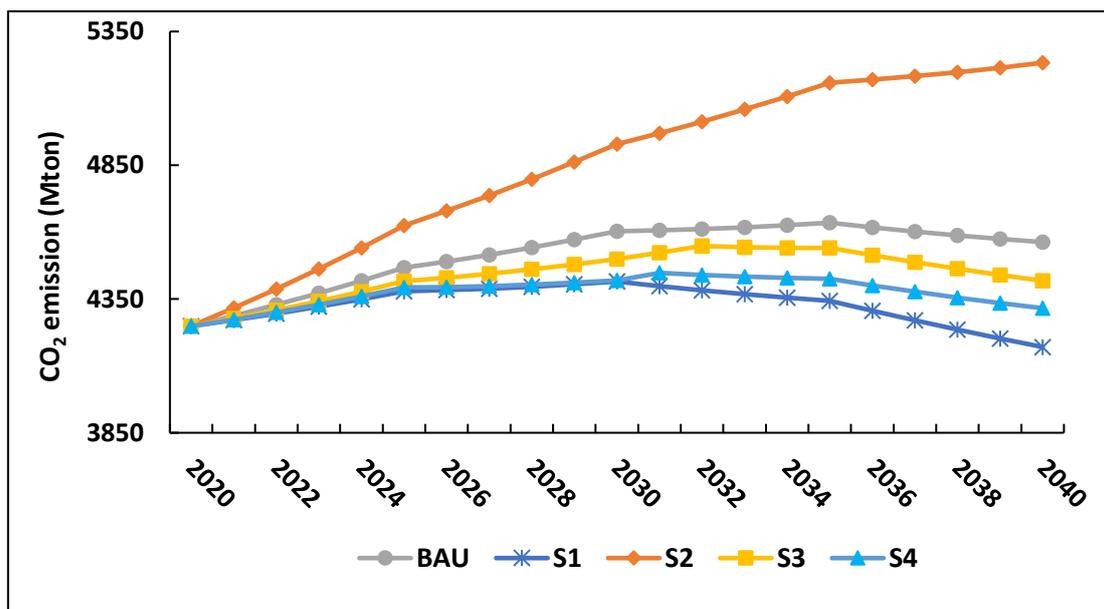
Figure 6. The carbon emission trend of power industry in BAU-S1-S2-S3-S4 scenarios

4. Conclusions

This paper uses the STIRPAT model to predict the carbon emission peak time and value of China's industrial sector and four carbon-intensive industries under different scenarios. The study found that under different emission reduction efforts, the gap between the peak year of China's industrial sector and various carbon-intensive industries is relatively obvious. In general, if the development goals set in the baseline scenario are followed, the industrial sector and the carbon-intensive industries will not be able to complete the peak targets on time. However, under the scale adjustment scenario, technical energy conservation scenario, and low-carbon scenario, each industry reaches its peak. Under the high energy

consumptions scenario, China's industrial sector cannot achieve carbon peaks before 2040. This conclusion is more consistent with Yuan's (2020) research. Her research shows that under the baseline scenario, China's industrial sector and various industries will reach their carbon emission peak around 2032. Under the low-carbon scenario, the industrial sector and various industries will peak in 2028. Under the high energy consumption scenario, the industrial sector and various industries will peak in 2040. However, the conclusions of this paper are quite different from Wang's (2017) research. His research shows that under the baseline scenario, the peak time of the industrial sector and various industries is quite different. Some industries will reach their carbon emission peak in 2030, but some industries will reach their carbon emission peak after 2040. In the high energy consumption scenario, industry and most industries will peak in 2036.

In order to promote the realization of carbon peaking and carbon neutrality as scheduled, this paper puts forward the following suggestions for the design of carbon peaking policy in the industrial sector: First, all industrial sectors should further implement the concept of green and low-carbon development, actively develop renewable energy, and constantly adjust the energy consumption structure; secondly, since the peak time of various industries in the energy conservation scenario is earlier than that in the scale adjustment scenario, the use of technical means to reduce the carbon emission intensity of the industrial sector should become the focus of emission reduction, managers should strengthen the guidance and support of public policies for energy technology and process improvement; finally, considering the differences in the peak time, peak value of various industries in different scenarios, the government should strengthen cooperation between different industries and formulate corresponding peak-achieving strategies according to the specific conditions of each industry.

Conflict of interest: none

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Financial Tools with the State Support. The Case of Building Societies in Czechia

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Abstract: Saving with the services of a building society is popular in the Czech Republic, mainly due to financial state support combined with low risk that is typical for savings. At first glance, the Czech environment of building societies seems like an oligopoly, where there are currently five entities on the market with a not very differentiated product. It is therefore proposed to carry out an analysis to ensure that these features do not give rise to undesirable effects, in particular with regard to public expenditure and its justification. That is why the aim of this paper was to defend or question the position of building savings among financial market savings and investment instruments with regard to the presence of state support within the Czech environment. Special attention was paid to bank fees. From the result of the analysis it is possible to conclude that not only clients but also building societies themselves are significant recipients of state support which reduces the efficiency of public spending. On the other hand, state financial support helps to attract a significant amount of deposits, which largely serve as housing loans. Thus, this finding speaks in favor of the efficiency of public spending.

Keywords: building societies; financial tools; public expenditures; savings; state support

JEL Classification: G21; G51; H50

1. Introduction

A number of authors are involved in building societies with their research. According to recent publications in the Web of Science database, these are authors mainly from those countries where building societies actually operate, such as the United Kingdom, Germany or the Czech Republic. For example, Scott and Walker (2019) focus on post-war Britain house-building and restrictions affecting the availability of housing loans (mortgages) in the building society system. Molterer (2019) focuses on building societies as special financial intermediaries, analyzing 41 years of data from the German economy. Molterer (ibid) contributes to the discussion of whether specialized financial institutions (in this case building societies) contribute to the stability of the entire banking system. Shiwakoti, Keasey, and Hudson (2008) carried out a study aimed at measuring the performance of building societies in the UK in connection with the change of organizational form from a mutual fund to a public limited company. Stephens (2001) also deals with the issue of demutualization, circumstances and evaluation of this change in the UK environment. Another specific assessment of demutualization in the UK is offered by Webb, Bryce, and Watson (2010), who were investigating the effect of UK building society demutualisation on levels of efficiency at the largest five commercial banks in the UK. Last but not least, de-Ramon and Straughan (2020),

again in the UK environment, seek to measure competition in the deposit-taking sector, i.e. between banks and building societies in the years 1989-2013. In the Czech environment, for example, Paleekova (2015) or Horvath and Teply (2013) conducted some studies on building societies. Paleekova (2015) focuses on measuring the dynamic efficiency of Czech and, in fact, Slovak building societies using the dynamic DEA method. Horvath and Teply (2013) focus on the risk management of building societies in the Czech Republic and, for example, from the point of view of interest rates, they conclude that the building society interest rates are more stable and less responsive to interbank market rates as well as to government bond yields.

Thus, this contribution expands knowledge about savings in the system of building societies, here in the environment of the Czech Republic, with an overlap in the field of public finance.

In some countries, saving accounts provided by a building society (hereinafter building savings) are an integral part of the group of financial instruments that are used for ordinary savings purposes. Ordinary savings mean deposits with a bank (i.e. a financial intermediary), for which the client expects a reward in the form of interest collected. Building savings, as the name of this financial instrument suggests, is intended to finance housing needs, whether it is construction, reconstruction or the acquisition of new housing. And because housing is a socially sensitive topic, it is naturally in the interest of the state. The state supports building savings with a state financial contribution provided to the building savings account, depending on the bank's client's annual deposits. However, the system currently set up in the Czech Republic cannot completely monitor the actual use of the funds saved, or at least use of the state support. Practically certainly, state support is used for the intended purpose in providing a building savings loan. However, the state knows nothing about what state support is used for for those contracts that only go through the savings phase. That is why, the effectiveness of public funds spent in this way is the subject of debate from time to time.

Table 1 below provides an overview of the development of building savings in the last 10 years, i.e. from 2011 to 2020.

Looking at Table 1, it is clear that building savings is a financial instrument with a relatively stable number of new or recurring users (see the first line "newly concluded contracts"). On the other hand, the total number of building savings users is declining in the period under review, looking for its stable position (see the lines "Contracts in the savings phase" and "Total loans"). Possible reasons for the decrease include the limitation of state support to the maximum amount of CZK 2,000 (previously CZK 3,000) and the imposition of a withholding tax on this support of 15% since 2011. At the same time, given the overall level of interest rates, interest rates on building savings also fell, which continued to undermine the attractiveness of this instrument. From the point of view of paid state support, it can be stated that, despite its initial decline (given the circumstances above), it has stabilized at around CZK 4 billion. It is also possible to note that the efficiency of savers' work with their deposits has increased. This is evident in the amount of average state support per contract, which increased in the period under review. Finally, looking at the total savings in Table 1, it can be stated that building

savings, despite the decline in total deposits, is still a significant source of funds for financing the housing market in excess of CZK 350 billion.

Table 1. The development of building savings in the Czech Republic in 2011-2020. Selected indicators (own processing based on MFCR (2021))

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2020 vs 2011
Newly concluded contracts (abs. number)	410,461	433,093	449,588	481,439	373,096	403,259	370,707	422,048	485,176	461,885	+51,424 (+12.53%)
Contracts in the savings phase (abs.; thousands)	4,550.5	4,316.9	4066.7	3,825.4	3,503.3	3,312.1	3,212.4	3,166.8	3,226.7	3,242.7	-1,307.8 (-28.74%)
Total loans (abs.; thousands)	956.7	894.4	815.2	752.6	695.4	650.2	613.0	588.2	555.4	520.3	-436.4 (-45,62%)
State support paid (bil. CZK)	10.729	5.290	4.953	4.761	4.562	4.280	3.947	3.916	3.978	4.118	-6.611 (-61,62%)
Average state support granted per contract (CZK)	1,324	1,312	1,316	1,315	1,327	1,342	1,373	1,397	1,434	1,461	+137 (10.35%)
Total savings at the end of the period (bil. CZK)	433.433	434.986	429.110	413.576	384.225	362.603	358.904	355.037	359.732	362.653	-70.78 (-16.33%)

Table 1 provided information on the basic parameters of the development of building savings in the Czech Republic. The research part of the article is devoted to the effectiveness of state support in building savings with a focus on selected aspects – in this article account management fees, the rate of conversion of contracts in the savings phase to the loan phase, and, last but not least, the rate of use of deposits to provide loans. The position of building savings in relation to similar alternative financial instruments in terms of yield, risk, liquidity and investment horizon is also outlined. The purpose of the analysis is to defend or question the position of building savings among financial market savings and investment instruments with regard to the presence of state support.

The limiting factor for the validity of the analysis results is the limited view of building savings as a savings financial instrument, i.e. there is no comprehensive assessment of the entire environment.

2. Methodology

The analysis below works with secondary data that are openly available either on the website of a public institution (Ministry of Finance of the Czech Republic) or the banking entities listed below.

Summary data on building savings were obtained from the website of the Ministry of Finance of the Czech Republic. And the subject of the analysis is the years 2011 to 2020.

Further, the analysis works with the data of all building societies operating in the Czech Republic to the year 2022, i.e. Raiffeisen building society (RSTS), ČSOB building society (CSOB SS), ČS building society (SSCS), Moneta building society (Moneta SS) and Modrá pyramida building society (MPSS).

Due to time and cost constraints, only financial products offered by large banks in the Czech Republic, i.e. ČSOB Bank (CSOB), Komerční banka (KB), Česká spořitelna (CS) and Moneta Money Bank, were selected for comparison.

Savings accounts & term deposits and low as well as medium risk bond funds were chosen for comparison as representatives of alternative financial instruments similar to building savings in terms of yield, liquidity, risk and investment horizon.

In order to fulfill the purpose of the analysis, the following research questions, respectively theses were defined:

- RQ1: The ratio between contracts in the savings phase and allocated loans is low, and thus the demonstrable effectiveness of public spending is low.
- RQ2: Fees associated with building savings show signs of an imperfect market structure and continue to reduce the efficiency of public spending.
- RQ3: Building savings show a higher burden of fees than alternative selected products.
- RQ4: With regard to the investment horizon and the risk taken, building savings is the most profitable of the analyzed financial instruments.

3. Results

This chapter provides results needed to answer above stated research questions. First subchapter is devoted to more detailed analysis of building savings. It provides, for example, an analysis of public spending effectiveness. Second and third subchapters are devoted to close alternatives to building savings in terms of risk, liquidity, yield, and time horizon; i.e. an analysis of savings accounts as well as term deposits, and an analysis of opportunities to invest in bonds through collective investment funds are provided.

3.1. Building Savings

The purpose of this subchapter is primarily to point out the effectiveness of public funds spent on state support and related issues. For this purpose, several indicators were taken over or derived in the secondary data analysis.

First, the following Table 2 shows the ratios between building society loan agreements and savings phase agreements for the years 2011 to 2020. Furthermore, the table contains the ratio between the total volume of loans and the total volume of deposits within the same period.

Table 2. The development of ratios signaling suggesting the effectiveness of public spending (own processing based on MFCR (2021))

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Loan agreements to saving agreements	21.02%	20.72%	20.04%	19.67%	19.85%	19.63%	19.08%	18.57%	17.21%	16.05%
Total volume of loans to total savings	67.6%	64.9%	60.9%	60.4%	63.2%	66.4%	68.5%	74.1%	77.3%	80.9%

Table 2 shows that while fewer and fewer contracts are changing from savings to loans, on the other hand, this smaller number of contracts draws an ever-increasing volume of deposits. In addition to that, on the one hand, it can be stated that from the point of view of

state support, it is becoming less and less conclusive that state support will actually be used by savers for housing purposes (the loan can only be obtained for housing needs) and therefore the position of state support as public expenditure is less defensible. On the other hand, the indicator on the ratio of loans to deposits or savings says the complete opposite, namely that state support, as one of the components of savings, is playing an increasingly important role as a source of loan financing. Thus, the credited state support does not necessarily serve to finance housing needs directly to those to whom it is ultimately credited, but also indirectly to those who are users of a building savings loan.

Attention is now turning to state support and building savings fees, especially the account management fee. Unlike common types of bank accounts for savings purposes, such as a savings account or a term deposit, where these accounts are currently maintained free of charge in the Czech environment, building savings accounts are subject to account management fees. And because building savings, unlike a savings account or a term deposit, provides a benefit in the form of state support, it is a bit of an exaggeration to talk about the account management fee as a fee for arranging state support. So, who is the real recipient of the state support, the client or the bank? The following Table 3 provides results on the efficiency of savings from the client's point of view with regard to state support and bank management fees.

Table 3. State support – the highest & the lowest account management fee – deposit efficiency

		Variant 1	Variant 2	Variant 3	Variant 4
Monthly deposit		300	1,000	1,217.50	1,700
Annual deposit		3,600	12,000	14,610	20,400
Annual fee	CSOB SS	360	360	360	360
	MPSS	300	300	300	300
State support (gross)[1]		360	1,200	1,461	2,000
State support (net)[2]		306	1,020	1,241.85	1,700
Fee to state support (net)	CSOB SS	118%	35%	29%	21%
	MPSS	98%	29%	24%	18%

[1]In fact, for variants 1 to 3, the state support will be lower due to the account management fee, which reduces the annual amount saved per year.
[2]After withholding tax (15%).

Variant 1 in table 3 shows that at the lowest monthly deposit, which was chosen in the amount of the annual account management fee at the MPSS bank, the state support covers the account management fee (MPSS) or does not even cover it in the case of the CSOB SS bank. It can thus be said that in this variant the actual recipient of state support is the bank, not the client.

Variant 2, which is based on the average value between the CZK 300 deposit (Variant 1) and the highest deposit of CZK 1,700 (Variant 4), shows that in this case about a third of the state support goes to the bank to cover the account management fee.

The deposit in variant 3 is derived from statistics showing the average amount of state support per contract in 2020 (see MFCR, 2021). In this case, about a quarter of state support falls on the account management fee. See 24% in case of MPSS, respectively 29% in case of CSOB SS.

The deposit in variant 4 is usually stated as optimal. Thanks to such a high deposit, the client, on the one hand, already reaches full state support, on the other hand, the client does not deposit an unnecessarily large amount, which does not bring additional state support and is usually at a lower percentage than other savings instruments. In this case, the commission for intermediation of state support (actually an account management fee) ranges from 18 to 21%.

It follows from the above that building savings are rather an unsuitable financial instrument for households with a low potential for generating savings. The benefit in the form of state support is deleted or at least significantly reduced by the account management fee. On the other hand, households that can work with an optimal deposit and that do not expect a significant benefit other than state support from building savings must count on approximately a 20% commission for a building society for arranging state support. In other words, the efficiency of public spending in the form of state support is about 20% lower than the total amount spent by the state.

So, would it not be better to abolish state aid from the point of view of public spending, or at least to find another aid scheme? And does the current client, who is used to using building savings, have very similar alternatives among financial instruments? The following two subchapters focus on the second question in particular.

3.2. Saving Accounts & Terms Deposits

Now the text focuses on savings accounts and term deposits. That is, to two financial instruments that are similar to building savings in terms of interest rate (yield), or in the case of term deposits, similarly to building savings, the amounts in the account are unavailable for an agreed period (liquidity). At the same time, since in all cases they are savings instruments, which are also insured by law, they are instruments with a similar credit risk undertaken. The text below compares savings accounts and term deposits of those four largest banks whose banking group also offers building savings.

In the case of these instruments, the fees associated with them (e.g. account opening, management, withdrawals) have been *zero* for some time, unlike building savings.

As for the interest rates provided on deposits, they do not currently differ much from each other (building savings vs. savings account or term deposit). See Table 4 below. From this it can be concluded that building savings now does not offer an illiquidity premium.

On the other hand, the situation with interest rates is not that simple. Thanks to rising, high inflation, the Czech Republic is in the phase of raising key interest rates (2-week repo rate). And from the observations made so far, it is possible to conclude that savings accounts and term deposits adapt to new interest rates faster than building savings. This probably follows from the caution of building societies, as they guarantee the offered interest rate for the entire binding period of the contract (i.e. 6 years).

From a purely interest rate point of view, it seems more rational to use a savings account or term deposit than building savings. Thanks to state support, however, the total income from the financial instrument is the highest for building savings (slightly below 5% p.a. on average over 6 years with an annual deposit of CZK 20,000).

	% p.a.[1]
Building societies	
MPSS	1.5
RSTS	1.5
CSOB SS	1.5
SSCS	1.5
Moneta SS	1.7
Savings account	
KB	1.5
CSOB	2.25
CS	1.5
Moneta Money Bank	2.5
Term deposits (1Y)	
KB	2.0
CSOB	3.0 (4.25)[2]
CS	2.8
Moneta Money Bank	2.5

[1] These are often bonus interest rates (i.e. the highest offered ones). However, achieving them is not difficult.

[2]The rate is 4.25 when combined with an investment product. It is therefore a mix of products.

From the above, it can be estimated that the current situation may further weaken the popularity of building savings as a savings tool, especially for those households that are unable to save the maximum amount for the highest state support each year.

3.3. Lower and Middle-Risk Bonds

Bonds are also a potentially close tool for building savings. Although bonds are riskier in nature, they can carry the same yield over the same investment horizon as a six-year building savings binding period. However, instead of buying bonds directly, an alternative to buying bond funds is chosen. For comparison, those bond funds that bear a lower or middle level of investor risk were selected. At the same time, all funds were offered by banks from the group that includes building societies and were denominated in CZK. As with the savings account and term deposit, the text first deals with fees, then profitability.

In terms of fees, for the vast majority of funds included in the analysis, entry fees ranged from 0.0 to 1.0% of the amount invested, exit fees were zero. Short-term bond funds carried an entry fee in the order of tenths of a percent. Longer-term funds that also invest in corporate bonds most often ranged with an entry fee of around 1%. With regard to these fees, the situation is basically similar or slightly more favorable than with building savings, where the fee for opening an account is most often 1% of the target amount. On the other hand, building savings offer a certain return in the form of state aid. The fee for managing funds ranged from 0.07% to 1.35%. With higher invested amounts, this fee is higher than with building savings. (KB, 2022b; CSOB 2022b; CS 2022b; Moneta Money Bank, 2022b)

While investing means that past results are no guarantee of future returns, it is natural that potential investors are interested in them. The following Table 5 provides a five-year

return on bond funds. I.e. such a horizon, which is commonly presented by investment companies for funds, is at the same time the horizon closest to the six-year building savings binding period.

Table 5. Five-year return on bond funds included in the analysis (first half of March 2022)
(own processing based on KB (2022b), CSOB (2022b), CS (2022b), and Moneta Money Bank (2022b))

Bond funds offered by	five-year yield (min; max)	median	average	no. of funds included in the analysis
KB	(-12.31; 5.74)	0.07	-0.42	6
CSOB SS	(-2.25; 0.35)	1.17	-1.33	6
CS	(-5.58; 0.50)	-0.54	-1.41	11
Moneta Money Bank	1.7	-6.95	-6.36	5

[1] These are often bonus interest rates (i.e. the highest offered ones). However, achieving them is not difficult.

Table 5 shows that this period was not very favorable for the funds concerned in terms of the five-year return. These numbers would therefore hardly serve as a selling point for an alternative choice of financial instrument in the form of building savings.

However, it should be noted that interest rates have risen significantly in the Czech Republic over the last year (see information above). And thanks to this movement in interest rates, bond prices are falling.

It is clear from this subchapter that investing requires a higher level of financial literacy than saving.

4. Discussion

The purpose of the analysis was to defend or question the position of building savings among financial market savings instruments with regard to the presence of state support. To fulfill the purpose of this analysis, the following research questions were asked:

- RQ1: The ratio between contracts in the savings phase and allocated loans is low, and thus the demonstrable effectiveness of public spending is low.
- RQ2: Fees associated with building savings show signs of an imperfect market structure and continue to reduce the efficiency of public spending.
- RQ3: Building savings show a higher burden of fees than alternative selected products.
- RQ4: With regard to the investment horizon and the risk taken, building savings is the most profitable of the analyzed financial instruments.

Regarding RQ1, the analysis performed gave two conflicting results. First, the ratio of loan agreements to building society savings contracts was calculated at some 16% in 2020. This provides the certainty that only a lower amount of total state support is actually used for housing purposes. In addition, this number has been declining almost continuously throughout the period monitored here (i.e. since 2011). Second, however, the ratio between the total volume of building savings loans and total deposits is growing when it was around 80% in 2020 (that is about +20 percentage points from the low in 2013). From the point of view

of this indicator, the overall involvement of state support in the financing of housing needs is therefore rather growing. The answer to RQ1 is therefore ambiguous.

The answer to RQ2 can be found mainly in the fee policy and offered interest rates. Four out of five building societies have the same fee for concluding a contract in the amount of 1% of the target amount. Even account management fees do not differ much. On an annual basis, the difference between the maximum and minimum is around CZK 60 (min. CZK 300 per year; max. CZK 360 per year). The fee set in this way is not insignificant and, even with the most efficient variant of savings, it draws about 20% of state support. In March 2022, the interest rates on deposits (savings) were 1.5% p.a. in four out of five cases. Only one building society differed with the offered interest rate. The rate was 1.7% p.a. (i.e. +0.2 pp compared to the competition). The findings in this paragraph therefore rather confirm the claim made in RQ2.

Logically substantiated savings accounts, term deposits and collective investment bond funds were selected as alternative products to building savings. While a savings account or term deposit does carry a smaller burden of fees (fees are zero for these financial instruments), for bond funds, the fee structure is more expensive, with fees increasing with the amount invested and the riskiness of the portfolio. Thus, as with RQ1, the response to RQ3 is rather ambiguous. But the above analysis of fees rather supports the thesis that the fee for maintaining a building savings account is essentially a fee for arranging state support.

Finally, with regard to RQ4, it is possible to comment positively on RQ4 in the current circumstances. A savings account or term deposit cannot compete with building savings, mainly due to the lack of state support. Even if the fees associated with these two alternatives are zero. Bond funds, on the other hand, cannot be a good alternative, especially given the environment where interest rates are currently rising. On the other hand, if building societies do not respond more to the current growth of basic interest rates by increasing the rates offered on deposit products, as is the case with traditional savings accounts, the resources of building societies may starve. Scott and Walker (2019) describes similar circumstances on the example of building societies in the UK.

Without state support, there would probably be no building societies in the Czech environment under otherwise the same circumstances. This would place new demands on the financial literacy of households and individuals that want to save or invest with low or medium risk. The analysis performed here suggests what financial instruments households could switch to. At the same time, such an environment without building societies would be a challenge for banks, which would probably provide a large part of loans as mortgages. Mortgage banks are already a significant competitor of building societies. However, current mortgage loans cannot finance all the cases that a building society can do (e.g. small loans, cooperative housing, etc.) and that is their competitive advantage for now.

The limiting factor of this study is mainly that the offer of savings accounts, term deposits, and collective investment funds is in fact much wider due to the offer of other banks. For example, smaller banks in particular were able to offer a higher rate on savings accounts in the period analyzed (i.e. the first half of March).

In the same way, the analysis of the entire building society environment was not carried out in an exhaustive manner. For example, the parameters of loans offered by building societies can be compared in relation to mortgage loans offered by banks (not building societies).

5. Conclusions

This paper focused on the issue of building societies, especially on the topic of client savings within the products of these financial institutions. This financial product – building savings – is specific in that it involves state support. And like many public spending, this is from time to time the subject of questions about how this public spending is necessary and effective in terms of housing finance for households. The analysis performed here provided two indicators, one of which, from the point of view of the efficiency of public expenditures, speaks against state support for building savings, and the other in favor of state support. In other words, state support is, in fact, significantly the income of building societies, which reduces the effectiveness of state support as money for housing needs. On the other hand, state support helps to attract a significant amount of deposits, which are used as loans to finance housing. With regard to alternative savings or investment products, it is not surprising that building savings continue to have a place among households used by financial instruments.

The eventual abolition of state aid as public expenditure would not only mean the end of the current form of the building society environment, but would also mean new demands on very conservative savers, who probably use building savings as a savings financial instrument. And, as Hedvicakova (2017) points out in her study, choosing the right financial product can be a very complex decision-making task.

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Consumer Awareness and the Preference for Domestic Products in Slovakia and Hungary

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Abstract: Are Slovak and Hungarian customers more cohesive with local traders during the COVID-19 pandemic? Over the last two years, both countries have introduced various restrictions that aimed to alleviate the consequences of the virus. These restrictions have some downsides as they affected the entire population. Thanks to the strong perseverance of the companies and their immediate response to these restrictions, a lot of them were able to switch to online distribution. Needless to say, the demand for the necessities comes to the fore and to some extent the shopping habits change during these times. The main purpose of this research is to analyse whether there is a linear association between the preference for domestic products and consumer awareness and between the length of COVID-19 and the growing interest in e-commerce. Cochran-Armitage tests of trend and Mantel-Haenszel linear-by-linear association chi-squared tests were used to study the main objectives. Thanks to the statistical analysis it can be stated that the Slovak respondents will prefer domestic products over foreign ones, whereas Hungarian respondents presumably will not. Moreover, it can also be said that there is no association between the length of COVID-19 and the growing interest in e-commerce in case of Hungary.

Keywords: consumer awareness; shopping habits; e-commerce; domestic traders

JEL Classification: E21; P36; L81

1. Introduction

The current circumstances have proved to be an extremely complex situation in all areas. Regarding the last two years we can state that the demand for certain products increased at such a level that panic buying came to the fore and there were huge stock losses also. According to Besson (2020), these shortages can negatively affect the helpless part of the society, as either older or low-income individuals won't find the goods they are particularly searching for. This fact can result in fewer opportunities in combatting the COVID-19 disease. In order to alleviate the consequences of the coronavirus, many countries all over the world have introduced a myriad of restrictions. These restrictions mainly aimed to decrease the number of infected people by limiting the movement or introducing lockdown. (Spinelli & Pellino, 2020; Vázquez-Martínez et al., 2021) These rules have broadly affected every part of society, and to abide by these guidelines, a myriad of businesses had to temporarily close, and just the pivotal shops could stay open where only the various necessary goods could be bought. The aforementioned facts have had a very negative impact on businesses

It is essential to point out that those businesses that have switched to fully online services have been able to reduce these effects to some extent.

Some businesses were struggling to switch, whilst the other were more successful in this matter. This is valid for a myriad of internet-based companies, mainly related to the entertainment industry, online purchasing, education and resolutions for telecommuting. They are always created to provide competitive prices and earn profit and the pandemic had negatively affected them. (Donthu & Gustaffson, 2020; Toubes et al., 2021; Okanazu, 2018) These new methods and solutions simultaneously affected the attitudes of consumers. In regard to the previously mentioned facts, the primary aim of this research is to seek information about the relationship between the preference for domestic products and consumer awareness, and the length of COVID-19 and the growing interest in e-commerce.

According to Sheth (2020), COVID-19 resulted in mobility shortages, which means that there is no need to follow various schedules in work or school, thus, consumers have more time flexibility. Based on his opinion, most habits will return back to normal, whilst there will be some habits that won't return as the consumers discovered alternative methods which result in more convenient, affordable, and accessible shopping opportunities. According to AlixPartners's survey in which 7,000 participants were involved, from which 48% marked that their shopping habits have been permanently changed by the pandemic. Needless to say, when such a crisis hits, the shopping habits ultimately change, and people start to buy necessities, for instance, protective devices and sanitizing gels. In these times, various psychological factors like attitudes, feelings, and behaviours can get less attention from researchers. Notwithstanding the less attention, these factors play a key role both for companies and customers. Analysing these factors can help companies to understand the new needs, and they can adjust their supply to meet them. It is also pivotal for the marketing strategies as advertising efficiency is crucial in present marketing environment. From a different point of view, it can also help consumers as they can be more prepared for these times which leads to a better response to these needs and feelings during the COVID-19. (Larson & Shin; 2018; Diebner et al, 2020; Tomčík & Rosenlacher, 2018; Di Crosta et al, 2021) According to Adwan (2020), in case that a consumer finds all the available information about a product or service they are looking for, the decision about the purchase is not made immediately. Based on this fact, the consumers try to read up on more about the product or look for new alternatives that fit best to what they want. After all the alternatives have been searched, they consider whether or not the purchase is worth it. For this reason, they consider different aspects of the product or service, such as the prices, packaging, size, quality, durability, and after-sale services.

However, it is essential to mention that there are downsides to the tangible increase of using e-commerce. According to Ishak and Zabil (2012), unawareness and lack of knowledge can negatively affect the consumers as they will not be able to defend themselves against the frauds that can happen by purchasing online, and there is also a slim possibility of financial theft. In such cases, customers should be more conscious about their purchases and make sure they do everything to prevent these frauds. Online shopping naturally requires stronger

consumer knowledge as they should be able to distinguish the websites from one another, thus, it can facilitate safer shopping.

2. Methodology

In our research we tried to give an international comparison between Slovakia and Hungary to cover an extensive range of information. Regarding our aims we have formulated two hypotheses.

The first hypothesis is the following:

H01: There is a linear association between the preference for domestic products and consumer awareness.

H11: There is no linear association between the preference for domestic products and consumer awareness.

For this purpose, we have used the Cochran-Armitage trend test for association. In order to successfully run this test, it is pivotal to meet the two main assumptions. Firstly, we should have one ordinal independent variable. In our case we have fulfilled this assumption as the preference for domestic products was measured on a five-point Likert-scale. Secondly, we should have one dichotomous dependent variable, which has also been fulfilled as the consumer awareness was decided by a Yes/No question. In fact, the question contained a cannot decide option, but we have excluded those answers as we had to fulfill all the assumptions. Lastly, it is essential to mention that this statistical test analyses whether there is a linear trend. This statistical test was used to determine whether a linear trend between an ordinal independent and a dichotomous dependent variable exists.

In case of the second hypothesis, we stated the following:

H02: there is a linear association between the length of COVID-19 and the growing interest in e-commerce.

H12: there is no linear association between the length of COVID-19 and the growing interest in e-commerce.

In the current case we have also analysed whether there is a linear trend, but between two ordinal variables. For this purpose, we have used the Mantel-Haenszel linear-by-linear association chi-squared test. At this point, both variables need to be measured on an ordinal measurement level. This assumption is fulfilled by our study design as one variable was measured on a five-point Likert-scale, whereas the other can be divided into different groups as we have measured the length of the COVID-19 pandemic.

The analysed respondents were Slovak and Hungarian citizens. We have used the one-time cross-sectional research methods, as we have taken a single sample of the population only once. The answer collection has taken place between January 2021 and March 2021. The survey was built up from 24 mainly closed questions, from which we have used 4 to analyse our objectives. These questions were the following:

The first question was part of various statements in which respondents could express their opinion on a 5-point scale (Not typical at all, Slightly typical, Cannot decide, Highly typical, Typical at all) about how typical the listed statements are true for them.

1. I will try to choose the domestic traders' products more often due to the COVID-19 pandemic.

The second question was a dichotomous one, in which respondents could decide whether they agree with the statement or not. In this case, the respondents were also able to choose cannot decide as an option. The statement was the following:

2. I will reconsider my shopping decisions more seriously and simultaneously gather all the available information about the product I want to purchase.

The third question was about the length of COVID-19 pandemic.

3. In your opinion, how long will the effects of the economic crisis caused by the coronavirus pandemic be felt from 2021?

The options were the following:

1 year; 2-3 years; 4 years; more than 5 years.

The fourth one was also included in the statements section and it was about the respondents' interest in e-commerce.

4. I believe that my interest in online commerce continues to grow.

In order to derive meaningful conclusion in our research it was essential to calculate the required sample size. According to Wiley (1999), we have used the following formula:

$$\frac{N*Z^2*p*(1-p)}{(N-1)*e^2+Z^2*p*(1-p)} \tag{1}$$

According to the Statistical Office of the Slovak Republic (2020b) and the Hungarian Central Statistical Office (2021) the population equals to 15,190,136. Moreover, the critical value at 95% confidence level equals to 1.96, whilst the expected prevalence to 0.4. Finally, the precision equals to 0.05. Therefore, a size of 385 respondents could be appropriate to derive relevant inference in our research. Judging by the fact that 862 people have answered our surveys, our research can be considered as a fully representative one.

The proportion of the respondents was the following: 40.37% was received from the Hungarian respondents from which 54.03% were women, and 45.97% men. The Slovak answers formed 59.63% of all the answers, from which 50.77% were women and 49.23% men.

3. Results

Thanks to the following contingency table (Table 1) that had been produced for Hungary, we can illustrate whether the analysed trend exists.

Based on the illustrated contingency table (Table 1), we can notice in the Yes %within Preferences row that 23 respondents whose consumer awareness has changed marked the not typical at all choice. We can see that the percentage of respondents whose consumer awareness has changed for certain Likert-scale points was 71.9%, 88.0%, 71.9%, 92.5%, respectively. This means that based on the descriptive data we cannot observe a linear association, but we will statistically support this with the following Table 2.

Based on the value of Sig., we can declare that there is no statistically significant linear association between the examined variables as $p > 0.05$ (see Table 2).

In order to sum up the results in case of Hungary:

A Cochran-Armitage test of trend was run to find out whether a linear trend exists between the consumer awareness and preference for domestic products. Certain points of the

Table 1. Contingency table for Hungary

			Not typical	*Slightly typical*	*Cannot decide*	*Highly typical*	*Fully typical*
Consumer_ awareness	Yes	Count	23	88	23	62	15
		% within Preference	*71.9%*	*88.0%*	*71.9%*	*92.5%*	*100.0%*
	No	Count	9	12	9	5	0
		% within Preference	28.1%	12.0%	28.1%	7.5%	0.0%
Total		Count	116	32	32	67	15
		% within Preference	100.0%	100.0%	100.0%	100.0%	100.0%

Table 2. Value of the Cochran-Armitage test of trend - Hungary

			Score	df	Sig.
Step 0	Variables	Preference	0.578	1	0.447
	Overall Statistics		0.578	1	0.447

five-point Likert-scale were the following: Not typical at all ($n=23$), Slightly typical ($n=88$), Cannot decide ($n=23$), Highly typical ($n=62$), Typical at all ($n=15$) and the proportion of respondents with the strengthened consumer awareness was 0.719, 0.880, 0.719, 0.925, respectively. The statistical analysis pointed out that there is no statistically significant linear association between the analysed variables as the value of p is greater than 0.05. Based on this evidence, we cannot reject the null hypothesis and cannot accept the alternative hypothesis.

In case of Slovakia, we have observed the following results (see Table 3).

Table 3. Contingency table for Slovakia

			Not typical at all	*Slightly typical*	*Cannot decide*	*Highly typical*	*Typical at all*
Consumer_ awareness	Yes	Count	151	31	112	74	21
		% within Preference	*79.9%*	*83.8%*	*88.2%*	*94.9%*	*80.8%*
	No	Count	38	6	15	4	5
		% within Preference	20.1%	16.2%	11.8%	5,.%	19.2%
Total		Count	189	37	127	78	26
		% within Preference	100.0%	100.0%	100.0%	100.0%	100.0%

Based on the above illustrated contingency table, we can notice in the Yes % within Preference row that a linear association exists between the analysed variables, but for a more detailed analysis, we will statistically support this with the following Table 4.

Table 4. Value of the Cochran-Armitage test of trend - Slovakia

			Score	df	Sig.
Step 0	Variables	Preference	4.686	1	0.030
	Overall Statistics		4.686	1	0.030

Based on the value of Sig., we can declare that there is a statistically significant linear association between the examined variables as $p < 0.05$.

In order to sum up the results in case of Slovakia:

A Cochran-Armitage test of trend was run to determine whether a linear trend exists between the consumer awareness and preference for domestic products. Certain points of the five-point Likert-scale were the following: Not typical at all (n=151), Slightly typical (n=31), Cannot decide (n=112), Highly typical (n=74), Typical at all (n=21) and the proportion of respondents with the strengthened consumer awareness was 0.799, 0.838, 0.882, 0.949, respectively. The statistical analysis pointed out that there is a statistically significant linear association between the analysed variables as the value of p is greater than 0.05. Based on this evidence, we can reject the null hypothesis and accept the alternative hypothesis.

In case of the second hypothesis the following Table 5 illustrates the observed results for Hungary.

Table 5. Mantel-Haenszel linear-by-linear association chi-squared test - Hungary

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	88.772	12	0.000
Likelihood Ratio	95.583	12	0.000
Linear-by-Linear Association	0.053	1	0.818
N of Valid Cases	348		

Based on the value of Linear-by-Linear Association, the value of p is greater than 0.05, which doesn't indicate a statistically significant result. Therefore, further analysis is not necessary, thus, we can conclude that a Mantel-Haenszel linear-by-linear association chi-squared test was used to determine whether a linear association exists between the length of COVID-19 and the growing interest in e-commerce. The test pointed out that there is no statistically significant linear association between these two variables as $p > 0.05$. Coming from the observed results, we cannot reject the null hypothesis and cannot accept the alternative hypothesis.

1

The following tables (Table 6 and 7) illustrate the observed results for Slovakia.

Table 6. Mantel-Haenszel linear-by-linear association chi-squared test - Slovakia

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	53.065	12	0.000
Likelihood Ratio	63.225	12	0.000
Linear-by-Linear Association	5.468	1	0.019
N of Valid Cases	514		

Based on the value of Linear-by-Linear Association, the value of p is not greater than 0.05, which indicates a statistically significant result. For this reason, we have analysed the value of Pearson Correlation to examine the strength of this statistically significant result.

Table 7. Correlations - Slovakia

		Length_of_COVID	Growing_Interest
Length_of_COVID19	Pearson Correlation	1	0.103
	Sig. (2-tailed)		0.019
	N	514	514
Growing_Interest	Pearson Correlation	0.103[*]	1
	Sig. (2-tailed)	0.019	
	N	514	514

The table above, illustrates the value of the Pearson Correlation which equals to 0.103. The existing association can be characterised by weak strength. In case of Slovakia, we can conclude that a Mantel-Haenszel linear-by-linear association chi-squared test was used to determine whether a linear association exists between the length of COVID-19 and the growing interest in e-commerce. The test pointed out that there is a statistically significant linear association between these two variables as $p < 0.05$. The value of Pearson Correlation indicated a weak strength between these two variables; thus, we can reject the null hypothesis and accept the alternative hypothesis.

4. Discussion and Conclusion

Based on the acquired results from our statistical analysis, we can claim that Slovak answerer will choose domestic products over international ones, whereas Hungarian respondents presumably will not. Concerning the Slovak respondents, we can state that there is a linear association between the length of COVID-19 and the growing interest in e-commerce, whilst in case of Hungary there is not. Based on our statistical analysis, in the case of Slovak respondents we can reject the null hypotheses and accept the alternative hypotheses, whilst in case of the Hungarian respondents, we reject the alternative hypotheses and accept the null hypotheses. We hold the view that in order to stimulate the business of

local traders, consumers should reconsider their shopping habits, and if there is a slim possibility to support them by purchasing their products, they should do it. Choosing local products and traders over foreign ones can shield domestic sellers and strengthen their financial security during these challenging times. This point of view is also supported by Smith (2020), as he holds the view that the coronavirus pandemic has caused a financial problem for small and domestically owned businesses. His advice is that consumers should reconsider their shopping habits, and they can help the local business by purchasing their products and services. According to his opinion, by choosing a local trader, consumers not only support the local business community, but they can also get their products much faster. We can strongly relate to his opinion as we also reckon that consumers should reconsider their shopping decision in order to support the local community. In case that we take into account the wider scale of available information, we can notice that the President of CCI addressed an urgent meeting in order to encourage consumers to avoid online shopping as they should choose local traders. (Daily Excelsior, 2021) According to a report issued by the OECD (2020), COVID-19 is a humanitarian crisis at a wider scale. Given this fact, the virus seriously affects the economy, and it would be essential to keep trade flowing, in order to ensure the supply of essential products. This flow definitely requires co-operation and trust. Based on Cassia et al's (2012) results, consumers' satisfaction can be influenced by a myriad of factors, for instance, product quality, comparative price convenience, but also by the complementary impact of some intangible factors. In most cases, domestic sellers can offer good quality and after-sale service. In general, domestic traders try to maintain the existing close-knit bond with the customers and enhance them to choose their products and services once again. In many cases, it can greatly contribute to the consumers' satisfaction, and perhaps they will recommend either their products or services to others. From a company's point of view, during these times it is essential to implement new marketing methods in order to entice new customers and retain the existing ones. This is also supported by (Karaffová – Polónyi & Kusá, 2018) as they think that marketing communication reflects on current requirements and experience. Besides, the up-to-date IT solutions provide an easy access to information, communication and buying possibilities. Thanks to these tools, the consumers are also able to read different reviews. Needless to say, these opinions play key-role in consumers' life as they greatly influence consumers' purchasing decisions (Graa & Abdelhak, 2020).

It is important to mention some limitation which can greatly serve as a basis for further research directions. In case of Slovakia, we can state that there is a growing interest in using e-commerce. In this sense, it is worth highlighting the fact that some domestic traders were not able to switch to online distributions. It would be interesting to examine whether the respondents are willing to avoid online shopping in order to buy products or services from domestic traders. On the other hand, the outcomes pointed out that the Hungarian respondents presumably will not prefer domestic traders' products over foreign ones. In spite of this fact, it would be intriguing to examine the reasons behind this decision. It is essential to take into account that the answers were collected between January 2021 and March 2021. In this case the approaches and decisions can slightly differ, which gives us an opportunity to examine the population's opinion once again and compare the existing data with the new

one. Finally, we reckon that it would be worth extending the research to other countries like Poland and the Czech Republic as some similarities can be observed regarding their culture and post-pandemic trends.

Conflict of interest: none

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Efficiency of Social Policy in the Czech Republic: Threat of Poverty

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Abstract: The dynamic development of today's world is the cause of many changes in the functioning of society as a whole. The covid-19 pandemic affected virtually every country in the world, and related government action resulted in an economic downturn and disruption of supply chains. The economic situation and the decline in living standards have led to an increase in social spending. However, the social system and implemented government measures may not always respond effectively to current developments. The reason may be not only the administrative and bureaucratic burden, but also the time lag in the effects of these measures, or their poor focus. This paper focuses on the development of paid benefits for material needs in the Czech Republic - these benefits are an example of social support for the population who is at risk of poverty or social exclusion the most. This paper aims to analyze the development of the volume of benefits paid for material needs in the Czech Republic in the context of the development of people living below the poverty line in the period from 2016 to 2021. It was found that the volume of benefits paid for material needs does not affect the proportion of people at risk of poverty. Higher social support during this period did not lead to a reduction in the proportion of people at risk of poverty.

Keywords: poverty; allowance; social benefits; social expenditures

JEL Classification: B55; E71; H55

1. Introduction

The covid-19 world pandemic has significantly affected the economic situation of representatives of all walks of life. Many people felt the impact of government measures, which led to a significant change in their socioeconomic situation and behaviour (Eikhof, 2020). A significant proportion of people had a reduction in their regular financial income and were thus dependent on state aid. The social policy of the state plays an important role in supporting the lowest social stratum of society, which is affected by the current economic events the most (Aidukaite et al., 2021).

Social security is one of the tools of social policy, through which assistance is provided to citizens at social risk. These are so-called social events, which are known by law and with which the law associates the creation, change or termination of rights and obligations, which can be used to prevent, mitigate or overcome the life situation caused by such an event. (Krebs, 2005). These social events are illness, unemployment, damage to health and disability, accidents at

work and occupational diseases, old age, maternity, parenthood and the death of a breadwinner (Tröster, 2013).

Generally, social security institutions consist of three interconnected systems – social insurance, state social support and social assistance (Krebs, 2015). The subjective right to social security is one of the social rights. Their fulfilment guarantees the dignity and free development of a person's personality. In the Czech Republic, social rights are defined in the Charter of Fundamental Rights and Freedoms in Title IV (Tröster, 2013).

The Czech social security system has an insurance and non-insurance character. The non-insurance system includes state social support benefits, assistance in material needs, social care benefits and foster care benefits. The insurance system consists of unemployment benefits, sickness insurance benefits, pension insurance benefits, health and long-term care and accident insurance (Holub et al., 2019).

State social support is regulated by Act No. 177/1995 Coll., The Act on State Social Support, guarantees the provision of benefits, which are child allowance, parental allowance, housing allowance, maternity and funeral allowance. Through social support benefits, the state is involved in financially covering the cost of maintenance and other basic personal needs of children and families. The costs of state social support are drawn from the state budget. The use of benefits is not affected by past contributions to the scheme or by the beneficiary's work activity or the state of his assets. However, the condition is the permanent residence of the citizen in the Czech Republic (Ochrana et al., 2015). The income and social situation of the family are also considered. The so-called net income of the family is included in the amount of the decisive income. This amount is compared with the subsistence level (Krebs, 2015).

Assistance in material needs is regulated by Act No. 111/2006 Coll. and Act No. 110/2006 Coll. The system of assistance in material needs is one of the measures by which the Czech Republic fights against social exclusion. It is a form of assistance for people with insufficient income, which motivates these individuals to actively try to secure the necessary resources to meet their basic needs. The benefits through which assistance in material need is addressed are the subsistence allowance, the housing supplement and emergency immediate assistance.

2. Methodology

Primary and secondary data published by national and international institutions are used for the following analyzes. The European Statistical Office – Eurostat is the source of data to find out the current situation in the area of people at risk of poverty. Because no aggregate data on this indicator for 2021 have been published until the publication of this paper, only data for the period from 2011 to 2020 are used.

Subsequently, the development of the volume of paid social benefits in material needs is analyzed. This is the type of social benefit that the state pays to people in material need. These persons can be identified as persons or families who do not have sufficient income and their overall social and property conditions do not allow the satisfaction of basic living needs at a level acceptable to society. At the same time, these people or families cannot increase these incomes for objective reasons and thus solve their difficult situation through their efforts. These benefits in the Czech Republic include a living allowance, a housing supplement and emergency immediate

assistance. The source of input data for the period 2012-2021 in this context is the Ministry of Finance of the Czech Republic. Following the development of the above types of social benefits, the distribution of people in the population who are at risk of poverty or social exclusion is analyzed. These are people whose net monthly income does not reach the value of 60% of the company's median income. These data are published by statistical offices, in the Czech Republic, it is the Czech Statistical Office. To evaluate the relationship between the volume of benefits paid for material needs and the share of people at risk of poverty, Pearson's correlation coefficient is used.

3. Results

3.1. At-risk-of-poverty Rate in the European Union

In the European Union, more than 70 million people are at risk of poverty, equivalent to around 17% of the European population. This number (share) has remained virtually

Table 1. At-risk-of-poverty rate by poverty threshold (%) (Eurostat, 2022a).

Goegr. unit / year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
EA-19 countries	16.8	16.9	16.7	17.2	17.2	17.4	17.0	17.0	17.4	16.7
EU-27 countries	16.9	16.9	16.8	17.3	17.4	17.5	16.9	16.8	17.2	16.7
Austria	14.5	14.4	14.4	14.1	13.9	14.1	14.4	14.3	13.3	13.9
Belgium	15.3	15.3	15.1	15.5	14.9	15.5	15.9	16.4	14.8	14.1
Bulgaria	22.2	21.2	21.0	21.8	22.0	22.9	23.4	22.0	22.6	23.8
Croatia	20.9	20.4	19.5	19.4	20.0	19.5	20.0	19.3	18.3	18.3
Cyprus	14.8	14.7	15.3	14.4	16.2	16.1	15.7	15.4	14.7	14.3
Czechia	9.8	9.6	8.6	9.7	9.7	9.7	9.1	9.6	10.1	9.5
Denmark	12.1	12.0	11.9	12.1	12.2	11.9	12.4	12.7	12.5	12.1
Estonia	17.5	17.5	18.6	21.8	21.6	21.7	21.0	21.9	21.7	20.7
Finland	13.7	13.2	11.8	12.8	12.4	11.6	11.5	12.0	11.6	12.2
France	14.0	14.1	13.7	13.3	13.6	13.6	13.2	13.4	13.6	13.8
Germany	15.8	16.1	16.1	16.7	16.7	16.5	16.1	16.0	18.9	18.5
Greece	21.4	23.1	23.1	22.1	21.4	21.2	20.2	18.5	17.9	17.7
Hungary	14.1	14.3	15.0	15.0	14.9	14.5	13.4	12.8	12.3	12.3
Ireland	15.2	16.3	15.7	16.8	16.2	16.8	15.6	14.9	13.1	13.8
Italy	19.8	19.5	19.3	19.4	19.9	20.6	20.3	20.3	20.1	20.0
Latvia	19.0	19.2	19.4	21.2	22.5	21.8	22.1	23.3	22.9	21.6
Lithuania	19.2	18.6	20.6	19.1	22.2	21.9	22.9	22.9	20.6	20.9
Luxembourg	13.6	15.1	15.9	16.4	15.3	15.8	16.4	16.7	17.5	17.4
Malta	15.6	15.1	15.8	15.8	16.6	16.5	16.7	16.8	17.1	16.9
Netherlands	11.0	10.1	10.4	11.6	11.6	12.7	13.2	13.3	13.2	13.4
Poland	17.7	17.1	17.3	17.0	17.6	17.3	15.0	14.8	15.4	14.8
Portugal	18.0	17.9	18.7	19.5	19.5	19.0	18.3	17.3	17.2	16.2
Romania	22.3	22.9	23.0	25.1	25.4	25.3	23.6	23.5	23.8	23.4
Slovakia	13.0	13.2	12.8	12.6	12.3	12.7	12.4	12.2	11.9	11.4
Slovenia	13.6	13.5	14.5	14.5	14.3	13.9	13.3	13.3	12.0	12.4
Spain	20.6	20.8	20.4	22.2	22.1	22.3	21.6	21.5	20.7	21.0
Sweden	15.4	15.2	16.0	15.6	16.3	16.2	15.8	16.4	17.1	16.1

Note: EA = Euro area

unchanged over the last ten years. The fact that approximately the same proportion of people are at risk of poverty is determined by the way this indicator is calculated. However, there are significant differences from the point of view of individual states. While in some Eastern European countries the proportion of people at risk of poverty is over 20% (e.g. Bulgaria, Romania), other countries keep their share at a much lower level through their social policies. These countries include, for example, Slovakia and the Czech Republic. The Czech Republic is the country in which the share of people at risk of poverty is the lowest and is below 10%.

3.2. Situation in the Czech Republic

In terms of the development of poverty in the Czech Republic, women are more at risk than men. While the proportion of men at risk of poverty has long-ranged between 7 and 8.5 percent, women at risk of poverty are between 10 and 12 percent (ČSÚ, 2022). This fact may be influenced to some extent by the different earnings of men and women, which in the European Union reach the limit of 13.0%, and in the Czech Republic, it is even 16.4% (Eurostat, 2022b).

This difference in income between men and women is reflected in all age groups. The economically active population is directly affected by this inequality, older non-working people as a type of economically inactive population are indirectly affected - due to lower earnings, and therefore also social security contributions, they are paid lower transfers (pensions). Because social transfers represent only a fraction of the average but also the median income in society, the recipients of these social benefits usually belong to the group of people who is at risk of poverty the most.

The distribution of the population at risk of poverty by age from 2016 to 2021 is illustrated in Figure 1.
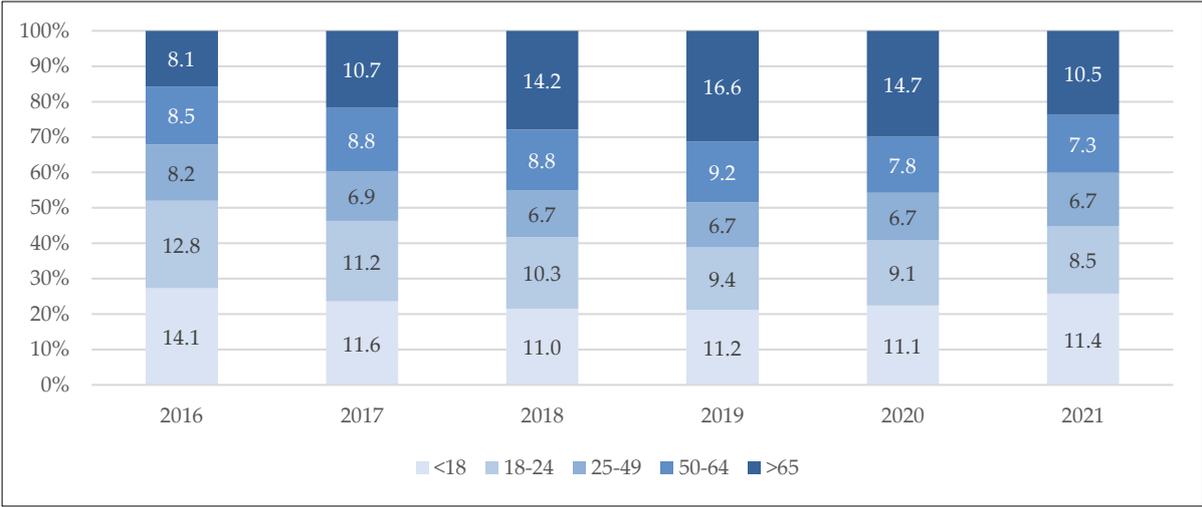
Figure 1. At-risk-of-poverty rate by age of people (%)

This figure shows that the long-term the most significant proportion of people at risk of poverty is economically inactive under the age of 18, as well as people over the age of 65. However, it is clear that while the share of poor pensioners has been increasing since 2016, since the beginning of the covid-19 pandemic, this share has fallen from 14.7% to 10.5%. Thus,

the share of people of retirement age in the total number of people at risk of poverty has fallen from 30% to around 24%. Although the distribution of the population at risk of poverty changed in the covid years 2020-2021, their total share fell from 9.5% to 8.6%.

The most significant decrease in the poor was recorded for individuals. In just two years, the poverty rate for this group of people fell by 4.9 percentage points to 21.89%. However, it should be noted that the poverty rate for individuals with a dependent child reaches almost 33% – this group of single women is therefore one of the most endangered (see Table 2).

Table 2. At-risk-of-poverty rate by type of people (%) (ČSÚ, 2022).

	2016	**2017**	**2018**	**2019**	**2020**	**2021**
1 adult, at least 1 dependent child	37.0	31.4	30.1	30.8	32.4	32.4
2 adults, 1 dependent child	6.4	7	8.5	7.1	5.5	3.8
2 adults, 2 dependent children	9.3	6.2	5.8	6.1	6.8	7.1
2 adults, 3 or more dependent children	21.0	17.4	15.7	17.6	14.6	18.6
other households with dependent children	5.7	5.6	5.9	5.0	4.8	3.5

People at risk of poverty are also the most important group of recipients of social benefits in dire need. These benefits aim to help people overcome periods of economic deprivation and help them live in dignity. However, the question is whether these benefits contribute sufficiently to reducing the proportion of people at risk of poverty. In terms of the development of benefits paid for material needs, it can be stated that they have decreased significantly in recent years. In 2014, the amount of money paid out under these benefits amounted to CZK 11.30 billion, in 2021 only CZK 5.24 billion. Of this volume, the largest share (on average 67.2%) was the subsistence allowance. On the contrary, emergency immediate assistance as a type of lump sum represents only less than 2 percent of the total volume.

The following graph shows the development of social benefits in the context of the development of the proportion of people at risk of poverty.
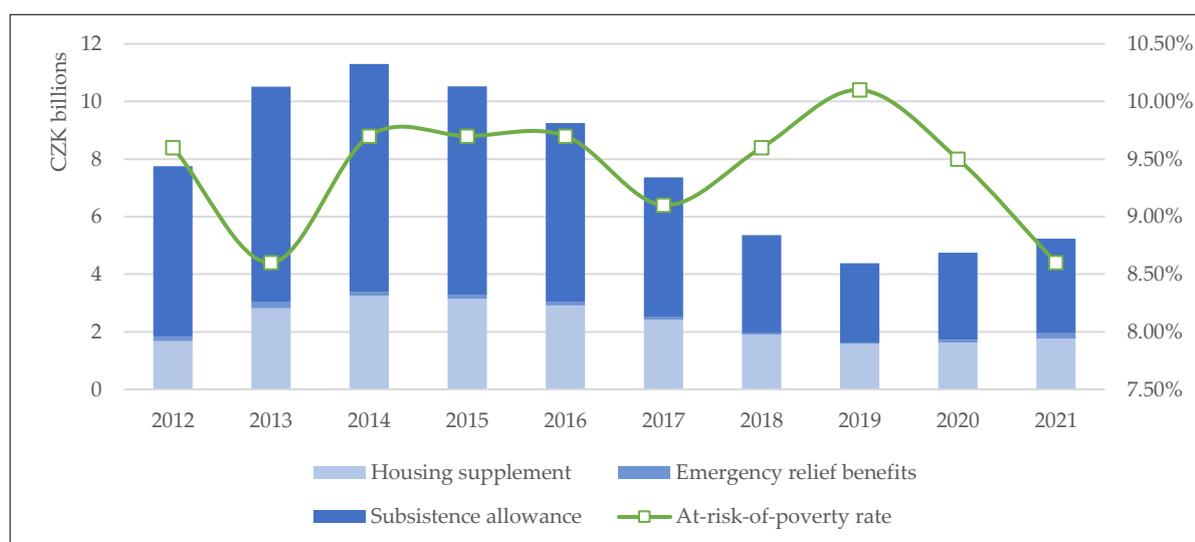
Figure 2. Development of the volume of benefits in material need and at-risk-of-poverty rate between 2012 and 2021

The increasing volume of benefits paid for material needs is not the cause of the decline in the proportion of people at risk of poverty. Likewise, the declining volume of these benefits is not necessarily the cause of the increase in the proportion of poor people. These statements can be proved through a correlation coefficient. During the period under review, Pearson's correlation coefficient reached -0.073. This value even shows a negative, albeit very weak, the value of the linear dependence. Thus, it can be stated that there was no direct dependence between the volume of paid benefits in material needs and the development of the share of people at risk of poverty. Therefore, higher support does not lead to a reduction in the proportion of people at risk of poverty.

4. Discussion and Conclusion

The growing bureaucratic burden and the desire of government officials to solve all the problems associated with market mechanisms have not been met with success in many areas. At a time marked by the covid-19 pandemic, the Industry 4.0 initiative, which is associated with production automation, can be cited as an example (Hedvičáková & Svobodová, 2017). In recent years, however, Western European governments have made an effort not to increase labour market flexibility, but to freeze it and maintain employment at all costs. However, the desire to maintain the current status quo is also evident in the private sector – for example, in the otherwise relatively dynamic banking system (Hedvicaková & Soukal, 2012).

Along with high government subsidies and other similar programs, sustainable growth has been halted in the last two years due to the covid-19 pandemic (Chen et al., 2021). The market thus shows an artificial trend of economic growth, which can be described as "non-growth". This situation is characterized by low unemployment and other optimistic socio-economic indicators. In the case of the Czech Republic, not only the current debt ratio (which is one of the lowest in the European Union) can be considered as very good indicator. Appropriate indicator is also very good social and economic situation of the population. At first glance, then, everything seems to be in order - low unemployment is accompanied by gradual economic growth, citizens are increasing their spending, and the state has ensured that people below the poverty line have decreased in recent years. Yes, this is one perspective. However, the reality is not nearly as rosy as these and other similar words may seem.

Many shortcomings can be found in terms of the effectiveness of state administration activities. Although there is a wealth of research and subsequent applications of performance evaluation in public administration (Král, 2021), political decision-making and subsequent manipulation of citizens in the media seem to be much more important to politicians and other elites (Salgado, 2018). The evidence from the analysis presented in this paper can be the proof. Although, for example, the former Minister of Labor and Social Affairs of the Czech Republic proposed an increase in social benefits every year as part of the fight against poverty (ČTK, 2018), Therefore, higher support does not lead to a reduction in the proportion of people at risk of poverty.

With the current level of inflation caused by many sub-factors, of which the expansionary policies of the states can be considered crucial (Ruiz Estrada, 2021), further pressure to maintain social peace can be expected. Many people may soon find themselves in a situation

where they will not be able to repay mortgages, they will pay very hard for energy costs, …
And at the cost of rising public debt, government officials will combat poverty and other
negative effects. At such a time, however, it will be necessary to ask whether this fight will
also be effective, or whether it will only be a form of pre-election advertising.

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Impact of Wage Increase and Estimation of Phillips' Curve in Czech Republic

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Abstract: The paper deals with the influence of wage growth on selected economic indicators in the condition of the Czech Republic. The estimate of the Phillips' curve in the conditions of the Czech Republic is constructed as a first step of the analysis, both for the original version, including the link between the change in wages and the unemployment rate, and in a modified form, examining the relationship between inflation and unemployment. The analyzed data show that the relationship between inflation and unemployment rate for the Czech Republic in the period 2005 to 2021 is not such significant (R^2 = 0.245), however, there is a stronger link between wage change and unemployment rate (R^2 = 0.495). Furthermore, the link between wage growth and consumption of households is examined, as it is referred to as a factor accelerating inflation rate. The data suggest that changes in consumption of households can be explained by 42.7% through wage changes. Thus, the results suggest that wage growth in the conditions of the Czech Republic was related to the low unemployment rate and is partly reflected in the growth of consumption of households, but the link to the accelerating inflation rate is missing.

Keywords: unemployment; inflation; wages; consumption; Phillips' curve

JEL Classification: E24; E31

1. Introduction

The last few years represent a significantly turbulent and unstable time. From the expectations and announcements of the upcoming economic crisis in 2019, through the unexpected and unpredictable effects of the pandemic in 2020, to the growing problems with the functioning of global trade routes and rising commodity prices in 2021. The economic situation in the Czech Republic and the world, is marked by uncertainty and concerns about future developments. Many economies of the Western world, including the Czech economy, are currently struggling with high levels of inflation (Czech National Bank, 2021).

The reasons for the rising price level can be seen in the rising prices of inputs to the production process, in the wake of a wide range of factors from insufficient capacity to meet growing demand, through problems with transport of raw materials in the wake of labor pandemic and unpredictability of the situation (Czech National Bank, 2021). This concept of inflation thus corresponds to cost-pushed inflation, and from the point of view of the Czech economy, due to the significant volume of imports of rising price raw materials, also to imported inflation. Another factor affecting inflation is growing aggregate consumption, stimulated on the one hand by the government's significantly expansionary fiscal policy, but also by growing household consumption. In the conditions of the Czech Republic, in 2020, and

subsequently also in 2021, we were able to observe a significant expansionary fiscal policy of the government to reduce the negative effects of the pandemic on economies (Ministry of Finance of the Czech Republic, 2022). In the area of household consumption, the information varies, from an assessment of a clear increase in household consumption due to long-term and persistent increases in average wages, stimulated by public sector wages (Bartušek, Bouchal, & Janský, 2022), to information on an increase in unused household funds in the form of a significant increase in household savings. because of restrictive anti-pandemic measures (Zábojníková, 2021).

In this context, the average wage therefore plays a significant role, with the potential to affect ongoing inflation at least indirectly. The average wage is linked not only to inflation but also to unemployment. The low unemployment rate that can be observed in the Czech Republic in recent years creates a suitable environment for the active negotiation of working conditions by employees, both existing and potential, including negotiations on wage increases. On the other hand, rising average wages also create the conditions for reducing unemployment by motivating people to enter the labor market, especially if wage growth is accompanied by growth in labor productivity and thus does not limit the ability of producers to increase the number of employees.

2. Methodology

The analysis is performed on economic indicators available through the Czech Statistical Office (2022a, 2022b, 2022c, 2022d)), for the longest possible period that was available for individual combinations of selected indicators. Most data are structured as quarterly data, except for data for the relationship between unemployment and inflation, where monthly data are used. Relationships including unemployment have been assessed for the period since 2005, the relationships between wage changes since 2001, and the relationship between consumption of households and GDP since 1996.

The results of analysis of the mutual relationship of chosen economic indicators presented below are based on the following indicators and data sources.

3. Results

The first relationship, which is presented in the result of the analysis, is an estimate of the derived Phillips' curve (Phelps, 1967). The left part of Figure 1 shows the development of unemployment and inflation by monthly data for the period 2005 to 2021. The data presented identifies the impact of the economically favorable period until 2008, which was reflected in declining unemployment and the growing indication of overheating of Czech economy in 2007 and 2008 and significantly rising inflation. Subsequently, in 2009 and 2010, the impact of the global economic crisis, which also affected the Czech Republic, manifests itself, namely by rising unemployment and a prolonged decline in inflation. The period from 2014 to 2017 is also clearly identifiable, manifested by almost zero inflation and a persistent decline in unemployment. The termination of the monetary commitment regime by the Czech National Bank in 2017 resulted in an increase in inflation to a level of around 2%, thus to a level

corresponding to the Czech National Bank's inflation target. Pandemic affected unemployment since 2020 and there is also the sharp rise in inflation in 2021.

The right part of the Figure 1 presents the relationship between unemployment and inflation. Based on the data, an estimate of the derived Phillips' curve is performed for the period 2005 to 2021 by means of a linear regression analysis using a linear trend to estimate the interconnection. However, the relationship between inflation and unemployment resulting from these data is inversely proportional (y = -0.4852x + 4.8084; where y: inflation and x: unemployment), however, this relationship cannot be considered significant (R^2 = 0.2454). Thus, it turns out that in the conditions of the Czech Republic, although the Phillips's curve in the period from 2005 to 2021 is valid, from the point of view of the government's economic policy, it does not represent a significant restriction on achieving the currently low inflation and unemployment values.
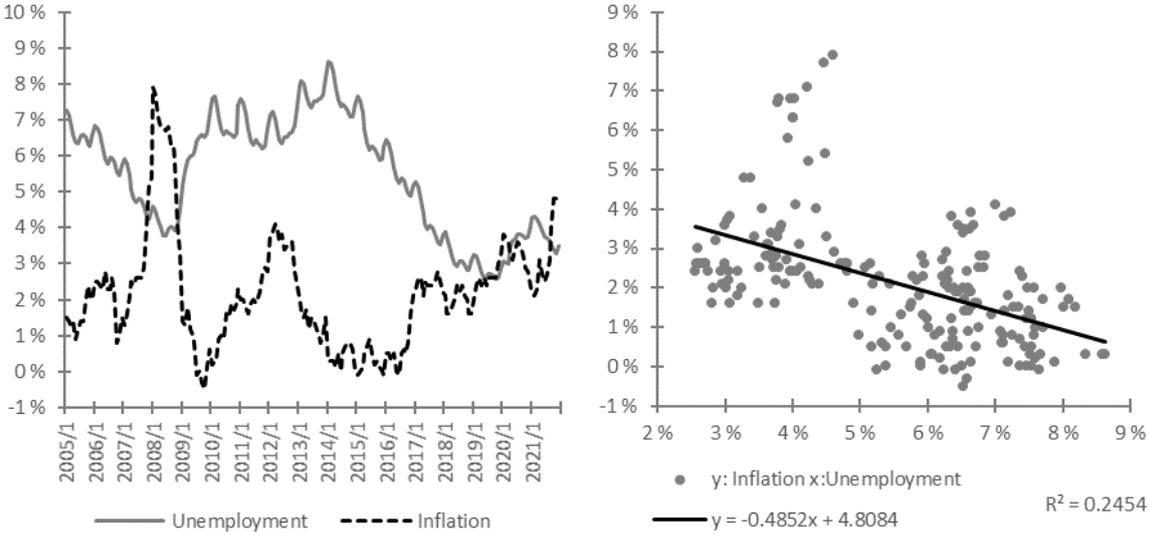
Figure 1. Development of unemployment and inflation in Czech Republic and mutual relationship with estimation of Phillips' Curve

In the next step of the analysis, Figure 2 presents data on unemployment and the rate of change in employees' average wages. Quarterly data for the same period as in the previous case were used, i.e., from 2005 to 2021. Moreover, compared to the already presented development of unemployment, the declining average wage change rate in the period since the outbreak of the economic crisis in 2008 can be identified and the continuing growth since 2014 can be seen in the left part of the Figure 2. The link between the average wage change rate and unemployment, thus the estimate of the original Phillips' curve (Phillips, 1958), is shown in the right part of the figure. Even in this case, the data point to a disproportionate relationship between unemployment and the average wage change rate (y = -1.1738x + 0.1116; where y: average wage change rate, x: unemployment) and this relationship is stronger than in the previous case (R^2 = 0.4953).

It turns out that the declining unemployment rate increases the average wage change rate and vice versa. This fact is logically justified also because if the volume of the available factor of production in the labor market decreases, its price increases. Thus, potential

employers are supposed to increase wages to acquire future employees, and this also leads to an overall increase in the wages of all employees and thus to an increase in the average wage in the national economy. At the same time, it can be assumed that the rising average wage represents a significant motivating factor that motivates even the inactive part of the population to enter the labor market and leads to a higher volume of employment.
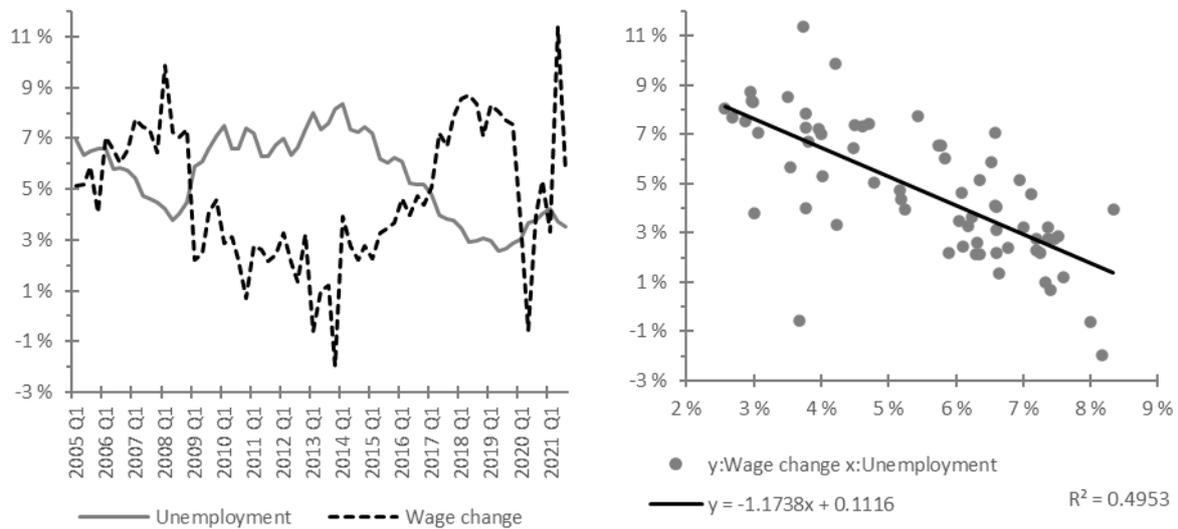
Figure 2. Development of unemployment and wage change in Czech Republic and mutual relationship with estimation of original Phillips' Curve

As pointed out, in the conditions of the Czech Republic, a relationship can be identified between the average wage change rate and unemployment. Therefore, in the next part of the paper, the analysis deals with the relationship between the average wage change rate and other selected economic indicators. From the point of view of employers, rising wages can also be reflected in rising compensation on employees. Figure 3 presents development and mutual relationship of average wage change rate and compensation on employees. It is already clear from the left part of the figure that the two mentioned economic indicators are significantly interconnected. Minor deviations in development, especially in the years 2009-2010 and in the period 2014 to 2019, are probably related to changes in unemployment, resp. total employment. A directly proportional relationship can be identified between the assessed economic indicators (y = 1.1551x - 0.006; where y: compensation on employment change rate, x: average wage change rate), within which compensation on employees can be explained from 68.92% by changes in average wage rate.

The average wage represents the income of employed individuals and thus the income of households. These funds can then be used by individual households to provide services to meet their needs. In this way, the average wage is linked to household consumption, and thus the existence of a relationship between the average wage change rate and the consumption of households change rate can be assumed. The analyzed data confirm this assumption, as direct relationship between the mentioned economic indicators is identified (y = 0.8103x - 0.0023; where y: consumption of households change rate, x: average wage change rate).
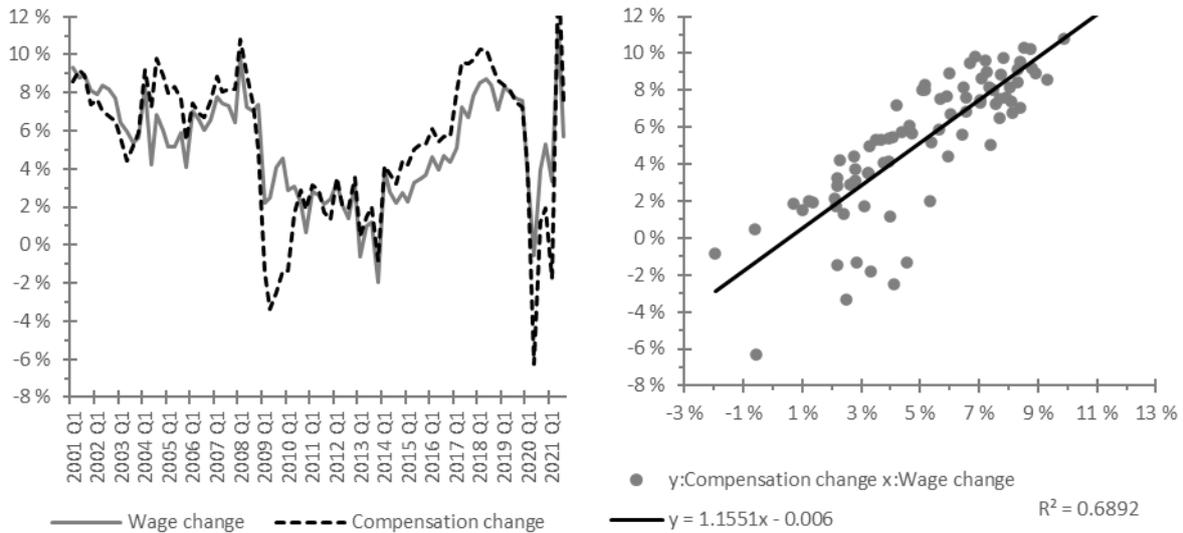
Figure 3. Development of wage change and change in compensation on employees in Czech Republic and mutual relationship with estimation of wage change influence

As the data suggest, consumption of households is not affected only by the average wage, because only 42.73% of consumption of households change rate can be explained by the average wage change rate within the identified relationship. This finding therefore points to the existence of other potential factors affecting consumption of households. Especially in the last 4 years, it can be seen from the left part of the graph that the consumption of households change rate is significantly lower than the average wage change rate. This is likely due to change the propensity to consume of individual households, and other factors influencing (limiting) consumption of households, especially in this period.
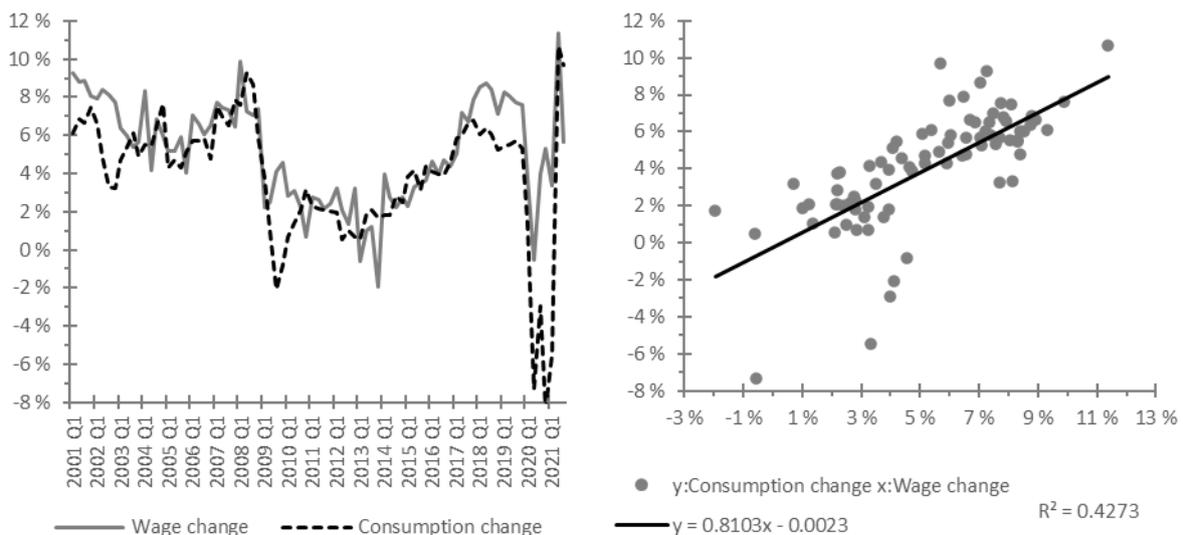
Figure 4. Development of wage change and change in consumption of households in Czech Republic and mutual relationship with estimation of wage change influence

In connection with consumption of households, the last part of the analysis examines its relationship to GDP. Consumption of households represents a significant part of GDP, and

its development is also influenced by the development of consumption of households. In this context, the analysis also shows a strong (R^2 = 0.7169) direct ratio of consumption of households change rate to GDP change rate (y = 0.8257x − 0.0124; where y: GDP change rate, x: consumption of households change rate).
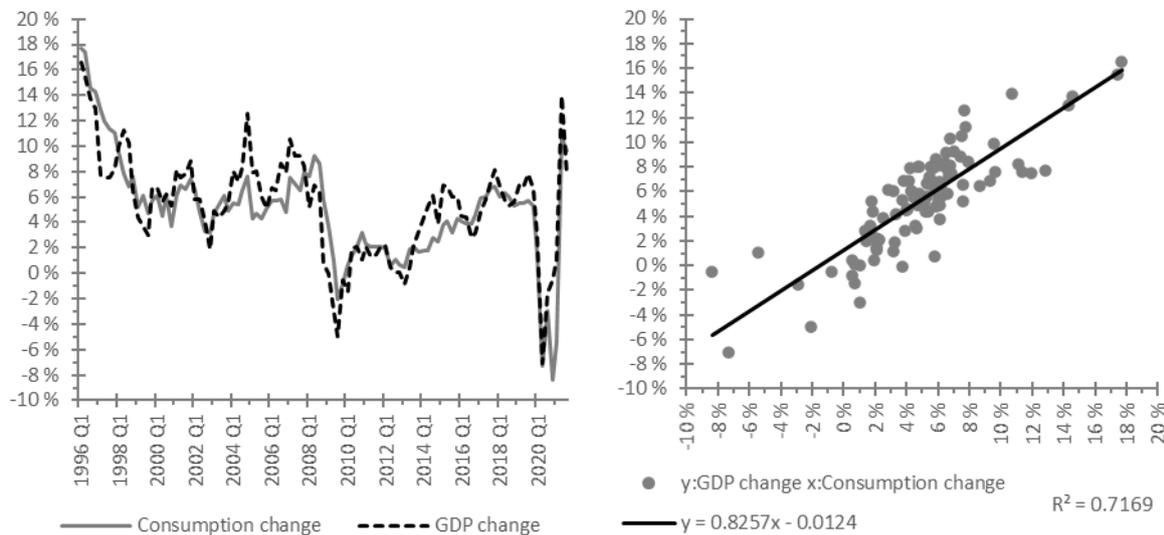
Figure 5. Development of change in consumption of households and change in GDP in Czech Republic and mutual relationship with estimation of consumption of households change influence

4. Discussion

The presented results of the Phillips' curve estimation point to some doubts about this relationship, especially in connection with its derived version. Although the link between inflation and unemployment in the conditions of the Czech Republic was identified based on the presented data, this link cannot be considered significant. The strength of the link would be increased by dividing the overall analyzed period 2005-2021 into at least two consecutive periods (for example, the division to periods 2005-2012 and 2013-2021 would increase the coefficient of determination for both periods to the value higher than 0.5). The results are therefore consistent with the findings reported in another study, where a standard Phillips' curve was identified not only in the conditions of the Czech Republic, but also in other V4 countries (Kadeřábková, Jašová, & Holman, 2020). However, the results contradict the study, which focused on estimating the Phillips' curve in the conditions of the Czech Republic in the same overall period (Krulický, Šanderová, & Dolejš, 2022). The verification of the Phillips' curve seems to be significantly influenced by the choice of period and by the methodological approach for its verification.

Furthermore, the results show that although average wages in the Czech Republic have been growing over the last two years, and although this means a logical increase in personnel costs for companies, their growth is not reflected in changes in domestic consumption. In the last two years, it has lagged average wages, so the data point to the existence of unused household disposable income, which is reflected in an increase in savings. The findings therefore correspond to the report of the Czech Statistical Office mapping the development of chosen economic indicators in 2020 (Zábojníková, 2021). On the other hand, in accordance

with Zábojníková and Kamenický (2021), the data point out that consumption of households has a significant effect on GDP in the Czech Republic.

According to the data, it seems that the average wage affects unemployment indirectly, and directly consumption of households, through which it also affects GDP. Unemployment, on the other hand, is disproportionate to inflation. From this, it can be assumed that there is a directly proportional relationship between the average wage and inflation. However, this relationship is not verified in the paper, because data sets do not match, while monthly data are used for inflation and quarterly data for the average wage. Thus, the existence of a wage-inflationary spiral cannot be assessed.

5. Conclusions

The paper presents an estimate of the original and derived Phillips' curve in the conditions of the Czech Republic for the period 2005 to 2021. The data indicate the existence of a derived Phillips' curve, i.e., disproportionate relationship between inflation and unemployment, although this relationship is not such strong ($R^2 = 0.2454$). In the case of the original Phillis curve, the data suggest a stronger link ($R^2 = 0.4953$) between the average wage change rate and unemployment. In this context, the relationship between the average wage change rate in relation to compensation of employees is further analyzed. The results indicate that other factors, such as the growth of total employment, also influence the development of compensation on employees. The average wage change rate also affects consumption of households, but data suggest that since 2017, consumption of households has been affected by factors other than the average wage change rate, especially after 2019, it can be assumed, that these factors are government restrictions in connection to pandemic.

Given the current development of inflation, i.e., its sharp rise in 2021 and the assumptions for maintaining a relatively high rate in the coming period, we can expect a persistently low unemployment rate in the Czech Republic according to the results of the analysis. In this context, continuing trend of average wage growth can also be expected.

However, these factors are not necessarily reflected in consumption of households, which, as the analyzed data suggest, is also influenced by other factors. If further measures would be taken to reduce consumption of households (such as increasing interest rates, which also affect the propensity to consume individual households), due to thesis that the current high rate of inflation is caused mainly due to excessive consumption of households, then impact on GDP could be seen. GDP growth could slow significantly, or GDP could decline. This assumption is further supported by the announced restrictive government policy, which would also negatively affect potential GDP growth.

Conflict of interest: none

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Trends in ICT Strategies in Financial Institutions

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Abstract: The current economic situation enriches our perception with new perspectives on IT strategies in the economy as well as in the financial sector. Previous concepts have become obsolete and are often at odds with new emerging trends. This article evaluates IT strategies of financial institutions in terms of expected trends. The main methodological approach was to study the IT strategies of the surveyed companies and to compare the identified trends with global trends in IT. One of the main findings is that the past development of corporate IT systems has created for these institutions a historical burden, i.e. an inhomogeneous state of corporate IT. The analyzed financial institutions' planned activities concerning the development of current IT mainly focus on reducing the impact of the historical burden and improving application support, human resources and insourcing, undervalued IT financing, overall corporate IT architecture and major shortcomings in the process management.

Keywords: ICT strategy; financial sector; ICT trends; ICT architecture

JEL Classification G3; G20; C80

1. Introduction

The relationship between a company's organizational structure, information systems and their architecture has been researched in economic entities for many years now. The conclusions differ in some areas, some trends have become obsolete (e.g. nobody remembers nowadays the Y2K problem, the Y2K-related changes in information systems and the solutions of their impact on data content and interpretation), while there are now new trends that mainly concern the interconnection of data with artificial intelligence tools, the evaluation of big data and the comprehensive category called Data Science. On the other hand, the architecture of corporate information systems, including financial institutions' systems, includes applications for automated training, such as various educational applications for the sale of new products e.g. in the banking sector and the insurance industry, for evaluating the financial standing of clients, for performing various market analyses, for managing the relationship with customers and suppliers and of course for training required by law and nowadays usually done in electronic form, such as occupational health safety and fire training.

2. State of Art

Professional literature has analyzed the state of corporate information systems and their relationship to organizational structures and an organization's actual management for many years now. One of the breakthrough articles concerning this area was the study (Nolan &

Koot, 1992). According to a survey, which was based on a total of 936 detailed questionnaires filled out by companies in Australia, North America, Western Europe and India, the harmonization of a corporate information system to organization structures is the most important critical factor of success of corporate information systems, regardless of the region is "Harmonization of a corporate information system to organization structures". In 1992, outsourcing was identified as an ignored factor of success and business process reengineering as the most controversial factor of success (Nolan & Koot, 1992; Messineo, 2019). Other critical factors of success of corporate information systems are discussed e.g. in Khandelwal and Ferguson (1999).

The results of this study and other elaborations helped to further develop this theory, especially towards the planning of corporate information systems. (Nolan, 1979) "Information system planning is focused on determining the information needs and also ensuring that information system planning aligns with the overall business planning. For information system planning Richard Nolan has given a model known as Nolan stage model. It initially had four stages of growth and later on, it was reviewed, and as a result, there is an addition of two intermediate growth stages "(Geektonight, 2021). The model has become obsolete, yet – despite the indicated problems of the entire theory – it has been used for corporate information systems planning to this day: "Despite this criticism, the model finds its validity in many applications of information system planning till today. Every organization realizes that their information system has to undergo these stages. But how long it stays in each stage depends upon the learning process of the organization" (Geektonight, 2021).

Not only large corporations but also small and medium-sized companies (SMEs) strategically plan their corporate information system. Critical factors of the strategy of corporate information systems are discussed e.g. in (Alderete, 2019; Sorensen & Carrol, 2021). The conclusions can be briefly characterized as "ICT and electronic commerce benefits and usefulness among SME. In this manner, they can strengthen firms' ICT strategic alignment" (Alderete, 2019).

The direct impact on the readiness for a digital transformation of financial institutions is shown e.g. in Hussain (2022). "We also find that Digital Financial Innovations (DFIs) positively impact the firms' financial performance and resilience (robustness and adaptability). The results are informative for practitioners and theoreticians. For practitioners, the study informs that realizing DFIs in organizations requires reconfigurability and flexibility of resources, IT, strategy, collaborations, and organization culture" (Hussain, 2022). However, a very interesting conclusion of the study is this fact ""…one crucial finding is that in a developing economy context, digital technology – business strategy alignment does not play a moderation role in realizing DFIs, which may not be the case in the developed economies…" (Hussain, 2022). For this reason, we excluded developing economies from our analysis and we focused only on developed economies, which also include the Czech economy in the area of financial institutions.

3. Methodology

The findings are based on analyses of IT strategies of selected multinational companies that provide services in the financial industry – four independent companies. Two companies are providing bank services (retail) and two companies are providing insurance services. All companies were significantly growing in last 4 years in all key measures, like turnover, number of total employees, number of employees in IT. Companies have significant difference in comparison number of employees in IT with total number of employees.

The main research method included analysis and synthesis as well as consultations and the results of controlled interviews. As a key input were Annual Reports of the selected companies, information about IT which are included in these Annual reports or annual reports of the IT itself.

The authors take into account Annual Reports published by analyzed companies during between 2017 and 2021. Authors search for measures defined above and were analysis especially trends in all four analyzed companies and their IT departments.

For the purpose of this paper were defined two research questions:

- RQ1: What are the main trends in the development of ICTs in financial institutions for the next three years?
- RQ2: Do companies believe that the roles of architects are important roles that need to be established/strengthened in the company?

4. Results & Discussion

The analyzed strategies are extensive documents. The first interesting finding is that all companies approach the preparation of their IT strategies in a similar way. The document includes an analysis of the current state and a definition of the future state. The analysis shows similar problems and critical areas; after that the target state and improvements in the given areas of corporate IT are defined.

The basic approach of all companies to their IT strategy is that they analyze the current state and then define the future state. The analyses of the current and future state focus on four basic factors:

- human resources as the main parameter of success and failure of any IT strategy,
- provided applications,
- provided services,
- future state of IT.

4.1. Conclusions from the Analysis of the Current State

Based on the analyses of the current state, all companies have reached conclusions that they mention as significant. According to the companies, the following outputs of the current state are crucial:

1. historical burden,
2. undervalued human resources & insufficient in-house know-how,
3. application support,

4. process perspective,
5. financial perspective.

A historical burden is understood to mean a set of applications that individual companies use and that – in most cases – are not integrated, are not adequately updated and especially are not in compliance with current trends and requirements. A key finding in this context is that the companies do not use a unified client database. Therefore, same clients are registered in different systems under different identifiers that cannot be linked together, which results in highly insufficient data quality. There is a similar finding concerning reference data management, where individual applications use different code lists for identical things.

Security, reporting and IT infrastructures represent a separate area of the historical burden. All analyzed companies mention significant problems in this area that have already been identified during internal and external audits.

An interesting conclusion in all companies is their objective to reduce the total number of applications in order to improve operability and stability.

Undervalued human resources & insufficient in-house know-how

Almost every financial institution struggles with a shortage of internal employees and their remuneration. According to the companies, their employees have been historically undervalued. The rationale for the current situation varied; nevertheless, the following two common factors were identified in all companies:

A. Insufficient remuneration of their employees, especially of those who have worked in the company for a long time.
B. Insufficient human resources for all IT roles that are necessary for a long-term IT functioning.

Other important findings are as follows:

- Insufficient investments in human capital development. One of the consequences of insufficient investments in the human capital is IT lagging, which mainly stems from the fact that modern trends and best practices are not respected/accepted. This can affect the satisfaction of both internal customers of corporate IT and external consumers of services of the entire company. An internal service is e.g. the company's business system for opening bank accounts, and an external service is e.g. a mobile application.
- Insufficient building of in-house know-how mainly because of the use of external human resources in the form of outsourcing, not only for non-key activities/processes, but also for activities/processes that are important and even critical for individual companies.

Application support

Application support is closely connected with the historical burden, which refers to existing problematic applications, while application support refers to applications that are not available or do not provide the necessary or adequate functionality.

The companies mainly pointed out the following two key areas affected this way:

- customer sales support applications,
- company core systems for processing customer requests made both through digital channels and the traditional way - by visiting a branch office or having a personal meeting.

Based on the analysis and especially consultations with IT directors, the two previous points are the main cause of identified insufficient application support. Due to insufficient in-house know-how, the companies are not able to unambiguously identify the needs of internal and external end users. Furthermore, it is difficult to identify the application among existing applications that should ensure/provide the potential functionality. Another reason is the obsolescence of applications and often also the insufficient architecture and documentation of solutions that would help to develop the architecture. The importance of architectures and IT architects and their qualifications is discussed e.g. in Gellweiler, 2020; Turek & Werewka, 2015; Selcan & Buchalcevova, 2013.

Process perspective

According to all companies, the process perspective is handled insufficiently or not at all, which is reflected in the quality and security of the delivered/provided services. The following key problematic areas from the process perspective were identified:

- missing/insufficient,
- security,
- compliance.

Financial perspective

The financial perspective is the last of the identified areas that all analyzed companies mentioned. According to all companies, IT budgets are undervalued, which affects all previous areas.

All companies identified this issue as a critical output of the analysis and mentioned it as the number one priority in implementing their strategy.

4.2. Conclusions from the Analysis of the Target State – Strategy Definition

The definition of the target state closely follows up on the previous part of the analysis of the current state and expands the analysis by future expectations. The analysis of the IT strategy identified the following main areas on which all companies, although they provide different financial services, will focus:

- reduction of the impact of the historical burden and the improvement of application support,
- human resources and insourcing,
- finance,
- IT architecture,
- processes.

Regarding the **historical burden** and related **application support**, the companies have reached the following same conclusions:

- it is necessary to analyze the existing applications and decide about their future,
- some applications will be suppressed or replaced,
- it is necessary to create a unified database and to set up master data management principles and processes, based on which the company will work with data as with an information asset and every specific customer will have the same meaning and parameters in each part of the company,
- where meaningful, applications will be integrated into a created unified database,
- the implementation of mobile device management technologies will be more secured,
- applications that are critical for IT functioning and will support the implementation of IT processes will be implemented,
- transnational and local directives that have a significant impact on the company's operation, such as IFRS 17 in the insurance industry, GDPR in financial services, etc., will be implemented.

In the context of the three previous points, it is necessary to analyze the objective of applications replacement in more detail. According to the companies, it is better for them to remove some existing applications and to develop from scratch/ buy new applications than to re-engineer existing applications (they will not use the re-engineering techniques). Another reason that the companies mention is the maintenance cost of the applications that use old technologies that are difficult to maintain because they are obsolete and also because there are not enough persons who know these old technologies; outdated technologies are usually not interesting for young employees, which reduces the chance to hire new employees.

Human resources, which affect both the previous and all other analyzed areas and are closely linked to financing, represent the second key and most important plan. All companies specified a new request for the size of the budget of their IT department and the target number of experts working in their IT department. The companies decided that their turnover should be the benchmark for the size of their budget. This benchmark is based on averages, is also mentioned by the Gartner Group and represents 3% of the company's turnover. The benchmark and thus the total IT budget significantly affect the size of investments in human resources, applications, infrastructure and processes, i.e. in the areas critical for sustaining and developing the company's IT services.

All companies have concluded that it is necessary to considerably increase the share of their existing IT human resources to 15-20% of the total number of company employees. The companies have also concluded that it is necessary to:

- ensure the development of employees so that they would be able to implement the requirements for modern information systems,
- remunerate their employees in line with the current situation on the labor market and to offer such remuneration not only to their new employees, but also to their current employees so that they would not leave and take away the company's key know-how',

- increase employee satisfaction and achieve an open culture that would also attract a potential influx of new employees,
- **limit outsourcing and develop in-house know-how** that will ensure the company's sustainability and use outsourcing only to acquire new know-how, which is currently unavailable in the company and must be built up this way, or to cover peak workloads since hiring a new employee would cost more. where it is not cost-effective to hire a new employee.

The infrastructure development and the verification of the option to move applications to a cloud environment represent another area that the companies evaluate similarly. All companies mention, as a first step, the transfer of e-mail services to a Microsoft Office 365 cloud environment and the implementation of services that will ensure security and reduce the risk of cybercrime. All companies have identified a weakness in the design of both the overall corporate architecture and its components, such as IT architecture, data architecture, etc. Therefore, all companies want to create/formalize the roles of architects in the company and to give them the appropriate mandate that will ensure a logical structure and integration of all IT solutions in the company. All companies have identified two main roles that are crucial for their future functioning – the role of **Enterprise Architect responsible for overseeing a comprehensive design of the entire IT landscape** in the context of business needs and the role of **Data Architect**. However, the companies had different plans concerning other roles, such as IT architect, software architect, business architect.

As to processes, the companies very much emphasized the need to transform IT into a process-controlled organization and to improve IT processes so that IT services would be provided in appropriate quality and at appropriate costs. This area also includes the actual transformation of corporate IT that will focus on the delivery of business services and not on the existence of IT as a general service provider that is not business-oriented. This will also affect the organizational structure of corporate IT and IT roles and will strengthen the role of business analysts and business architects, which will then reflect in the application area.

An important part of the process perspective was the implementation of security enhancement processes and documentation of all solutions and design in the company, which will help to develop know-how and to reduce the risk of employee turnover.

RQ1: What are the main trends in the development of ICTs in financial institutions for the next three years?

We can say that the analyzed companies have similar strategic plans for the next three years. The main trends and requirements concerning their IT strategy are as follows:

- strengthen the budgets of IT Departments,
- focus on employee care, the development of employees and insourcing,
- strengthen the role of architects in the companies,
- reduce and replace or improve historical applications in order to achieve application integration and synergy effects from their use,
- set up processes.

RQ2: Do companies believe that the roles of architects are important roles that need to be established/strengthened in the company?

The answer to RQ2 is YES and it has already been answered in previous RQ1, where the role of architects is perceived as important and critical for ensuring the sustainability of IT systems in the company.

4. Conclusion

Based on the analysis of IT strategies of selected multinational companies in the financial sector and interviews with the IT directors of the companies whose IT strategies were analyzed, we have discovered some interesting findings and trends.

The main trend is that in consideration of all of their current and planned activities, all companies want to increase the budget of their IT department and insource their IT activities, i.e. to transfer them from external suppliers to in-house employees. This is justified by two facts: 1) long-term internal employees are cheaper than external employees and 2) know-how should always be kept within the company. The first fact is connected with the companies' efforts to expand their employee care.

A significant trend from a technical and organizational point of view is the pressure to strengthen the role of architects in the companies and the efforts to optimize the entire IT portfolio, which often results in the suppression/cancellation of existing applications and their replacement with new ones.

The IT strategies of the selected companies were made for 3-5 years, i.e. they are truly long-term strategies, with the knowledge that all activities mentioned in this article represent fundamental changes in the functioning of the companies and that they are long-term projects.

Conflict of interest: none

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Model of Successful Spin-off Support Based on the Czech-Norway Cooperation

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Abstract: Technology and knowledge transfer is a set of activities and processes that lead to the costing of knowledge outcomes of universities and other research organizations on the market. Technology and knowledge transfer is not limited to results of research and development (R&D) but includes other outputs of universities that can be commercialized in the form of providing various professional services by selling intellectual outputs to industry. Generally speaking, transfer knowledge is of utmost importance for the university, for students and especially for researchers including early stage researchers such as Ph.D. fellows that should know about the possibilities of bringing the intellectual outputs to the industry. However, there are various problems associated with this topic which must be effectively solved in order to achieve its full potential since this topic is less mature and developed at universties compared to R&D. The paper provides an insight into an effective scheme of development and start-ups setting in a progressivly growing and rapidly developing university environment in Norway.

Keywords: spin-off; university; fablab; conceptual model of spin-off support; transfer technology

JEL Classification: O31; O32; O34

1. Introduction

Experts in management and economics agree about the importance of innovation and the ability to transfer technological innovation not only in science, research, and development, but also innovation arising from practice or innovation which arose from thinking about things "in a different way" to the business sphere. Technology and knowledge transfer represents a key capability that has a major impact on overall economic growth, GDP growth, value-added employment growth and the overall rise in society. There is a consensus among experts that knowledge is growing in importance for economic growth and that the role of innovation and the ability to use new knowledge and innovate will play an increasingly important role in the economic development of countries and regions in the future.

Changes in labor market requirements are a natural part of a company's development. It is estimated that 35% of current jobs may be held by computers in the next 20 years (OECD, 2018). Some jobs will naturally disappear and be replaced by new ones. The technological revolution is stimulated by the sense of improving human lives and it requires strategic management not only at the system level but also for each individual. The boundaries between

the work performed by humans and those left to machines or algorithms are rapidly shifting. Based on production trends and monitoring the growth of the economy, the global labor market is likely to undergo a major transformation in the next few years. If this transformation is well managed, it can lead to economic growth, job creation, and an overall improvement in the quality of life for society as a whole. As already mentioned, in order to increase the added value of products and services, a transformation into a manufacturing sector is necessary, in which it is possible to produce products or services with high added value.

A very important part of this new manufacturing sector in the future is especially start-up companies and spin-off companies, which start from practically zero. For successful market penetration, it is crucial for them to enter the market often with a new, unique solution, which no one has yet tried to solve a specific problem. For this reason, the segment of startup companies is desirable for the development of a healthy economy and should be supported not only at the national level but also at the regional one.

Some subgroups of start-ups are provided with special support in their efforts on improving competitiveness and growth. Some start-ups might evolve at a high pace resulting into fast-growing companies (so-called gazelles) or "born globals" (new companies that are internationalizing very quickly). In particular, innovative companies have moved interest to academic spin-offs companies. It is estimated that their impact on improving the competitiveness of the national economy is particularly high (see, e.g., Shane (2004) or Klofsten and Evans (2000)).

New academic companies change into a knowledge society. However, there are still new academic companies additionally supported by developments in the university field related to the concept of knowledge company. In a knowledge-based society, the role of the "classical" university is closely connected with the question of the commercialization of knowledge. This commercialization also includes academic companies. Etzkowitz's thematic transformation plays a significant role at Humboldt University. The latter focuses on three tasks: two traditional tasks – research and teaching and a third task emanating from the entrepreneurial nature of the university namely knowledge evalaution (Etzkowitz, 1998).

In Europe, however, it is precisely this new, third task for universities – valuing knowledge – where a deficit arises, especially when it regards the successful implementation of innovation in the market. Therefore, the American legilization "The Bayh Dole Act" is considered as a benchmark for the commercialization efforts of the universities and support of licenses of research results. Universities see licenses as their best commercialization opportunities, while the establishment of spin-off companies is attributed to a more secondary priority.

Experts and scientists usually consider creating their own business structures in the form of "spin-offs supported by licenses. Creating adequate framework conditions for commercialization of knowledge, whether it is a license or a company, remains one of the key issues in both positions' questions. Answering this question under adequate framework conditions is therefore very relevant, both from a theoretical and a practical point of view. The article focuses on the description of a successful model for the development of spin-off

companies. The article was created based on Czech-Norwegian cooperation and the interconnection of mutual models of spin-off support.

2. Methodology

This work uses the following main methods: synthesis of knowledge, qualitative research represented by a sophisticated questionnaire of academic and TTO′s specialist. Qualitative research works with diverse data sources and enables a wide range of methods to be used to find and process data. However, it is more time-consuming and the results are more difficult to interpret. Research can also emante from field work, where information and opinions are obtained from respondents through direct contact with them. Structured questionnaire interviews are a sophisticated concept of these surveys. There were used also case study methods. In the social sciences, the term case study refers to both a method of analysis and a specific research design for examining a problem which can be used to generalize findings across populations. A case study examines a person, place, event, phenomenon, or another type of subject of analysis in order to extrapolate key themes and results that help predict future trends, illuminate previously hidden issues that can be applied to practice, and provide a mean for understanding an important research problem with greater clarity.

As a case study was used the model which is applied in Metropolitan OsloMet university in Oslo, Norway. The methods used to study a case can rest within a quantitative, qualitative, or mixed-method investigative paradigm. A case study encompasses a problem contextualized around the application of in-depth analysis, interpretation, and discussion, often resulting in specific recommendations for action or for improving existing conditions. Practical considerations such as time and access to information can influence case selection, but these issues should not be the sole factors. Methodological approaches were based on modeling include retrospective analysis, qualitative and quantitative surveys in the university′s environment. The proposed model allows the evaluation of quality benefits and contributes to the expansion of the possible methods used in knowledge management. The initiating element was a joint project focused on the development of technology transfer within the grant scheme EEA grants 2014-2021, where the basic elements of the conceptual model were discussed at the level of top management of both universities.

3. Academic Entrepreneurship – Spin-off

There are several definitions of spin-offs (sometimes also spin-outs); for example, the US Securities and Exchange Commission (US Securities and Exchange Commission) defines a spin-off by distributing a subsidiary's shares to the parent's shareholders as part of a spin-off, so that the subsidiary becomes a separate, independent company. The reason why the parent organization creates a spin-off is its belief that the spin-off will do better on its own than within the parent company. There is some form of consideration for the transfer between the parent company and the spin-off (for example, share ownership or a license agreement).

A specific case of spin-offs is high-tech startups, which are produced by universities from master's students or doctoral students when the idea proves to be interesting and practical

enough to be further developed in the academic sphere. Spin-off as a business entity is established for the purpose of commercializing intellectual property created by a research organization. The connection between the company and the university can be made tight. The school directly invests its intellectual property in the newly established company and acquires a stake in it, or inserts intellectual property into the company in the form of a license, or the new company bases the university staff on its personal know-how and ties to the school are only informal (for such companies uses the start-up label).

Germany became the cradle of academic spin-off companies in the 19th century (Mowery & Sampat, 2001a, pp. 317-318; Mowery & Sampat, 2001b, p. 781; Shane, 2004, p. 40). The concept of modern universities as we perceive them today was born in Germany, and where initial attempts were made to establish companies that would benefit from the use of theoretical scientific knowledge in practice. Among the first successful business swallows were Professor Johann Pickel, who founded a salt, potash, and acetic acid company, and Justus von Liebig, who based his research on building a food supplement company (Gustin, 1975). The German concept of the organization of university life was also adopted by universities in the United States, which became the main driving force in the development of the business environment at universities in the 20th century (Powers & McDougall, 2005, p. 291). A specific feature that contributed to the massive development of the university's business environment was the system of so-called state grant funding and the adoption of The Hatch Act of 18877, a standard that forced universities to apply scientific knowledge in practical life. It was the de facto first norm ordering the commercialization of intellectual property (Shane, 2004; Powers & McDougall, 2005).

The process of establishing innovative spin-off companies is very slow compared to the Western world in the Czech Republic. Despite the richly subsidized support of a number of European and national programs, the process of establishing academic spin-off companies encounters the non-existence of some mandatory preconditions. In order for the process to be successful, it is necessary that there are legally sufficiently protected and at the same time commercially usable results of research and development. A system of internal standards must be established within individual research organizations aimed at intellectual property protection and participation in other legal entities.

4. Case Study – OsloMet

Oslo Metropolitan University is one of the largest universities in Norway with a student body of approximately 20,000 students and 2,000 employees. OsloMet seeks to be an urban university with regional and national responsibilities, and with a clear international character. Its mission is to deliver knowledge to solve the future challenges of the welfare society. The university consists of four faculties and two research centers: The Faculties of Health Sciences, Education, and International Currently, University has nearly 300 partnership agreements with institutions in over 60 countries, including collaboration within research, education, and innovation. The majority of partner institutions are in Europe, but also there are strategic partnerships in countries such as the United States, China, India, South Africa. The university is committed to increasing its participation in the EU Framework Programme for Research and

Innovation. In collaboration with Simula Research Laboratory OsloMet hosts Simula Garage which is a technology and knowledge transfer incubator. The organization is an incubator for early-stage, technology-intensive startups, with the purpose of providing a working and breathing space for entrepreneurs turning ideas into successful businesses. In this way, the Oslo Metropolitan University has a large experience with technology transfer and protection of intellectual property which is the main objective of the proposed project. And the experience of Oslo Metropolitan University will play a key role in creating project outputs. OsloMet is a natural place for those wanting to connect with the network of researchers, students, and technology experts, as well as those who are doing business. University technology transfer offices (TTOs), or technology licensing offices (TLOs), are responsible for technology transfer and other aspects of the commercialization of research that takes place in a university. TTOs engage in a variety of commercial activities that are meant to facilitate the process of bringing research developments market, often acting as a channel between academia and industry. Most major research universities have established TTOs in the past decades in an effort to increase the impact of university research and provide opportunities for financial gain. While TTOs are commonplace, many studies have questioned their financial benefit to the university. The OsloMet innovation structure is shown in Figure 1 and Figure 2. The models are based on slides from Nina Helene Løvmo OsloMet, Innovation Team, OsloMet 2021. The project brings unique possibilities to share the knowledge with TTO of OsloMet – Oslo Metropolitan University.

OsloMet is closely connected with an innovation incubator called Simula Garage@OsloMet which is a free place to work on innovative ideas for 12 months. The goal of the Garage@OsloMet is to provide an inspirational and supportive community for entrepreneurs who aim to turn ideas into successful businesses. The Garage is open to all students, alumni, and employees at OsloMet. The Garage is a competence center for start-ups developed by Oslo Met. The Garage is an initiative from Simula Research Laboratory in collaboration with OsloMet to give ambitious entrepreneurs the opportunity to work in a free office space alongside other inspirational innovators. The company must be early stage. With Oslomet there is bonding a makerspace, this identity is a kind of digital craft, a room full of tools and innovative technology that allows you to create things in new ways. One example of student project consists of builduing a self-propelled drone in collaboration with the Norwegian Defense Research Establishment.

And there is also close cooperation with SimulaMet, which is a new research unit that is jointly owned by Simula Research Laboratory and Oslo Metropolitan University, formerly Oslo and Akershus University College (HiOA). It is the home of Simula's research activities on networks and communications, machine learning, and IT management, and it is OsloMet's strategic partner in research, Ph.D.- and MSc- education in digital engineering. SimulaMet is organized as a limited company and it is part of the Simula lab. The mission of Simula Metropolitan is to do research in digital engineering at the highest international level, to educate and supervise Ph.D.- and master students at OsloMet, and to contribute to innovation in society through collaboration, startup companies, and licensing of research results.

In this case study, we can see that support of successful spin-off is a complex of key role players and stakeholders and that why Oslo Met belong to very successful university in this field.

4.1. FaB LaB

FabLab from the English Fabrication Laboratory is an open high-tech workshop for the public (usually for registered members paying contributions to the running of the workshop) and a training center in the field of modern technology. The purpose of FabLab is to make otherwise very expensive machines and technologies available to early stage scientists, companies, students, etc., and to provide them with appropriate training and education for mastering given technologies. Fablab provides tools, space to create, machine operator training, technical support, and educational events for brokers (individuals using technology and creative thinking to create).

FabLab is usually based on the principles of sharing know-how, open-source. In addition, modern European FabLabs strive for maximum urban independence, in-house production, and ecological thinking with maximum waste reduction. The purpose of FabLab is to connect students, universities, companies, and other workshops. FabLab provides an environment for student projects, and beginning entrepreneurs and seeks to bring the university and private spheres closer together. Sharing know-how between universities, workshops, and other entities is also a prerequisite.

FabLab should better prepare students for the job market, which is now closely linked to modern technologies (such as 3D printing, IoT, robotics, automation, drones, digitization, and other related areas) and connect more the student sphere and the practical requirements of today's companies. Another goal is to support students in the opportunity to start their own companies and provide the necessary support for starting their own startup. Thanks to the available technologies, students can implement their ideas without major initial investments. It seems that role of fab labs in the spin-off support chain is significant.
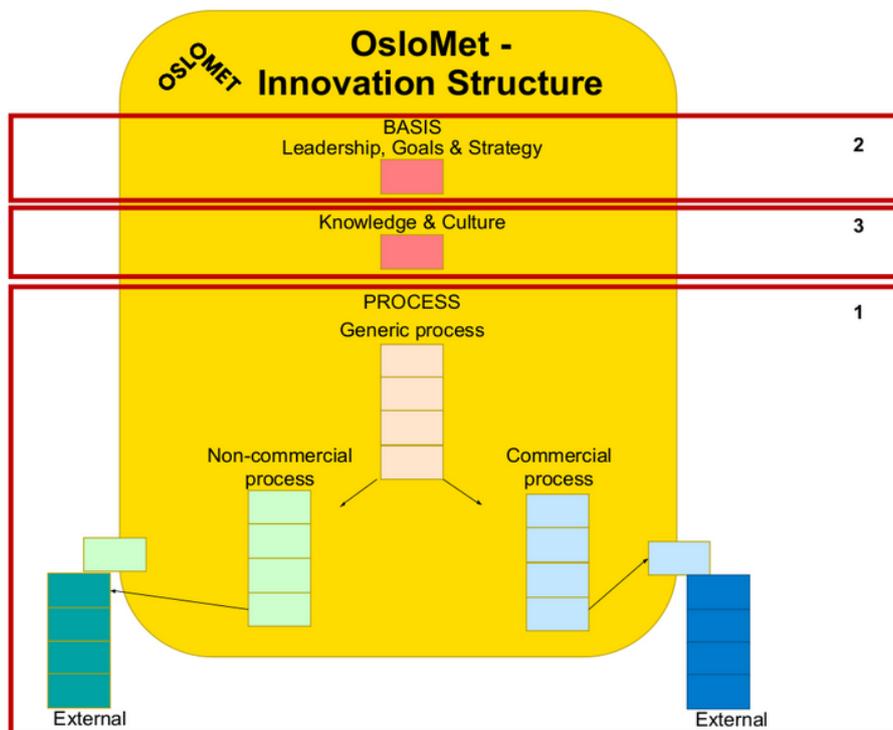
Figure 1. The OsloMet innovation structure (Source: own based Løvmo (2021))

Figure 2. The OsloMet innovation structure (Source: own based Løvmo (2021))
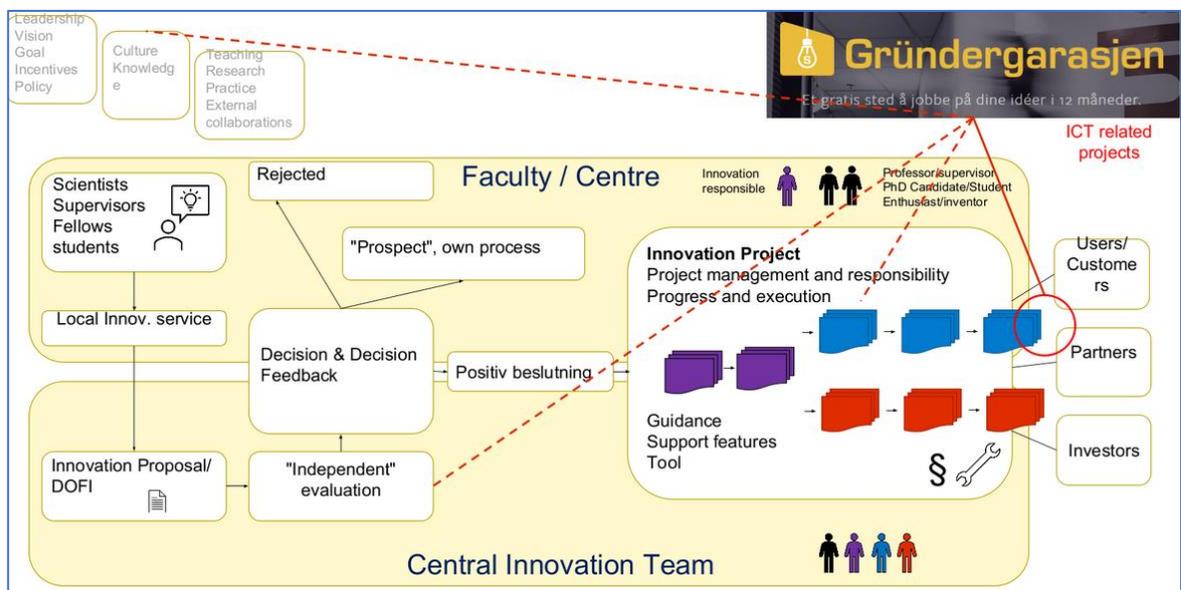
Figure 3. The conceptual model of succesfull spin off environment based on Czech – Norway cooperation (Source: own based Løvmo (2021))

5. Scheme of Successful Model of Spin off Development based on Czech-Norway Cooperation

Based on the identified functional models at OsloMet, the following model was created suitable for the development and support of spin-off in the university environment in general. It was found out that different subjects in one holistic environment play a very important role. These subjects are under university control and they are: independent incubator provided for 12-month support for the most promising ideas coming from university, there is the significant role of research unit which is outstanding of the university and has its own business partners, focusing on industry research. And also to successful environment belong so-called FaB Labs, where also small projects can be tested and they are very supportive to proof of concept level. All these subjects actively participate and contribute to a successful spin-off creative environment.

All these outputs were placed in the conceptual model Figure 3.

6. Conclusions

One of the initial questions asked at the beginning of this work was whether Academic spin-off companies can contribute to building a knowledge society and improving the competitiveness of the national economy. The Czech Republic, based on the Lisbon Strategy of the European Union, with its own National Program for Scientific Progress, also seeks to build a knowledge-based society. Therefore, this work examines the crucial issue of supporting and limiting factors for academic spin-off companies including the benchmark in the Norway university environment.

Based on the identified functional formulas and models, a model of a successful spin-off environment based on Czech-Norway cooperation was created which is a suitable model for the development and support of spin-off in the university environment. The factor limiting the business climate is favorable rules and well-established processes of transfer of intellectual property to academic spin-off companies. Tough rules are decisive factors hindering the emergence of a supportive climate. This limiting factor is not just due to rules for intellectual property rights, but has also to do with the whole process, up to the emergence and growth of academic spin-off companies.

Here are listed recommendations of multi-level spin-off support:

- Improve the management of academic spin-off companies at the management level.
- Universities must show appreciation of their work and their business risk.
- Establish at the university level the rules, which include all aspects of academic spin-off firms such as conflict of interest regulation.
- Different way for licensing and for spin-off – recognition at the beginning of whole process.
- Building FaB Lab as a part of the university environment. Support of proof of concept level.
- Access to innovation incubator for 12 months free for promising project ideas.
- Build independent research unit driven by industry demand.
- Ensure cooperation between all the above-listed subjects.
- Improve academic mobility from research centre to cooperate with FabLab and research unit.
- Improve the distribution of revenue from sold licenses and increase value assets in spin-off companies, incentives for setting up spin-off companies; better respect to the faculty in the distribution (eg laboratory equipment).
- Demonstrate to the faculties staff that spin-off companies also bring benefits to them. Support of proof of concept.

Not all academic factors could be taken into account in this research. For example, the type of technology was not monitored, which is also one of the influencing factors, or the kind of the university which is involved in spin-off companies, or the motivation to establish a spin-off company, where it would be interesting to note the cultural dimension. Along with the established propositions, a rich collection of starting points for further research is proposed, which should be understood more broadly. More institutions as well as spin-off

companies should be included. As final remarks, the goal of the work was fulfilled. The work aimed to capture aspects of a successful model of technology transfer support, which was devised within the Czech-Norwegian cooperation and thus supports cooperation within EEA Grants and helps to contribute to a more equal Europe, both socially and economically. In this sense, the work contributes to the overall objectives of reducing economic and social disparities within the European Economic Area and strengthening bilateral relations between Czech education and Norway education in the field of transfer technology and protection of intellectual property. This systematic support is necessary not only for nationally oriented transfer technology departments but especially in the case of cross-border transfer technology. There are going to be three peer-learning activities for the staff from both participating universities.

Conflict of interest: none

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Multi-Criteria Model for the Performance Measurement of Companies and its Application to Participants of the Olomouc Region Entrepreneur of the Year

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Abstract: The aim of this paper is to develop a multi-criteria model suitable for the performance measurement of firms. The constructed model will consider in addition to the traditionally used quantitative financial criteria (return on assets, current liquidity ratio, indebtedness, and asset turnover ratio) also nonfinancial qualitative ones such as customer feedback or company involvement in activities in the region. Also, the cooperation of the firms with foreign countries will be taken into account within the model. The model will be created using a weighted average operation, which is mathematically sufficiently complex as well as easy to use for practical evaluation problems. The created model will be subsequently applied to analyze selected companies that participated in the competition Olomouc Region Entrepreneur of the Year in previous 14 years. The analysis of companies will be carried out for two years, 2018 and 2020, which will enable besides other to examine the COVID-19 pandemic impact on these companies.

1. Introduction

Performance measurement in companies is an important topic for economists engaged in either practice or theory. The process of performance measurement is very complex and various measures have been used during history (Wagner, 2011). Various financial metrics which are now taken as standard and well established in textbooks served as traditional performance measures (Atkinson et al., 2012; Drury, 2015). The latest research in the field of performance measurement is shifting towards the Key Performance Indicators (KPI) which is the term set up in 1992 (Kaplan & Norton, 1992). The goal of the KPIs was to cover other non-financial areas which are important for the performance measurement (Norton, 1999). The systematic approach towards the KPI (usually within the framework of BSC) has been researched in the past two decades (Kaplan & Norton, 2001; Niven, 2005; Jones, 2011; Lawrie & Cobbold, 2014; Uddin et al., 2020). Since some of the KPIs (or just PIs) have high level of uncertainty, new methods of dealing with the uncertainty have been developed (Pokorný &

Menšík, 2014; Malviya & Kant, 2019). As in the past decade, the importance of Environmental issues is increasing the specific tools to measure the environmental aspects have been introduced (Jasch, 2003; Chytilová & Jurová, 2012; Rafiqet al., 2020).

The performance measurement has been, among other uses, used for comparing companies and benchmarking. There are many contests on national or international level where "the best" companies of the year are announced. Within these contests, traditional financial performance as well as the modern non-traditional is in use.

The traditional performance measures are well understood, exactly defined, determined by mathematical formulas, based on the audited and verified data. This is not the case for the new, modern KPIs. The KPIs are often highly individual, based upon internal data, often with fuzzy nature (Zadeh, 1975; Pokorný & Menšík, 2014).

From the methodological perspective, different mathematical approaches have been used for the performance measurement and evaluation of the firms from the various points of view. E.g., structural equation modelling was applied to test correlations between the variables analyzed in Wall, 2021 in order to evaluate family firms in Thailand. In Eickelpasch et al., 2016, firms' evaluation of location quality by regression analysis was analyzed dealing with East German firms. Except for those statistical methods, fuzzy sets theory has been also used for creating the firms´ evaluation methods (see, e.g., Ertuğrul & Karakaşoğlu, 2009; Magni et al., 2006; Magni et al., 2020). The advantage of such attitude lies in the fact that it enables to properly implement the qualitative criteria into the analyzed model as well as the uncertainty of the inputs. On the other hand, it is usually quite difficult for practitioners to apply fuzzy sets theory evaluation methods to their specific problems.

In this paper, we will focus on creating a multi-criteria model for the performance measurement of companies. This model will consider, in addition to the traditionally used financial criteria, several other aspects - customer feedback, company involvement in activities in the region, etc. This model is not purposed to replace or substitute bankruptcy models (Wu et al., 2010; Mossman et al., 1998). The purpose of the model is to measure the performance of companies while using traditional financial measures as well as nonfinancial measures and compare the situation before and during the COVID pandemic. The model will be created using weighted average operation that allows to consider the importance of the criteria and that is very easily applicable to practical evaluation problems. The outputs of the evaluations will be described by real numbers in the interval [0,1], which represent the value-creation power of the firms. The created model will be subsequently used to analyze selected companies that participated in the competition Olomouc Region Entrepreneur of the Year in previous years. The analysis of companies will be carried out in two years – before the COVID-19 pandemic and during it, which will examine its impact on these companies.

2. Methodology

If we consider the multi-criteria evaluation problem in which n variants

$$a_1, a_2, \ldots, a_n$$

are to be evaluated with respect to k criteria

$$c_1, c_2, \dots, c_k,$$

then it is possible to describe the variant $a_i, i = 1, 2, \dots, n$, by the vector of criteria values

$$(y_{i1}, y_{i2}, \dots, y_{ik}).$$

If we consider all criteria and variants together, then the following criteria matrix fully describes the inputs of the studied multi-criteria problem:

$$Y = \begin{pmatrix} y_{11} & y_{12} & \cdot & \cdot & \cdot & y_{1k} \\ y_{21} & y_{22} & & & & y_{2k} \\ \cdot & & \cdot & & & \cdot \\ \cdot & & & \cdot & & \cdot \\ \cdot & & & & \cdot & \cdot \\ y_{n1} & y_{n2} & \cdot & \cdot & \cdot & y_{nk} \end{pmatrix}$$

Figure 1. Criteria matrix for n variants and k criteria

After the specification of the criteria, the variants and their criterion values, it is necessary to evaluate each of variants and to compare the results of the evaluation process. Many different methods have been used for such an evaluation (see the Introduction for the brief overview). In this paper, the weighted average operation will be applied for the calculation of the final evaluations since it is very easily applicable for the practitioners on one side and mathematically complex enough on the other side.

The application of the weighted average operation consists of few steps:

1. Determination of the types of criteria.
2. Rescaling the values y_{ij} from the criteria matrix into the unit interval.
3. Expressing the importance of the criteria by normalized weights.
4. Computation of the overall evaluation.
5. These steps will be described in more details in the following paragraphs.

Step 1. In order to convert all the values from the criteria matrix into the same scale, it is necessary to determine the type of each criterion. Quantitative criterion of maximization type is the criterion with numerical values satisfying "the more the better"; a typical example of such a criterion is profit. On the other hand, quantitative criterion of minimization type is the criterion with numerical values satisfying "the less the better" – e.g., average collection period. The criteria with non-numerical values are called qualitative.

In practical applications, it is sometimes necessary to deal with other types of criteria than the above-mentioned standard ones. As an example, we can consider current liquidity ratio, which is a quantitative criterion but neither maximization nor minimization type, since its optimum value lies usually in the interval between 1.5 and 2.5. Too small values of this criterion may mean a low ability to pay short-term liabilities; too high may indicate

inefficiency in management. Therefore, it is necessary to deal with the criterion individually and to use non-standard, sometimes nonlinear, re-scaling in such cases.

Step 2. After the determination of the types of criteria, it is necessary to rescale the values y_{ij} into the same scale – standardly, to the interval [0,1]. The way how this rescaling is done depends on the type of criterion. For the quantitative criterion of maximization type, the formula is:

$$b_{ij} = \frac{y_{ij} - y_j^{min}}{y_j^{max} - y_j^{min}} \qquad (1)$$

where y_j^{min} is the minimum value of the j-th criterion in the considered problem and y_j^{max} is the maximum one. For the quantitative criterion of minimization type, the rescaling formula is again linear and has the following form

$$b_{ij} = \frac{y_j^{max} - y_{ij}}{y_j^{max} - y_j^{min}} \qquad (2)$$

where y_j^{min} and y_j^{max} have the same meanings as above.

If the quantitative criterion is neither of maximization nor of minimization type, then it is not appropriate to use the standard re-scaling formulae (1) or (2) and it is necessary to create an individual re-scaling formula by which the input values are transformed into the values from the interval [0,1].

Finally, the values b_{ij} for the qualitative criteria are generally set by the experts directly on the scale [0,1], where 0 is standardly assigned to the worst variant and 1 to the best one.

Step 3. After rescaling the values of the criteria into the unit interval, it is necessary to describe the importance of the criteria by normalized weights, i.e. by positive real numbers v1, v2, … vk satisfying $\sum_{i=1}^{k} v_i = 1$.

Step 4. Finally, the overall evaluation h_i of the i-th variant is computed by formula

$$h_i = \sum_{j=1}^{k} v_j b_{ij}. \qquad (3)$$

Final evaluation values can serve for the comparison of the variants or can be used to find the best variant which is the one with the highest overall evaluation.

For more details about weighted average operation and other aggregation methods, we recommend the book (Atkinson et al., 2012). If the weights or the values of the criteria are set imprecisely or vaguely, it is appropriate to use the fuzzy weighted average of fuzzy numbers instead of the weighted average operation (see, e.g., Dubois & Prade, 1981; Pavlačka & Pavlačková, 2021).

The multi-criteria model, which will be developed in the paper, will be subsequently applied to the research sample that will be formed by the companies that ranked first in the competition "EY Entrepreneur of the Year Olomouc Region" since its inception in 2006. These companies are evaluated by a jury, and the rules of the competition stipulate that, in addition to monitoring financial indicators (but exact selection of indicators is not listed), it also monitors the impact and involvement of companies in the region, their relationship with employees, the overall business story, etc. Thus, to win such a competition, it is not enough

to have good financial results, a company must have something more. Hence, we also collected non-financial measures / data.

The information on the winners of each year's competition was obtained from a publicly available database maintained by the Ministry of Justice of the Czech Republic. The financial statements of the companies are published in this database. From the financial statements, the information was transferred to a spreadsheet in MS Excel during the spring and autumn of 2021 to obtain the initial data on the research sample file. Using this data, indicators that are considered common or standard in financial analysis (profitability, activity, liquidity, and debt ratios) were calculated. These indicators have the character of traditional financial performance indicators and although other key performance indicators (KPIs) are also currently used, for the purposes of our research we take these traditional indicators as sufficient. To follow the intention of the contest we also collected the data from public databases or portals. The first of the non-financial measures is the customer feedback, which reflects the BSC approach and measures how these companies are perceived by its customers. The second non-financial measure serves as the proxy for 3rd generation BSC external perspective (Jones, 2011; Lawrie & Cobbold, 2004) and depicts the company's involvement in the region where it is active. This could be also proxy variable for the CSR activities (Bernardová et al., 2019). The last non-financial measure is the international activities, this shows whether the company is doing business on the international level.

3. Results

In this section, the multi-criteria evaluation model suitable for rating of companies based on the weighted average operation will be developed. Afterwards, this model will be used for the evaluation of the selected companies that participated in the competition Olomouc Region Entrepreneur of the Year in previous years. The analysis of companies will be carried out for two years 2018 and 2020 – before the COVID-19 pandemic and during it, which will enable to examine its impact on these companies.

3.1. Multi-Criteria Evaluation Model for Firms' Rating – Criteria

As the first step for the creation of the multi-criteria evaluation model, it is necessary to specify the criteria the evaluation process is based on. For this purpose, a few experts from the firms' managements have been addressed and according to their ideas, 7 criteria will be taken into the consideration. The importance of criteria is specified by normalized weights; their values are again set according to the experts´ recommendations. The recommended values differs according to region or country as well as during the time, hence we used values typical for Czechia from the textbooks (Knápková et al., 2013; Rejnuš & Fio banka, 2014). For the overview of the criteria, their types and the corresponding normalized weights (that describes the importance of the criteria) see Table 1.

Usually the firms from the same sector or the companies engaged in the same activities are considered to be the variants of the firms' evaluation. On the other hand, it is possible to also analyze companies that are connected in some other sense. In this paper, the selected

Table 1. The criteria and the normalized weights describing their importance

Criteria	Criteria type	Normal. weights
c_1 = Return on assets	quantitative, maximization	0.30
c_2 = Current liquidity ratio	quantitative, neither max. nor min.	0.05
c_3 = Indebtedness	quantitative, neither max. nor min.	0.20
c_4 = Asset turnover ratio	quantitative, maximization	0.25
c_5 = Customer feedback	qualitative	0.10
c_6 = Company involvement in activities in the region	qualitative	0.05
c_7 = Cooperation with foreign countries	qualitative	0.05

Table 2. The criteria matrix for the year 2018

	c_1	c_2	c_3	c_4	c_5	c_6	c_7
SIWATEC	5.92%	2.74	0.08	0.46	Above average	Partly	Yes
HOPAX	4.38%	1.70	0.71	0.94	Highly above average	Partly	Yes
SHM	22.44%	9.40	0.35	0.94	Above average	Above average	Yes
SEV Litovel	-2.81%	4.31	0.36	0.88	Above average	Partly	Yes
Česko-slezská výrobní	17.90%	2.10	0.26	2.27	Average	Average	Yes
Fenix Trading	63.02%	7.95	0.12	3.18	Above average	Above average	Yes
Ing. Petr Gross	0.86%	0.93	0.68	0.97	Above average	Average	Yes
Koutný	24.73%	11.95	0.08	1.12	Highly above average	Average	Yes
FARMAK	6.78%	10.42	0.07	0.57	Average	Average	Yes
Brazzale Moravia	5.99%	1.85	0.58	1.36	Highly above average	Average	Yes
ABO valve	8.50%	3.49	0.26	0.98	Average	Partly	Yes

Table 3. The criteria matrix for the year 2020

	c_1	c_2	c_3	c_4	c_5	c_6	c_7
SIWATEC	1.68%	4.91	0.05	0.22	Above average	Partly	Yes
HOPAX	0.38%	1.55	0.70	0.77	Above average	Partly	Yes
SHM	18.45%	5.92	0.06	0.82	Above average	Above average	Yes
SEV Litovel	0.09%	4.23	0.29	1.05	Above average	Partly	Yes
Česko-slezská výrobní	18.61%	1.92	0.31	2.07	Above average	Average	Yes
Fenix Trading	52.70%	8.31	0.11	2.59	Average	Above average	Yes
Ing. Petr Gross	0.49%	1.05	0.67	0.70	Above average	Average	Yes
Koutný	16.40%	15.08	0.05	1.00	Highly above average	Average	Yes
FARMAK	8.71%	12.42	0.09	0.58	Average	Average	Yes
Brazzale Moravia	4.72%	3.02	0.61	1.34	Highly above average	Average	Yes
ABO valve	5.35%	3.94	0.27	0.81	Above average	Partly	Yes

companies that that have won the competition Olomouc Region Entrepreneur of the Year during last 14 years will be taken into account as the variants of the evaluation.

Since the analysis will be carried out for years 2018 and 2020, it will be necessary to select only the firms that existed in both years and that have published the balance-sheets for both years. Therefore, the following 11 variants $a_1 - a_{11}$ will be analyzed by the multi-criteria evaluation model for the firms' rating – SIWATEC, a.s., HOPAX, s.r.o., SHM, s.r.o., SEV Litovel, s.r.o., Česko-slezská výrobní, a.s., Fenix Trading, s.r.o., Ing. Petr Gross, s.r.o., Koutný s. r.o., FARMAK, a.s., Brazzale Moravia, a.s. and ABO valve, s.r.o. The corresponding criteria matrices for years 2018 and 2020 are shown in Table 2 and Table 3 above.

In order to compute the final evaluations of the variants in years 2018 and 2020, respectively, it is necessary to re-scale the values in the Table 2 and 3 into the interval [0,1] in accordance with the methodology. Since return on assets and asset turnover ratio are the maximization criterion, the transformation of the first and the fourth arrows will be done according to the formula (1). Customer feedback, company involvement in activities in the region, and cooperation with foreign countries are qualitative criteria, therefore, the values in the corresponding arrows will be re-scaled directly according to the experts´ opinions.

The arrow corresponding to the criterion c_2, current liquidity ratio, will be transformed according to the following formula

$$
b_{i2} = \begin{cases} 0, & for\ y_{i2} < 0.5 \\ 2y_{i2} - 2, & for\ y_{i2} \in [0.5; 1.5] \\ 1, & for\ y_{i2} \in (1.5; 2.5] \\ -y_{i2} + 3.5, & for\ y_{i2} \in (2.5;\ 3.5] \\ 0, & for\ y_{i2} > 3.5. \end{cases}
$$

The formula is derived from the fact that the current liquidity ratio between 1.5 and 2.5 is supposed to be ideal and values greater than 3.5 are considered to be completely unsatisfactory. For the purpose of this paper, we used the values from literature (Knápková et al., 2013; Rejnuš & Fio banka., 2014), however the values in the model can be calibrated or updated based upon the future research among the best companies or among the companies which have bankrupted.

Since the 4th criterion, indebtedness, is also neither maximization nor minimization, it will be necessary to derive the rescaling formula individually like in the case of current liquidity ratio. Since the values of the indebtedness between 0.3 and 0.6 are supposed to be ideal and values higher than 1.5 are referred to as completely inappropriately high, the re-scaling formula will be the following:

$$
b_{i3} = \begin{cases} \dfrac{10}{3} y_{i3}, & for\ y_{i3} < 0.3 \\ 1, & for\ y_{i3} \in [0.3; 0.6] \\ -\dfrac{10}{9} y_{i3} + \dfrac{5}{3}, & for\ y_{i3} \in (0.6;\ 1.5] \\ 0, & for\ y_{i3} > 1.5. \end{cases}
$$

We used the values based upon the literature, however for the precise calibration for the model, we suggest the future research.

The overall evaluations of the firms will be calculated from values in Table 4 and Table 5 according to the formula (3); weights of the criteria that are taken into account in the formula are specified in Table 1.

Table 4. The criteria matrix after re-scaling for the year 2018

	c_1	c_2	c_3	c_4	c_5	c_6	c_7
SIWATEC	0.13	0.76	0.27	0.08	0.70	0.30	1
HOPAX	0.11	1.00	0.88	0.24	0.90	0.30	1
SHM	0.38	0.00	1.00	0.24	0.70	0.70	1
SEV Litovel	0.00	0.00	1.00	0.22	0.70	0.30	1
Česko-slezská výrobní	0.31	1.00	0.87	0.69	0.50	0.50	1
Fenix Trading	1.00	0.00	0.40	1.00	0.70	0.70	1
Ing. Petr Gross	0.06	0.00	0.91	0.25	0.70	0.50	1
Koutný	0.42	0.00	0.27	0.30	0.90	0.50	1
FARMAK	0.15	0.00	0.23	0.12	0.50	0.50	1
Brazzale Moravia	0.13	1.00	1.00	0.39	0.90	0.50	1
ABO valve	0.17	0.01	0.87	0.26	0.50	0.30	1

Table 5. The criteria matrix after re-scaling for the year 2020

	c_1	c_2	c_3	c_4	c_5	c_6	c_7
SIWATEC	0.07	0	0.17	0.00	0.70	0.30	1
HOPAX	0.05	0	0.89	0.19	0.70	0.30	1
SHM	0.32	0	0.20	0.20	0.70	0.70	1
SEV Litovel	0.04	0	0.97	0.28	0.70	0.30	1
Česko-slezská výrobní	0.33	0	1.00	0.63	0.70	0.50	1
Fenix Trading	0.84	1	0.37	0.80	0.50	0.70	1
Ing. Petr Gross	0.05	0	0.92	0.16	0.70	0.50	1
Koutný	0.29	0	0.17	0.26	0.90	0.50	1
FARMAK	0.18	0	0.30	0.12	0.50	0.50	1
Brazzale Moravia	0.11	0	0.99	0.38	0.90	0.50	1
ABO valve	0.12	0	0.90	0.20	0.70	0.30	1

Table 6. The final firms´ evaluations in years 2018 and 2020

	2018	Rank 2018	2020	Rank 2020	Difference	Rank difference
SIWATEC	0.29	10	0.19	11	-0.10	-1
HOPAX	0.47	5	0.37	7	-0.10	-2
SHM	0.53	4	0.34	9	-0.19	-5
SEV Litovel	0.39	9	0.41	4	0.02	5
Česko-slezská výrobní	0.62	2	0.60	2	-0.02	0
Fenix Trading	0.79	1	0.71	1	-0.07	0
Ing. Petr Gross	0.41	7	0.39	6	-0.02	1

Koutný	0.42	6	0.35	8	-0.07	-2
FARMAK	0.24	11	0.27	10	0.02	1
Brazzale Moravia	0.55	3	0.49	3	-0.06	0
ABO valve	0.40	8	0.40	5	0	3

4. Conclusion and Discussion

Based upon the results presented in the Table 6, we can conclude that there is only marginal change in the performance of the companies. Since the metric is positive (the higher or closer to 1.00 the better) the original ranking in 2018 and the new ranking in the 2020 is depicted and, except for the companies SHM and SEV Litovel, there is no significant change. The change in the metric or in ranking is very small. This confirms the conclusion previously made by the jury – these companies are to be "the best" within the region and that is why these companies are expected to handle the COVID pandemic successfully as well. The first three companies in 2018 are the same as in 2020 (see column Rank difference in Table 6).

Despite the conclusion stated in the first paragraph of this section, there is visible trend – almost all the companies have slightly lower performance in 2020 compared to 2018 (see column Difference in Table 6). That shows expected – pandemic is influencing everyone.

The company SHM experienced the biggest downfall. The company is active in the coating materials business. Our guess is that this industry has been hit as a result of the problems in the automotive industry and generally engineering industry, which is a huge customer for SHM.

On the contrary, the company SEV Litovel experienced the biggest rise. This company produces gramophones, windscreen washers and regulators for vacuum cleaners. One possible explanation of their success could be the change in the behavior of consumers. During the pandemics there is significant change in the behavior of customers (they stay at home more often) that is why they are probably more interested in house electric appliances. However, these conclusions are yet to be confirmed or rejected based upon future research.

Based upon our findings, the best company in both observed years is Fenix Trading. As it is the producer of electric heating systems, we conclude that this company is successful thanks to the current ecological and sustainability trends, when the whole economy is reducing the fossil fuels and is searching for ecological / clean energy such as solar or wind.

Conflict of interest: none

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Reasons of Overpayments and Solutions for the Unduly Paid out Non-insurance Social Benefits in the Czech Republic

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Abstract: The aim of the paper is to evaluate the reasons of overpayments on all non-insurance social benefits and to define the cases in which a criminal complaint is filed. Partial aim is also to present the proposals of measures to eliminate the occurrence and to increase the enforceability of repayments of unduly paid out social benefits. The goals were achieved by the method of expert interviews with employees of regional labor offices of the Czech Republic, which were conducted in 2020 and 2021. The results show that the most common reason for overpayments on benefits tested for income is the concealment of decisive income and then the number of jointly assessed person in the household. Other reasons include not reporting decisive changes, receiving a benefit in the Czech Republic and also in another state of the European Union or not using the benefit for the intended purpose. The field survey identified an agreement of experts on three proposals to eliminate the occurrence and increase the enforceability of repayments of unduly paid out social benefits. These are the use and being equipped by a proper software, the possibility of deduction of overpayments from the paid out social benefits and the reintroduction of legal offences – misdemeanors for offenders as a form of prevention.

Keywords: social benefits; overpayment, repayment; labor office; debt collection

JEL classification: H53; H75; H83

1. Introduction

The abuse of non-insurance social benefits is a topic often discussed by professionals and general public, but the topic is not widely presented in professional literature. In the media, this topic is approached mainly politically, i.e., the level of benefits, the existence of these benefits and the financing, and is often used for political campaigns before elections. The authors are aware of the many ways the non-insurance social benefits are misused and abused, therefore a field survey was conducted with the aim, to identify in which cases a criminal complaint is filed and to find out the conclusions of state prosecutors and judges regarding these cases. Partial aim of the paper is to propose solutions leading to the elimination of unduly paid out benefits and increase the enforceability of repayments.

The aim of social benefits is to help people in difficult life situations that they are unable to manage on their own. These situations are called by law a "social event" in which the right to the benefit and its payment arises (Čeledová & Čevela, 2019). All laws stipulate the

conditions for entitlement to and payment of non-insurance social benefits and impose obligation on applicants. Failure to comply with these obligations may lead to the withdrawal of the benefit, reassessment of entitlement to thee benefit and, in the case of a benefit already paid out, to an overpayment, which the applicant is obliged to return. Enforcing the return of overpayments on benefits is very difficult. The Labor Office does not have the authority to issue execution orders like the Financial Administration of the Czech Republic which can enforce tax arrears through six types of execution orders (Kukalová et al., 2020).

Thus, if the social system of a given state is analyzed, it has a great importance on the perception on both of overuse and underuse of social benefits. (Wu, 2017). According to Roosma et al. (2016), overuse (abuse, fraud) and under-utilization of the social system is strongly perceived by the general public. Some studies also address the abuse of social systems. Gonzalez-Rabanal (2013) states the need to reduce the benevolence in social benefits in Spain. Delgado (2018) analyzes the sustainability of social systems in Spain in the context of fraud. The overuse of social systems by the population is related to their own interests and also to the level of economy and the spending on social benefits in the country (Roosma et al., 2016; Roosma et al., 2014). Lundstrom (2013) compared discussions about the benefits of fraud with social benefits in the Swedish and British newspapers and blogs. The profiles and motives of the perpetrators of these frauds were investigated by Tunley (2011). Social standards that discourage social benefit fraud and tax fraud are addressed by Halla a Schneider (2014) or Halla et al. (2010). Goveia and Sosa (2017) address fraud prevention through a risk management model. Appelgren (2019) analyzes the effects of different audit strategies on fraud in the social benefit system in Sweden.

Deliberate abuse can be considered as abuse of benefits, when the law allows a benefit to be provided even to those who would not be able to obtain the benefit (Průša, Víšek & Jahoda, 2014). All laws related to non-insurance social benefits contain a paragraph imposing a basic so-called reporting obligation on claimants or persons jointly assessed, consisting of the fact that these persons are obliged to notify changes in writing within eight days that affect the entitlement to the benefit, its amount or payment. The law also imposes an additional obligation, namely that if those persons have been called upon in writing by the Office to certify the relevant facts, they are required to comply with that request (Chladíková, 2021). If the claimant does not fulfill the imposed obligation or would accept the benefit, even if he was not entitled to it, he must return the benefit.

Before issuing a decision on the occurrence of an overpayment, it must be proven that the applicant was actually at fault for the overpayment. If it is proven that the person in question intentionally provided incorrect or incomplete data, manipulates tangible property, does not use the benefits for the intended purpose, does not fulfil the obligation to notify changes in decisive facts within eight days, etc., a decision on the overpayment is issued. Here it is stated how the overpayment arose, how this fact was found out, for what period it arose, in what amount, how it is to be paid back and by what date (Sirovátka, 2000).

However, neither in the Czech Republic, nor in the researches of international authors was it ascertained what reasons are prevalent in the creation of unduly paid out social benefits. Therefore, the authors of this paper decided to conduct a field research and bring

this knowledge, which can contribute both to the level of prevention and the level of repayments of unduly paid out benefits from the claimants.

2. Data and Methodology

In order to achieve the aims of the paper, the authors conducted a field survey, in which the method of expert interviews of a systematic nature was chosen. The expert interviews focused on the uniqueness of the experts´ knowledge and experience, and emphasis was placed on the comparability and combining of the information. All interviews had therefore a similar course which was given by a predefined structure. The field survey took place in the Czech Republic in 2020 and 2021, specifically in 14 regional branches of the Labor Offices of the Czech Republic in individual regions. Within each regional branch, two experts were interviewed, so the total of 28 interviews were conducted by a single interviewer (in order to maintain a uniform interviewing style). The questions combined the possibility of open narrative answers and answers determined according to the Likert scale.

Experts from the regional branches of the Labor Offices were selected on the basis of the findings that the registration of receivables to claimants due to return overpayments is carried out by the relevant departments, which monitor the payment of receivables by the debtors within the due date set in the overpayment decision. If the debtor appears in front of the Labor Office of the Czech Republic to discuss the overpayment, the deadline for repayment is discussed with him and, depending on the situation, set so that the debtor can return the overpayment in instalments. If the debtor does not appear to discuss the return of overpayment, the deadline for repayment if short (usually until the end of the month following the enforcement date of the repayment decision) and after its expiration the receivable to the debtor is handed over to the legal control department. Partially paid receivables, which the debtor does not pay within the specified due instalment date or cease to repay in full, are also transferred to the control legal department. The employees of the legal control department must determine how the receivable to the debtor will continue to be handled. The department has to determine whether the Labor Office is competent to recover the claim or whether it is a claim without the authority of recovery by the Labor Office. The fact if the Labor Office of the Czech Republic has authority to recover the claim is determined by individual laws on social benefits.

The limitations of the survey are given by the method used – expert interviews, the disadvantage of which may be the wrong choice of respondents due to differences on the part of experts (degree of trust, length of practice, degree of sharing experience). For further research it would be appropriate to conduct a field survey at more levels of professional experience which would also increase the sample of respondents.

3. Results

3.1. Reasons of Overpayment Occurrances

All experts agreed that the most common reason for overpayments on income-tested social benefits was the concealment of decisive income. Claimants often believe they do not

have to prove all their income at all and the Office will never find out. Such income may be an income from short-term employment, received rent (residential or non-residential premises), received alimony provided for children, business income or income from abroad (from employment or receiving family benefits). The Office usually finds out about the existence of these incomes retrospectively after inspections in companies that the Labor Office of the Czech Republic must carry out by law, or during electronic inspections of income evidenced by the Czech Social Security Administration (payment of sickness benefits, pensions, etc.) or evidenced by the Financial Administration of the Czech Republic (the income subject to income tax). Income from abroad is most often found out due to the coordination of benefits according to EU Regulation EC No. 883/2004 and EC No. 987/2009.

As the amount of state social support and basic material needs of benefits also depends on the number of jointly assessed persons in the household, the second most common cause of overpayment on the benefit is the failure to notify of a change in the number of persons in the household. The change in jointly assessed persons is mostly found out by the officials during local or social inquiries, checks in population registers or with the help of other citizens notifying this fact. Determining the correct number of persons for the material needs benefit and housing allowance is based on the Living and Subsistence Minimum Act, and the most frequent problem arising is the inclusion of the child´s father in the application. Some female claimants intentionally do not mention their children´s fathers in the child´s birth certificate (even though the children´s father lives with the family), some purposefully end the relationship with the children´s fathers, so they do not have to prove his income.

Changes that affect the amount of the benefit also include a change in the child´s dependency (if a child under the age of 26 completes full-time study or a child under the age of 18 is excluded from the register of job seekers, it is considered dependent). These changes are most often found in cooperation with the department of employment.

The reason for the overpayment on the benefits of child allowance and parental allowance is the fact that the claimant stops taking care of the child. This fact is in most cases reported by the institution that took the child into its care or by the person who got entrusted the child to care. The claimant who caused the overpayment on these benefits (by not notifying the decisive fact within the statutory time limit) usually does not even respond to calls or notifications about the overpayment proceedings.

Another reason (also addressed internationally) for child allowance and parental allowance (the so-called family benefits) is receiving a similar benefit in the Czech Republic and at the same time in another country of the European Union. Regulation (EC) No. 883/2004 does not allow receiving several benefits of the same kind for the same period of insurance. Nevertheless, some citizens apply for the same benefit in the Czech Republic and the EU country, in both countries. However, there is now fast electronic system called the Electronic Exchange of Social Security Information (EESSI) through which EU countries communicate with each other to verify the information, so the number of cases has decreased rapidly.

In foster care benefits, overpayments arise mainly on the foster care allowance and the allowance for the child´s needs. The most common reason is not notifying a change in the child´s dependency. Overpayments also arise on the foster parents´ remuneration due to the

termination of the care of the entrusted child. It is important that the caregiver notifies in time that the child has been placed in the car of another person or institution. Overpayments on this benefit also arise because the claimant does not declare that the child is receiving pension insurance benefits (orphan's pension benefit, disability pension benefit).

Another benefit where care is terminated and not notified within the statutory time limit is the care allowance benefit. The overpayment arises for this benefit if the person being cared for is hospitalized throughout the calendar month (and the carer is not hospitalized with him and does not provide care) or if that person dies. Caregivers most often state that they did not report the hospitalization in time because they did not know that the hospitalization would be long-term. According to experts, there are arguments from claimants for not reporting the death that the Office should find out from electronic databases. Due to the failure to notify the death of the entitled person, overpayments are most often incurred also on the mobility allowance benefit.

The fact that the benefit was not used for the purpose for which it was granted was stated on the Likert scale as a common and for some benefits the only reason for the overpayment. Such a benefit is the emergency immediate assistance benefit.

The allowance for the purchase of a personal motor vehicle will result in an overpayment if the claimant does not purchase the vehicle (or does not have it repaired according to the decision to provide the benefit), does not use it or the persons for whom it was intended, sells the vehicle or uses it for business purposes. Similarly, the benefit of aid for special aid is checked (the check will take place directly at the claimant's place of residence), where the recipient of the benefit is obliged to use this benefit within 3 months of payment (to buy a guide dog, adjust the bathroom, buy a motor vehicle, etc.) and to use this aid at last for the statutory time period.

According to experts, the most thoughtful reasons for overpayments are revealed on the state social support benefit – housing allowance. In addition to the above reasons (not proving the income, change in the number of persons or change in the child's dependency), another common reason for the overpayment is the termination of the tenancy to the apartment for which the claimant claimed the benefit. The benefit is paid to a specific property at a specific address. Therefore, if the rental agreement is concluded for a specific apartment and the tenant leaves the apartment (the rental relationship with the apartment has ended), he must report this fact and the benefit must be terminated. The procedure is similar for the owner of the apartment (house) who used the property and applied for the benefit. If he stops using the property or sells it, he must report this fact within eight days. In this context, "modified" leases are also documented, which were issued by the property owner only for a definite period of time and the tenants do not pay the rent or costs, and the owner no longer extends the agreement. However, some claimants still document the extension of the lease, after doctoring the old contract themselves (sometimes these modifications by the claimants are quite professionally looking).

Experts consider the providing of false data for the housing costs to be a truly fraudulent intent of intentional misuse of this benefit. The long-term experience of the expert showed that claimants most often edit or directly prepare themselves the income documents for the

payment of rent or costs associated with the use of the apartment, or altering the bank account statements by computer themselves, or postal orders that were actually sent but not to the correct account number (the amount will be then returned to the sender as undeliverable). Proving this behavior is very demanding and requires not only the precise work of officials, but also cooperation with property owners and, last but not least, the law enforcement agencies.

3.2. *Solution for Overpayments by Reporting Criminal Offence*

According to the Czech Criminal Procedure Code, the Labor Office of the Czech Republic is obliged to report to the public prosecutor or police authorities facts indicating that a criminal offense has been committed. In the area of non-insurance social benefits, criminal reports are filed in writing pursuant to Section 158 (1) of the Criminal Procedure Code on suspicion of the criminal offense of fraud pursuant to Section 209 of the Criminal Code. The perpetrator of such a criminal offense may be a person who misled another person (in the case of the Labor Office of the Czech Republic a representative of the body) or concealed decisive facts, as a result of which there was a damage to other people´s property and enrichment of the perpetrator or another person. At the Labor Office of the Czech Republic, these are all cases where the fault of the overpayment on the paid out benefit had been proven and a final decision had been issued quantifying the overpayment and the obligation to return the overpayment by the claimant by a specified date.

Until October 2020 the Labor Office of the Czech Republic filed a criminal complaint according to the experts, in cases where the amount of damage (total overpayment of benefits) was higher than CZK 5,000. Before filing a criminal complaint, the authorized employees of the Labor Office of the Czech Republic consulted the given cases with the representatives of the Czech Police (Economic Crime Department) who after studying the available file documentation assessed whether it could actually be a criminal offence and, in that case, an official written criminal offence report was filed. If the case could be resolved only as a misdemeanor (according to the Act No. 250/2015 Coll., on liability for misdemeanors and proceedings on them), a copy of the file is handed over to the municipal authority with extended powers, which is competent for misdemeanor proceedings. In some cases, the case is adjourned after a preliminary hearing, because even though the overpayment had been proven and quantified, further action by the claimant who caused the overpayment does not indicate an intention to enrich oneself. According to experts, postponing a case or handing it over to the misdemeanor proceedings is most often in cases where the quantified overpayment borders on the amount where the state authorities are obliged to report the case (formerly e.g. CZK 5,100), the claimant not only recognizes the overpayment on that date but will actually meet the obligation to return it. The police authority is also considering how the overpayment occurred, i.e., whether it was simply not reporting a decisive fact (e.g. not notifying the child´s change of care - termination of studies) or submitting false information (not paying the costs of the house/apartment). After the official filing of the criminal complaint, the Labor Office of the Czech Republic is waiting for the results of the investigation of the Police of the Czech Republic and after handing over the file for the result of the investigation to the public prosecutor.

The most common conclusions issued by prosecutors or judges in this regard are given in Table 1.

Table 1: Conclusions of prosecutors and judges (own findings according to internal sources of Labor Offices of the Czech Republic, 2021)

Type of conclusion	Content of the conclusion
Criminal command	Determination of a custodial sentence, but the execution of the sentence is conditionally postponed for a certain period of time, the obligation to pay damages is determined
Criminal command	Determining the obligation to pay damages and perform a specified number of hours of community service
Decision or resolution on conditional suspension of proceedings (for a definite period)	The debtor is obliged to pay damages
Verdict on imprisonment (with a time period)	No conditional postponement is set

3.3. Proposals of Measures to Eliminate the Occurrence of Unduly Paid Out Benefits and Increase the Enforcability of Repayments

During the field survey the authors identified agreement in three areas, in which it would be realistic to make adjustments leading to the elimination of the occurrence of unduly paid out benefits and increase the enforceability of repayment. These areas are the software use and equipment, the possibility of deducting overpayments from the paid out benefits and the reintroduction of the misdemeanour offenses as a form of prevention.

At present, the Labor Offices of the Czech Republic have a very imperfect and in some areas no software application for processing the overpayment receivables to the claimants. According to the internal regulations of the Labor Office of the Czech Republic, the handling of these receivables is a matter of the workplace where the receivables arose. Experience confirms that it is necessary to record all receivables in one nationwide application program so that there is an overall overview of both their volume and settlement methods. Individual regional offices keep records of receivables and their settlement (repayments) just for their region. According to the findings, receivables are entered manually into one economic program, but there is a high percentage of error both at the time of entering and the settlement of the receivable. Furthermore, neither the economic program nor the application program can process all the necessary ways of managing the receivables. For example, it is not possible to determine how many receivables were issued as executions and which ones, how many receivables were enforced to repay in this form and in what amount. Or at how many receivables the preclusive period is interrupted and for what reasons and for what reason the receivables were written off. This and other information are kept by the staff handling receivables themselves in auxiliary tables or notebooks, some do not keep it at all because they do not have to. It would be appropriate to have a program where the receivables generated in individual departments and offices were copied automatically (without the operator´s intervention) and could then be monitored in detail from all aspects necessary for successful recovery of overpayments. The application should be nationwide and enable the

complete digitalization of file documentation, so that it is possible to successfully recover the receivables even if the debtor moves to another region.

In the case of receivables arising from non-insurance social benefits, the inconsistency in terms of their collection and recovery is striking. According to the law, the Labor Office may recover some benefits, but not others. It depends on the law according to which the benefit was granted, paid out and according to which the overpayment was calculated. This fragmentation should be unified by legislation.

One of the possible solutions to achieve a higher return of overpayments is to deduct the incurred debts from the normally paid out tor later granted benefits. At present, this possibility is offered only by the Act on Material Need, but it is conditioned by the fact that the person has to have at least the substantial living minimum. In practice, it was found that this method of repayment of receivables is very inefficient and used very rarely, and only if the receivable is a few hundred CZK. A similar option is to issue an execution order for certain benefit overpayments that can be affected by execution (parental allowance, foster parent´s remuneration, child allowance), but even here the execution rules are set, so the success of recovery is not great.

There are still many debtors who have received benefits illegally, overpayments have been quantified, the debtor has not returned the overpayment, and the receivables have been written off due to lack of property of the debtor, and the debtor continues to receive benefits. He often asks for the benefits retrospectively, because he knows that if he fulfils a legal claim, he must be granted a benefit, but the debt must not be deducted from it. Debts incurred on non-insurance social benefits should be deductible (even without the content of the debtor) of the benefits normally paid out or subsequently granted, regardless of the fact on which non-insurance social benefit it arose and from which it will be deducted. Of course, even here, certain restrictions would have to be set in order for the debtor to receive at least part of the benefit. For example, a deduction of one third of the granted benefit could be made (without consent). If there was a single program in which all the receivables were entered and the laws allow the deduction of these debts from the paid out benefits, the repayments of overpayments would be higher and only recovered by the employees of the control and legal departments but also by employees of the departments where the receivables to debtors arise (by calculation the overpayment) and where benefits are granted.

4. Discussion

Until 1st January 2018 the State Social Support Act allowed a person (benefit claimant or a person jointly assessed) to be fined for failing to comply with the legal obligations (e.g. not reporting a decisive change within eight days and causing an overpayment). The maximum amount of the fee could be CZK 10,000. In practice, this meant that if it was found that the claimant had intentionally reported a decisive factor that affected amount of benefit or its entitlement itself, or provided false information (forged leases, proof of payment of housing costs, etc.) and it was proven, such a person could be fined. This form of „punishment" was more effective for many claimants that today´s calculation of the overpayment and its transmission to the Police of the Czech Republic (especially when the Labor Office is obliged

to make a criminal report from a receivable over CZK 10,000). If the claimant received a fine, the justification always stated exactly why the fine was imposed. Claimants then mostly did not try further frauds. The fines were imposed in a reasonable amount, taking into consideration whether or not the claimant violated the law repeatedly and also how high overpayment was caused. This possibility of imposing fines for breaches of obligations was allegedly cancelled due to a change in the Misdemeanor Act. As the Labor Office is a state organization, the possibility to impose fines for non-compliance with legal obligations and their violation should be reinstated and extended to all laws on non-insurance social benefits.

5. Conclusions

Expert interviews identified concealment of decisive income and the number of jointly assessed persons in the household as the most common reason for overpayments on benefits tested for income. Other reasons include not reporting a change in decisive events, receiving a benefit in the Czech Republic and in another country of the European Union, and last but not least, not using the benefit for the specified purpose. According to experts, the most thought out reasons for overpayments are revealed on the state social support of housing allowance, where there is often a creative correction of documents by the claimants.

The field survey identified the agreement of experts in three proposals to eliminate the occurrence of overpayments and increase the enforcement of repayment of the unduly paid out benefits by the claimant. These are the use of a proper software, the possibility of deducting overpayments from the normally paid out social benefits and the reintroduction of misdemeanors as a form of prevention. These proposals could enable more efficient management of non-insurance social benefits within the framework, as i tis state money resp. taxpayers´ money – whether current or future.

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Does the Term Structure of Interest Rates Hold True for East-Asian Countries? More Powerful Nonlinear Cointegration Tests

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Abstract: The expectations hypothesis of the term structure (EHTS) of interest rates is one of the cornerstones of financial theory and macroeconomic theory. It's vital for predicting future interest rate changes, analyzing monetary policy, and developing macroeconomic models. This study evaluates the effectiveness of the EHTS of interest rates for seven East Asian countries from January 2011 to November 2021, using the nonlinear smooth transfer error correction model (ST-ECM) established by Kapetanios et al. (2006). Compared to the traditional linear ECM, the ST-ECM is more powerful in detecting the cointegration relationship between economic variables in the presence of policy interventions and transaction costs. The empirical results indicate that the EHTS of interest rates stands true for all the East-Asian nations under study, with the exception of Singapore and Thailand, and the adjustment towards the EHTS of interest rates is found to be nonlinear for the majority of the East-Asian nations. These research findings have significant policy implications for East-Asian countries.

Keywords: term structure of interest rates; East-Asian countries; smooth transition error correction model

JEL Classification: C32; E43

1. Introduction

The expectations hypothesis of the term structure (hereafter, EHTS) of interest rates has always been an important proposition in macroeconomics and financial research. This hypothesis points out that the long-term interest rate equals the mean of current and predicted future short-term interest rates, adding the risk premium. And the establishment and adjustment mechanism of the EHTS has important economic implications: firstly, the EHTS reflects the validity of information in the bond market, revealing whether there are arbitrage opportunities in the bond market; secondly, the EHTS implies that long-term rates are decided by short-term rates, and policy makers can regulate long-term rates via operating short-term rates and thus affect economic operation; thirdly, the spread between long-term and short-term rates can provide valuable information about inflation rates and future interest rates. Therefore, it is critical to study this topic not only for theoretical research but also for policy implications.

Empirical research on the EHTS of interest rates is luxuriant but far from unequivocal so far. In the related studies, the conventional linear model and threshold model are frequently employed to analyze the EHTS of interest rates, such as Campbell and Shiller (1978a,1991b), Quiros-Romero and Sosvilla-Rivero (1997), Enders and Granger (1998), Camarero and Tamarit (2002), Sarno et al. (2007), Suardi (2010), Esteve et al. (2013) and Muzindutsi and Mposelwa (2021) et al. Recently, a growing agreement has emerged that the EHTS of interest rates demonstrates nonlinear adjustment, for example, Bachmeier and Li (2002), Maki (2006), Haug and Siklos (2007), Sun and Lai-Lei (2012), Guney (2013), Huang and Wang (2014), Grisse (2015), Zhu and Rahman (2015), Cai and Wang (2017), Song et al. (2017), Bekiros et al. (2018), Liu et al. (2020) and Mineo et al. (2020) et al. Consequently, the conventional cointegration tests, such as the Engle-Granger (EG) test, have low power in detecting the cointegration relationship in the EHTS of interest rates. As a result, nonlinear cointegration tests must be used. All of the above studies offered in-depth information on the EHTS of interest rates from both theoretical and empirical aspects. To our knowledge, however, no research has been conducted that uses nonlinear econometric techniques to examine the EHTS of interest rates in East-Asian nations.

This empirical study enriches this line of research by evaluating whether the EHTS of interest rates holds true in a sample of seven East Asian nations, and whether the adjustment towards their equilibrium takes place in a nonlinear manner. Economic integration appears to be increasing in Asia, and Asia is now playing a significant role in the globe as well. The Asian nations are progressively establishing themselves as major players in global marketplaces as a result of their rapid economic expansion. We test the nonlinear cointegration association of the long-term and short-term rates in seven East Asian nations based on the simple and powerful nonlinear cointegration approach of Kapetanios et al. (2006). The major advantage of this approach is that it can analyze the inherent nonlinear adjustments resulting from market friction, such as structural changes in monetary policy (Mankiw and Miron, 1986), time-varying risk premiums (Fama, 1990), transaction costs (Anderson, 1997) and institutional transfer behavior (Bekaert et al., 1997). Thus, the current research aims to fill a gap in the existing research. This is, to our knowledge, the first study to employ the nonlinear Smooth Transition Error Correction Model (hereinafter, ST-ECM) cointegration test on seven East-Asian EHTS interest rates. We find that the ST-ECM cointegration test strongly rejects the null hypothesis that EHTS of interest rates doesn't hold true for all the countries examined except Singapore and Thailand, indicating that EHTS of interest rates holds true for five of the seven East-Asian countries. Additionally, the adjustment process towards equilibrium is nonlinear for the majority of these East-Asian nations.

The rest of this article is arranged in this way: Section II expounds the EHTS of interest rates and outlines the ST-ECM for nonlinear cointegration tests. Section III introduces the data and empirical findings, and Section IV concludes this article.

2. EHTS of Interest Rates and Methodology

2.1. The EHTS of Interest Rates

The EHTS of interest rates connects long-term rates to present and predicted short-term rates, and is defined by Campbell and Shiller (1991) as follows :

$$i_t^{(n)} = \frac{1}{q} \sum_{i=0}^{q-1} E_t i_{t+mk}^{(m)} + c(n,m) \tag{1}$$

where $q = n/m$ and $i_t^{(n)}$ contains a weighted mean of current and predicted short-term rates, $i_t^{(m)}$ and a continuous risk premium, $c(n,m)$.

To evaluate the effectiveness of the expectation theory conveniently, empirical researches on the EHTS of interest rates have frequently utilized a linear model such as:

$$i_t^{(n)} = \alpha + \beta i_t^{(m)} + \mu_t \tag{2}$$

where α is a constant, β is a cointegration vector, and μ_t is the residual difference. Considering the long-run equilibrium relation is not always one-to-one proportional, therefore, it's more crucial to assess the above long-run relation using a flexible modality instead of the pre-specified cointegrating vector as Campbell and Shiller (1991) claimed.

2.2. Kapetanios et al's. (2006) Nonlinear Cointegration Test

This study applies Kapetanios et al's. (2006) ST-ECM for nonlinear cointegration approach to examine the EHTS with nonlinear adjustments for seven East-Asian nations. Following Kapetanios et al. (2006), the ST-ECM is expressed as follows:

$$\Delta y_t = \phi u_{t-1} + \gamma u_{t-1}(1 - e^{-\theta(u_{t-1}-c)^2}) + \omega' \Delta x_t + \sum_{i=1}^{p} \psi_i' \Delta z_{t-i} + e_t \tag{3}$$

$$\Delta x_t = \sum_{i=1}^{p} \Gamma_{xi} \Delta z_{t-i} + \varepsilon_{xt} \tag{4}$$

where $t = 1,2,\ldots,T, z_t = (y_t, x_t)$, $\theta \geq 0$ is the ST-ECM model's transition parameter that controls the rate at which transitions occur, c is the threshold parameter that may be understood as the transition point between the two states, $\omega' = \sum_{xx}^{-1} \sigma_{xy}$, $\psi_i' = \gamma_{yi} - \omega'\Gamma_{xi}$, $i = 1,2,\ldots,p$, and

$$u_t = y_t - \beta_x' x_t \tag{5}$$

β_x' is a $k \times 1$ vector of cointegration parameters. The obvious difference from the traditional linear ECM is the transition function $(1 - e^{-\theta(u_{t-1}-c)^2})$, which is dynamic and changes with the deviations u_t. According to Kapetanios et al. (2006), there is no nonlinear cointegration if $\theta = 0$, so the null and alternative hypotheses for nonlinear cointegration are as follows:

$$H_0: \theta = 0 \quad H_1: \theta > 0 \tag{6}$$

Nevertheless, it is impractical to test the null hypothesis straightly because the parameter γ is unidentifiable. In order to solve this issue, they approximate (3) using a Taylor series of first order around $\theta = 0$ approximation to $(1 - e^{-\theta(u_{t-1}-c)^2})$, under the condition of $\phi \neq 0$, they acquire the ancillary testing regression as follows:

$$\Delta y_t = \delta_1 \hat{u}_{t-1} + \delta_2 \hat{u}_{t-1}{}^2 + \delta_3 \hat{u}_{t-1}{}^3 + \omega' \Delta x_t + \sum_{i=1}^{p} \psi_i' \Delta z_{t-i} + \varepsilon_t \tag{7}$$

Based on the above considerations, the null hypothesis $\theta = 0$ in (6) is converted to $\delta_1 = \delta_2 = \delta_3 = 0$. And the F_{NEC} test statistic is put forward for the null hypothesis of $\delta_1 = \delta_2 = \delta_3 = 0$ against they are not all equal to zero, which is expressed as follows:

$$F_{NEC} = \frac{(SSR_0 - SSR_1)/3}{SSR_0/(T-4-p)} \tag{8}$$

where SSR_0 and SSR_1 are the sums of squared residuals derived from the specification with and without the constraints $\delta_1 = \delta_2 = \delta_3 = 0$ in (7), correspondingly.

There are previous theoretical justifications for limiting the threshold parameter in model (3) to zero in a large number of financial and economic applications in the ST-ECM, which results in the following constrained auxiliary testing regression:

$$\Delta y_t = \delta_1 \hat{u}_{t-1} + \delta_3 \hat{u}_{t-1}{}^3 + \omega' \Delta x_t + \sum_{i=1}^{p} \psi_i' \Delta z_{t-i} + \varepsilon_t \tag{9}$$

The F^*_{NEC} test is presented according to the test statistic for $\delta_1 = \delta_3 = 0$ against they are not both equal to zero, and is given as follows:

$$F^*_{NEC} = \frac{(SSR_0 - SSR_1)/2}{SSR_0/(T-3-p)} \tag{10}$$

Under the condition of $\phi = 0$ and considering $c = 0$, model (7) can be simplified as the following model (10):

$$\Delta y_t = \delta_3 \hat{u}_{t-1}{}^3 + \omega' \Delta x_t + \sum_{i=1}^{p} \psi_i' \Delta z_{t-i} + \varepsilon_t \tag{11}$$

The t_{NEC} test is presented to test $\delta_3 = 0$ and expressed as follows:

$$t_{NEC} = \frac{\hat{\delta}_3}{se(\hat{\delta}_3)} \tag{12}$$

where $\hat{\delta}_3$ is the OLS estimate of δ_3 and $se(\hat{\delta}_3)$ is the standard error of $\hat{\delta}_3$.

They presented the above three statistics' asymptotic distributions and simulated their critical values respectively, and for more details see Kapetanios et al. (2006).

3. Data and Empirical Results

3.1. Data

This research includes seven East Asian nations: China, Japan, Korea, the Philippines, Singapore, Thailand, and Indonesia. And our empirical analysis uses monthly data and covers the period from January 2011 to November 2021. All the data is taken from the Wind Database. Table 1 summarizes the names of each country, the sample period, and the indicators of the long-term and short-term rates in this research.

Table 2 shows the statistical characteristics of the interest rate indicators in seven East Asian countries. As can be seen from Table 2, the digital characteristics of two interest rates indicators vary greatly among nations due to the monetary policies, economic development environment and economic development period. Compared to other nations, Indonesia has the highest short-term and long-term interest rates, with averages of 5.894 and 7.230, respectively.

Table 1. Sample interval and variable selection

Nation	Sample Interval	Long-term rate	Short-term rate
China	2011.01-2021.11	10-year GBY	1-year TBR
Japan	2011.01-2021.11	10-year GBY	1-year TBR
Korea	2011.01-2021.11	10-year GBY	1-year TBR
Philippines	2011.01-2021.11	1-year GBY	3-month TBR
Singapore	2011.01-2021.11	10-year GBY	1-year TBR
Thailand	2011.01-2021.11	10-year GBY	1-year TBR
Indonesia	2011.01-2021.11	10-year GBY	1-year TBR

Note: GBY denotes Government Bond Yield and TBR denotes Treasury Bill Rate.

These rates are 2-4 times higher than those of other countries owing to Indonesia's long-term high inflation rate. Japan has the lowest short-term and long-term interest rates, with the mean of long-term interest rate being 0.377, far lower than those of other countries, owing to the Japanese government's long-standing zero interest rate policy. Moreover, the mean of short-term interest rates in Japan is -0.059, owing to its policy of negative interest rates to stimulate economic growth recently. By observing the JB statistics of the short and long interest rates, it is obvious that both the two interest rates of almost all nations do not obey the normal distribution, which fully demonstrates the characteristics of the non-normal distribution of the peak and thick tail of financial time series.

Table 2. Descriptive statistics

Country	Index	Observations	Mean	Max.	Min.	S.D.	JB statistics
China	S-Rate	130	2.814	4.220	1.150	0.556	0.453
	L-Rate		3.439	4.550	2.540	0.445	3.059
Japan	S-Rate	131	-0.059	0.167	-0.344	0.138	8.569**
	L-Rate		0.337	1.290	-0.259	0.408	13.537***
Korea	S-Rate	131	1.953	3.590	0.611	0.837	7.165**
	L-Rate		2.568	4.760	1.254	0.859	9.114**
Philippines	S-Rate	119	1.936	5.754	0.001	1.310	32.090***
	L-Rate		2.528	6.546	0.190	1.414	28.705***
Singapore	S-Rate	130	0.827	2.050	0.180	0.598	15.427***
	L-Rate		1.959	2.850	0.810	0.500	8.959**
Thailand	S-Rate	131	1.804	3.600	0.420	0.840	3.510
	L-Rate		2.728	4.210	1.170	0.842	6.775**
Indonesia	S-Rate	131	5.894	8.819	2.944	1.289	5.075*
	L-Rate		7.230	9.624	5.167	0.952	2.582

Note: S-Rate stands for short-term rate and L-Rate stands for long-term rate.* signifies a 1% significance level, ** a 5% significance level, and *** a 10% significance level.

3.2. Empirical Results

To avoid spurious regression, the variables' stationarity should be examined by the Augmented Dickey-Fuller test before conducting a cointegration test. As the interest rates have no obvious trend over time and the raw data is not zero mean, all tests involve simply a constant term and determine the lag period with the SC criterion. Table 3 summarizes the

results of the Augmented Dickey-Fuller (ADF) unit root tests on both interest rates. The unit root hypotheses for the short-term and long-term rates in level are not rejected for all countries at the significance level of 5%, while these hypotheses are rejected in their first difference for all countries. Therefore, all the series are I(1). On the basis of these findings, we conduct a cointegration test.

Table 3. Dickey-Fuller unit root tests results

Country	Long term rate		Short term rate	
	Level	First difference	Level	First difference
China	-1.784[0]	-9.837[0]***	-2.461[0]	-9.722[0]***
Thailand	-1.246[0]	-9.863[0]***	-0.600[1]	-6.600[0]***
Japan	-2.398[2]	-8.498[1]***	-1.614[0]	-12.209[0]***
Korea	-2.736[1]*	-8.341[0]***	-1.983[1]	-7.509[0]***
Philippines	-1.096[1]	-7.867[1]***	-1.361[1]	-4.774[3]***
Singapore	-2.269[0]	-10.807[0]***	-1.452[2]	-9.916[0]***
Indonesia	-0.903[0]	-11.175[0]***	-0.907[0]	-12.376[0]***

Note: Each cell displays the ADF test statistic. The digit in parentheses is the appropriate lag order determined by the Schwarz Info Criterion (SC). * signifies a 1% significance level, ** a 5% significance level, and *** a 10% significance level.

For the sake of comparison, we also incorporate the linear EG cointegration test put forward by Engle and Granger (1987) and t_{NEG} test raised by Kapetanios et al. (2006) into our study. Table 4 displays the results of the cointegration test. Since the EHTS theory of interest rates does not allow for a tendency, all of the tests involve simply a constant term and the appropriate lag duration for each test is determined by the SC criteria. As shown in Table 4, the EG tests can only figure out the linear cointegration relationship of China and Philippines. Besides, the t_{NEG} and t_{NEC} tests confirm the nonlinear cointegration relationship for China, Indonesia and Korea at the level of 5% significance. Compared with the t_{NEC} tests, the cointegration relationship is also found in Singapore according to the t_{NEG} test. On the other hand, the F_{NEC} tests provide clear evidence of nonlinear cointegration relationship for China, Indonesia ,Philippines and Japan at the level of 5% significance as reported in Table 4. The nonlinear cointegration relationship is also found in Korea at the level of 10% significance both according to the F_{NEC} and F_{NEC}^* statistic, which reveals that the prior restriction of the switch point c to be zero is reasonable. Although the EG test and F_{NEC}^* test of China and the Philippines are both valid, according to the significance, the evidence of linear cointegration relationship for China is more significant, and the evidence of nonlinear cointegration relationship for Philippines is more significant. The results imply that differences from long term equilibrium for Indonesia, Korea, Japan, and the Philippines may be inherently nonlinear. All of these suggest that the EHTS of interest rates stands true for all nations with the exception of Singapore and Thailand. What's more, the adjustment towards the EHTS of interest rates is linear in China, but nonlinear in Indonesia, Japan, Korea and Philippines. The linear adjustment mechanism for China may be due to the government's strong regulation of the financial market. However, the reasons for the nonlinear adjustment mechanisms are very complex, most likely due to the transaction costs of investors, time-

varying risk premiums, regional transfer behavior, and structural changes of the monetary policy in various countries.

Table 4. Cointegration test results

Country	EG[a]	t_{NEG}[b]	t_{NEC}[c]	F_{NEC}*[d]	F_{NEC}[e]
China	-4.667***	-3.905***	-3.344**	8.143**	6.000***
Indonesia	-1.289	-3.956***	-3.478**	8.193***	5.990***
Japan	-2.351	-1.395	-2.876	2.473	5.700**
Korea	-2.116	-3.948 ***	-4.531***	5.908*	4.064*
Singapore	-2.553	-3.161*	-2.528	2.855	2.293
Philippines	-3.797**	-2.162	-1.995	8.470***	6.444***
Thailand	-2.733	-2.470	-2.010	2.569	1.822

Note: * signifies a 1% significance level, ** a 5% significance level, and *** a 10% significance level. a critical values of 10%, 5%, and 1% are -3.06, -3.36, and -3.91, respectively ,proposed by Phillips and Ouliaris (1990). b and c critical values of 10%, 5%, and 1% determined from Kapetanios et al. (2006) are -2.98, -3.28, -3.84 and -2.92, -3.22, -3.78, respectively. d and e critical values are equivalent to 4.99, 5.96, 8.17 and 3.81, 4.47, 5.94, respectively, based on Kapetanios et al. (2006).

4. Conclusions

This study evaluates the applicability of the EHTS for interest rates in seven East Asian countries from January 2011 to November 2021, based on the Kapetanios et al. (2006)'s ST-ECM for nonlinear cointegration approach. ST-ECM is more effective at detecting the co-integration relationship in the presence of policy interventions and transaction costs. The empirical findings reveal that the EHTS of interest rates stands true for all nations, with the exception of Singapore and Thailand, and that the adjustment toward the EHTS is nonlinear for the majority of East-Asian nations.

Our findings have significant policy implications for East Asian nations. Firstly, the EHTS reflects the information effectiveness of the bond market. The empirical results in this paper indicate that there is no arbitrage chance in the bond markets of most East Asian countries except Singapore and Thailand. Secondly, the major idea behind the EHTS is that long-term and short-term rates in the bond market have a stable cointegration connection. As the cointegration test indicates, most of East-Asian countries' central banks can control long-term rates by operating the short-term rates to affect the actual economic variables except Singapore and Thailand. Finally, the difference between long-term interest rates and short-term interest rates, according to the EHTS of interest rates, reflects the market's anticipation of future interest rate changes, therefore it can provide valuable information about inflation rate, future interest rate and economic operation. Our empirical results imply that the term structure of interest rates of banks will become an important information indicator within the monetary policy framework, as an important input variable in macroeconomic models and monetary policy evaluation, providing decision support for monetary policy makers in most of East-Asian countries.

Conflict of interest: none

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Collaboration of Students with the Commercial Sector at Two Selected Czech Regional Universities – A Case Study

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Abstract: In the current 21st century, more and more attention is being focused on so-called technology transfer. Universities and companies are the main actors in this transfer. Forms of cooperation with the commercial sector, i.e., the two-way flow of information and knowledge, are an important component of the modern university, which fulfils the given vision and goals in each region. Each region, in the Czech Republic we call them regions, has different precious resources, and needs at the same time. These needs are reflected by governmental units, including universities and companies, and together they create supply and demand opportunities in the labour market and try to utilise local resources. This article maps the current official forms of cooperation with the commercial sector at two selected Czech universities - the University of Hradec Kralove and the University of West Bohemia in Pilsen. The article aims to describe these activities, from available official sources, university websites, official social networks, and finally from interviews with staff and students at these universities. Another aim of the article is to compare individual activities and discuss the possibilities of sharing good practices in technology transfer between universities in the two regions of East and West Bohemia.

Keywords: cooperation with commercial sector; student; university; region; business

JEL Classification: M21; M53; M54

1. Introduction

The collaboration with businesses around providing students with practical professional experience is increasing in importance in the university environment at the present time. Companies approach local universities and offer various forms of practical experience, e. g. corporate internships, to their students already during their studies. Universities organise job fairs, invite keynote speakers from the commercial sector, practical courses led by expert professionals and other programmes with the objective to establish a space for successful collaboration between university students and businesses (Carayannis et al., 2018). In the Czech Republic, this extensive issue is very fractionalised and decentralised. Moreover, it is not given much attention by the scientific community, which results in the scarcity of scientific literature dealing with this topic in research databases. The sources of information most often used are the websites of various universities. The collaboration with the commercial sector is organised both by the university as one subject and by its individual

faculties as well as departments. This situation leads to students being unable to find one comprehensive source of information about these activities and thus take part in them. Potential employers of students therefore establish collaboration with individual faculties and even departments. For employers, these procedures are time-consuming and often lead to no results. The natural course of conduct as perceived by the employers would be to communicate on the university level with one centralised point of communication where all activities would be coordinated, and all information gathered and distributed. Such a place would also serve as the single point for contact for the potential employers as well as for the students and university graduates.

For technological companies, and not only for them, the practical skills and knowledge of students is the key criterion. The businesses and industries perceive the graduates from technical schools as overqualified but lacking in professional experience (Widiyanti et al., 2017). The ambition of this article is to map out selected activities at two regional universities stemming from the experience of the authors of this article. The two regional universities chosen for this article are in the two regional cities in the Czech Republic – Hradec Kralove and Plzen. Both cities support entrepreneurship through regional and local incubators and coworking facilities which, unlike in the capital city of Prague, struggle to stay operational and often must defend their significance and importance for the field of innovation and support of knowledge and technology transfer. In recent years, this situation has been improving due to new collaboration created through the support of entrepreneurial spirit in students and general support of entrepreneurship and start-ups by various NGOs, platforms, and the support of the Czech government. The two selected universities organise lectures, job fairs, programmes, practical courses, and other activities such as competitions and public presentations, with the aim to create room for successful collaboration between the university students and companies. The universities also support various possibilities of entrepreneurship and often co-organise such activities with business incubators and local entrepreneurs (University of West Bohemia, 2022). The aim of the universities is to offer students the widest range of possibilities, often as follow-up to their fields of study and accredited courses and programmes of individual faculties. The companies seek any opportunity to motivate the universities to fill their vacant positions, and university programmes are a very popular option to do so. With the increasing possibilities on the job market, transport infrastructure and the development of other industries, the students choosing the school they will study at are increasingly focusing on how the field of study will improve their employability in the respective field in their future career.

The Czech university environment, having been due to several decades of the Communist regime without any connection to private enterprise, which undoubtedly brings innovation and enables creativity, is gradually developing and learning to work on building relationships with employers (Rybnicek & Königsgruber, 2019). At present, unfortunately with a very limited budget and low staffing capacity, universities are trying to embrace all the opportunities the private sector offers and make them available to their students and thus also enhance their profile and attract a higher number of potential students (Studenta, 2019). In Czech conditions, as described above, it is advantageous to seek efficient formats of

collaboration with the commercial sector that are also cost-effective. The ideal solution for universities is to involve their graduates, who are willing to commit their time without seeking standard financial compensation which they normally receive from their employment or business activities (University of Hradec Kralove, 2022). The current university environment and conditions do not yet make it possible to hire managers who should build above-standard relationships with employers and would be responsible for administering this whole agenda (Rajalo & Vadi, 2017).

To provide an example of how it works abroad, the authors briefly mention Cambridge University. At prestigious British universities, it is common for career centres to have consultants who build high-quality relationships with employers through regular contact and a well-designed system. Cambridge University, for example, has a well-designed website of their career centre, which provides their students with valuable information in a very comprehensive manner. The students are guided by questions (see picture Figure 1). At each phase of their studies the students require a different kind of support as their needs also develop and change. This simple map helps the students to get oriented and find the solutions to their issues or answers to their questions and quickly and efficiently deal with them and it also caters to their specific needs (University of Cambridge, 2022).
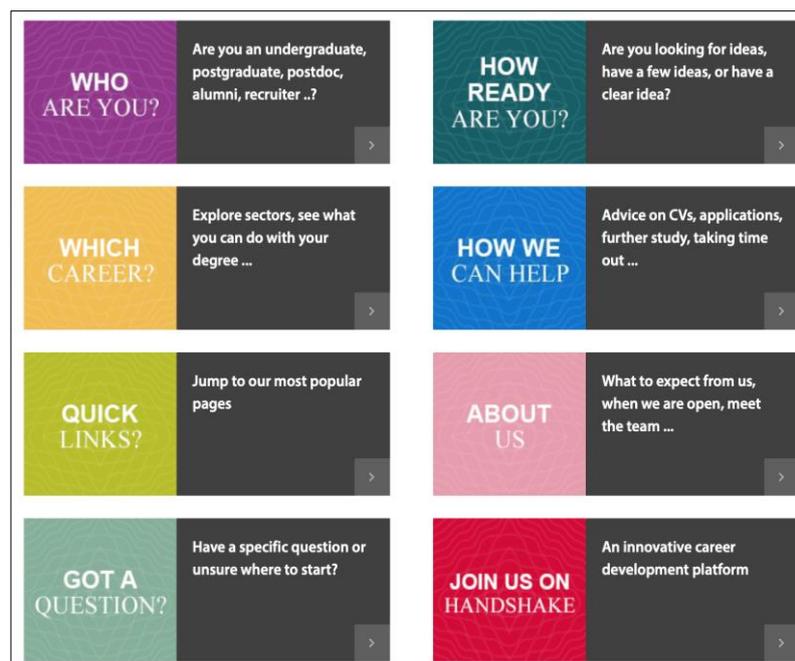
Figure 1. Offer for students at the University of Cambridge Career Center

Another good example of collaboration not only between a local university and local businesses but also with the municipality can be found in Tallinn, Estonia. Estonia has become famous for their start-up environment and e-government success. The Tallinn University of Technology also known as TalTech not only provides students with career guidance but mainly supports the entrepreneurial spirit in their students, especially by focusing on innovative business and start-ups. For this purpose, and based on the collaboration between the university, local and national government the Taltech Innovation

and Business Centre Mektory was established and still serves as the ideal meeting point for potential employers and investors. Mektory is composed of a larger building where organisations interested in working with talented students can provide not only financial support to those students who wish to develop their business ideas. The Mektory building is located near several administrative buildings that are prepared to subsequently house the businesses born in Mektory and serve as a source of income as mostly technological companies rent their office there to be closer to the innovative students from TalTech and Mektory (Tallinn University of Technology, 2022).

2. Methodology

This article uses mostly qualitative research. The authors drew data and information from in-person interviews with stakeholders (employees of selected universities, students at selected universities, business owners from selected regions). The main source of material and information for the research part of this article were the official websites and social media sites of the respective universities, which are except for interviews with stakeholders the most relevant sources of information providing insight into the current activities this article is investigating. The interviews with business owners and managers various respondents across the business communities were approached. These communities feature business owners and managers across all fields of industry and markets. For the region of West Bohemia these communities were the Pilsen Business Network and in the East Bohemia Region it was Business Friends East Bohemia. The authors of the article founded these communities and have led them since their commencement which has enabled them to interview more than 50 business owners and managers about their ways of collaborating with students and universities. The methods used in the research phase are analysis, induction, generalisation, comparison, and analogy. The research questions that the authors asked are. Q1: Do the selected universities have a sufficient variety of opportunities to work with the commercial sector? Q2: Can regional universities operating in different demographics, geographic locations and seeking other scarce resources share good practices, and if they can, how and under what conditions can this exchange occur?

3. Results

The University of Hradec Králové is a regional university located in a regional city of 92,000 inhabitants. The university was founded in 1992. It belongs to the category of regional universities. The university has 4 faculties, the Faculty of Education, from which all the other faculties were created, the Faculty of Philosophy, the Faculty of Informatics and Management and the Faculty of Science. The university has a career centre (Kariérní centrum, 2022), which is part of the Information and Career Counselling Centre. The Centre provides a full range of support services: information services for students, social counselling, psychological and therapeutic support, support for students with special needs and last not least also activities towards collaboration with the commercial sector. These investigated activities include individual counselling, preparing the student for the selection process, coaching for personal development, workshops, talks and lectures by guest speakers, facilitating contact with

potential employers and sharing job offers, as well as temporary jobs and job placements. These activities have their own projects, and they often have their own website. The career website is a sub-site that offers job opportunities advertised by companies in the region and beyond. The career web is also currently serving as an intermediary for the employment of war refugees from the Russian-Ukrainian war that started in February 2022. The career web is also the latest tool for collaboration with the commercial sector and technology transfer between the university and the commercial sector. Another significant activity is the Job Start job fair. A format that connects employers and university students. Employers present themselves in booths or by giving presentations for university students. There is always an accompanying programme, which aims to attract and invite as many students as possible to participate in the fair and obtain useful information about the various temporary jobs and other opportunities to gain professional work experience and how to later apply themselves on the job market. In addition to these activities the centre also offers the option to combine writing theses with internships in various companies and the university also features an alumni club. The alumni club is a database of thousands of alumni who work in a wide variety of fields of industry, positions in companies or manage their own business. This year, there are different types of meetings and networking for alumni, from online meetings to breakfasts or roundtables. Finally, the stakeholders can benefit from a new project run by an external company, Vzdělávačka s.r.o. which was created in 2021. The name of this activity is Student Business Breakfast, and it is often described as a "mobile two-way technology transfer". It brings together students interested in running their own businesses and regional business owners who give the students their experience and knowledge in the field of entrepreneurship and general business environment and practices. To conclude the list of activities it is necessary to also mention the activities of various societies within the university and the activities of the Academic Senate itself. In 2021 the six societies operating at the university presented how they can help students collaborate with the commercial sector. The finally interesting activity with a lot of potential for the future is called Hradec Economics Days which will in 2022 bring a whole panel on technology transfer and will connect academics, businesses in biomedicine and students.

The University of West Bohemia in Pilsen was founded in 1991 and currently has nine faculties, 62 departments and 275 study programmes and is one of the larger and high-ranking universities in the Czech Republic. The population of the city of Pilsen at the beginning of 2022 was approximately 168,000 inhabitants and the population of the Pilsen Region was 579,000. There are currently approximately 11,000 students studying at the UWB, who can use the services of the Information and Consulting Centre, which also include career counselling. In the past few years, this service was provided by the central Career Centre, whose activity was unfortunately terminated in 2021 and the activities were moved to the already mentioned Information and Consulting Centre. At the same time there is also a parallel centralised activity which was created at the same time as the Creek Centre but continues to exist – the BoostUp UWB Entrepreneurial Innovation Club. Both the Career Centre and the BoostUp club were founded in 2018 and BoostUp remains until today the part of the department of Technology Transfer. The purpose of BoostUp is to support students in

their journey to start and build their own business through mentoring and workshops with experts from the commercial sector. These activities are largely organised in collaboration with Pilsen Business Network (Dare2, s.r.o., 2022). In addition to these centralised activities, there are also other projects and collaborations with companies at the UWB, for example, the Faculty of Economics has its own Centre for Entrepreneurship and Sustainability (Centrum podnikání a udržitelnosti, 2022), which offers services to all students at the UWB but is managed by the Faculty of Economics and students from other faculties have very little awareness of it. Similarly, unless there is active promotion of these services directly by faculties and departments among students during classes, in most cases students at the UWB are not aware of the various consulting and support services offered by the Information and Consulting Centre of the UWB or the Centre for Entrepreneurship and Sustainability. Furthermore, individual faculties and departments have their own cooperation agreements with individuals and organisations from the commercial sphere. In terms of staffing and focusing on the centralised activities, BoostUp ZČU is led by Mgr. Šárka Trapp Cajthamlová, who stated in an interview that she has only one quarter of her working time allocated for the development of these activities which is not sufficient at all. Regarding career counselling for future employees a person dedicated to this work who would devote and develop this area on a full-time basis is also missing.

The authors are aware that there are other individual efforts and activities to promote collaboration between the university, the students and the commercial sector organised by individual faculties and departments, nevertheless the aim of this article is to map out the activities and services that can be accessed by and can benefit all students. The following Table 1 presents the list of the activities mentioned by the authors.

Table 1. Overview of cooperation with the commercial sector

University of Hradec Kralove	University of West Bohemia
JobStart	BoostUp
Alumni club	Ceupecko
Seslost	Technology transfer
Hradec Economic Days	Veletrh pracovních příležitostí (Job fair) - organised at university but not by the UWB
Student business breakfast	Partnership with Pilsen Business Network and Junior Chamber International

Within the university setting, we approached one member of staff from each university with whom we had a short interview on the topic of collaboration with the commercial sector. The following research findings emerged from the interviews with the university employees responsible for this area. In general, staff would like to be given more authority and competence to innovate and implement programmes of activities for collaboration with the commercial sector. This would accelerate the possibility of responding more flexibly to suggestions from the student as well as the companies interested or already included in collaboration. Of course, they would very much welcome it if this university priority could be better supported and a larger budget could be made available for these activities in the future, thus creating a larger team of people who could nurture relationships with students

and companies. We can see concrete examples and best practices already today at the leading European and world universities, for example the above-mentioned University of Cambridge and TallTech. This article aims to only investigate the situation at the selected universities, therefore other universities are not mentioned here in a more extensive way, however, they will be the subject of further future research into this topic.

The total of 30 students were randomly selected across all faculties and invited to answer questions about the collaboration with the commercial sector. The research yielded the following results. The questioned students perceive some processes and mechanisms at the university as slow, complicated, and often very rigid. When commenting on the website and that especially the one of the University of Hradec Kralove the students would appreciate a more comprehensive presentation and overview of the various possibilities of collaboration with the commercial sector. At the present day the website is their main source of information when they for example work on their master's or bachelor's thesis and their thesis supervisor could collaborate with the commercial sector. Other sources of information could be the faculty itself or the thesis supervisor. This article aims to analyse, compare, and contrast the umbrella collaboration with the commercial sector and the possibilities provided to all students regardless of their faculty or study programme, therefore individual activities and efforts organised by individual departments and faculties are not investigated, analysed, and included in the article. The students at the University of Hradec Kralove provided positive feedback to practical activities such as the above-mentioned Student Business Breakfast, a format of collaboration that allows them to meet with potential employers or mentors and acquire information about entrepreneurship on neutral grounds and in a very friendly atmosphere. In the interviews the students appreciated the practical skills they developed: *"it was real, I had to present myself the best I could, work with information I had at my disposal and also present the relevant information"* , *"you need to be ready to step out of your comfort zone"*, *"I was very nervous talking in front of real entrepreneurs"*, *"it is different when you talk to people who have done business for many years, totally different from talking to my classmates or teachers"*. The students mostly appreciated the real-life experience of getting to a meeting on time and being prepared and then presenting in real time to real people their real ideas, requests and really testing their nerves and skills. Further the students also provided positive feedback on the atmosphere and were surprised by being treated by these entrepreneurs as equals. This can be easily explained by the fact that the University of Hradec Kralove offers only one subject on entrepreneurship which is taught using the standard teaching methods and frontal teaching when one teacher shares information towards students who mostly passively absorb it. If we look for similar practices abroad, this is no longer the case at the top institutions. Leading universities encourage their students to get involved in real projects with university partners or work on their own practical projects.

The research also included interviews with 50 business owners across the industry spectrum. These owners were approached through regional networking platforms that connect local business owners, entrepreneurs, and managers. For Pilsen, respondents were from the Pilsen Business Network platform and their community organised by Dare2 s.r.o., and for East Bohemia it was Business Friends East Bohemia operated by Vzdelavacka s.r.o.

Respondents answered a set of six following questions: 1. Do you know exactly where to go to find cooperation options at your local university? 2. Can you name 2 activities that the university offers regarding collaboration with the commercial sector in 2022? 3. What source of information or marketing channel do you prefer for learning about the possibilities to collaborate with the regional university? 4. Are you familiar with the concept of technology transfer? 5. What type of collaboration with the university do you perceive is now missing? 6. Do you have any other comments or suggestions on this topic? The results of this survey are as follows. 90% of respondents do not know where exactly they would go to look for information or to start collaboration, at the same time they would reach out to the already existing contacts they have in their contact network and ask them for suggestions and help. 10% of respondents have met designated university staff in the past and can reach out to them directly. 50% of respondents could not name 2 activities that the local university organises to promote collaboration with the commercial sector. 20% of respondents listed 2 or more activities and 30% knew about 2 activities. The channels preferred by respondents are within the online platforms of email, telephone, and website. Within offline platforms, it is face-to-face contact at various networking events or opportunities where it is appropriate to meet university representatives and students. Only 5% of respondents are familiar with the concept of technology transfer. In the last question, the respondents gave similar answers, namely that they would like to get a more regular overview of the activities that the university is planning for the year, so that they have sufficient time and space to engage in activities within their own companies' agendas and plans.

4. Discussion

The research shows that universities, if they want to be modern educational institutions lucrative for future students, must not ignore trends on the job market. Universities should look for opportunities and forms of collaboration in their environment to establish interesting partnerships with interesting employers and to bring employers closer to students through various programmes such as connecting theory and practice. From the possibilities to write bachelor's theses to various internships, practical study subjects and classes and the most diverse collaboration to promote entrepreneurship. The student is a valued client for the university on this level and, students are also important for the future of the given society and country and therefore, it is necessary to make sure the students have access to the widest possible range of opportunities so that they can best decide on their career path that is at the same time aligned with their life goals and dreams (Orazbayeva et al., 2019).

An unknown variable remains the improvement of the financial capacity and staffing of university career teams so that they can cover all the employer and student relations agenda well. This work requires senior HR, management, and leadership skills. Given that we are currently in a post-covid and Russia-Ukraine war crisis, with inflation reaching record averages of 11% and the national budget deficit increasing, funding and state support will be decreased, which may make it more important in the coming years to build cooperation with the commercial sector, which can bring funding in various forms of cooperation. University centralisation versus decentralisation also remains a question. Bearing in mind the various

cooperation stakeholders of the tripartite relationship student, university, entrepreneur, is it advantageous for the stakeholders to have all possibilities centralised under one roof and in one place? Is it more advantageous and efficient to have forms of cooperation distributed across individual faculties and departments? What kind of information should be readily available to students and where? Can university staff work together to solve the funding issues and to agree on effective collaboration and support in a fully decentralised system? In the future, will internships be part of the studies and at what percentage the timetable will it form? Will universities also be evaluated by the success criteria of graduates and the established relationships with the commercial sector? Can the student business breakfast drive networking between these stakeholders and become part of the regular agenda of university semesters?

Technology transfer is becoming almost a buzzword. The application and commercialisation of the results of scientific research and their application in business practice is gaining importance as well. Technology transfer is gaining more and more importance and is getting into the focus within the scientific community in the Czech Republic. Technology transfer is dealt with by the Technology Agency of the Czech Republic, referred to as TACR (Technology Agency of the Czech Republic, 2022). There is a consultancy and advisory firm in the field of technology transfer called Transfera (Transfera, 2022). An interesting platform is the so-called spinoff companies. These are in their infancy in the Czech Republic and in the environment of our two selected universities. The first truly successful spin-off companies are yet to be created in the future. From the interviews we have conducted with academics, students and business owners and managers, many questions remain unanswered. These questions concern linking the ownership structure and management setup of a company through the spinoff format. Our interviewees, mainly from private companies, have the experience and bias that joining in on projects with a stakeholder such as a university, a large colossus that has its own lengthy processes, is a hindrance for businesses in terms of development and innovation. Within academia, the know-how acquired by graduates is more likely to be diverted to the private market rather than remain in and benefit the university itself. Respondents also point to the change of leadership every 4 years, which they consider risky in the context of long-term collaboration. Our research suggests that for technology transfer and collaboration with the commercial sector, there still remain many unknowns for the stakeholders which will need to be answered, anchored and described in order to expand further opportunities and space for successful collaboration.

5. Conclusion

The research shows that universities, if they want to be modern educational institutions lucrative for future students, must not ignore trends on the job market. Universities should look for opportunities and forms of collaboration in their environment to establish interesting partnerships with interesting employers and to bring employers closer to students through various programmes such as connecting theory and practice. From the possibilities to write bachelor's theses to various internships, practical study subjects and classes and the most diverse collaboration to promote entrepreneurship. The student is a valued client for the

university on this level and, students are also important for the future of the given society and country and therefore, it is necessary to make sure the students have access to the widest possible range of opportunities so that they can best decide on their career path that is at the same time aligned with their life goals and dreams (Orazbayeva et al., 2019).

Work-life balance and working on meaningful projects which students enjoy and are further developed by and which lead to a fulfilled and high-quality life are currently the topic of many expert discussions, articles, and books. Universities have vast human resources in their own students who they can involve in these activities. Nowadays, not only the two selected universities have various university associations and interest groups, as well as the student senate, which reflect and protect the students' interests when dealing with the academia and the university management. For example, at the University of Hradec Kralove, the student senate succeeded in running projects in the field of digitalisation and communication. The projects sped up internal as well as external communication. It is important to point out that the student' senate at this university is not paid and everything was done by students in their free time as they sought to improve the situation with their actions and feedback for their successors.

The motivation and positive relationship to the alma mater is often based on the highest values of self-realisation and helping social causes. It is also a way to work together in an environment that is limited in generating its own financial means. The University of Hradec Kralove has also managed to solve the problem of lack of finances through external collaboration with university alumni who are top managers, HR directors, business owners and event's organisers. The joint synergy has brought about tremendous and dynamic development in the collaboration with the commercial sector, as proven by student business breakfasts, JobStart festivals, active communication, and nurturing alumni relations. To this article, two examples of European universities that have a well-developed system of cooperation with the commercial sector for their students have been selected. Tallinn University shows the future of university campuses that resemble Silicon Valley and incubation environments. Cambridge University shows a modern way of presenting and communicating towards students. A clear signpost of Cambridge University is recorded in Figure 1 at the beginning of the article. Universities have different approaches to careers centres, some standing alone and others being part of other departments. The University of Hradec Kralove has a university career centre linked to psychological support activities and statutory support for specific student needs. The University of West Bohemia had a centralised career hower centre, its activities have since been incorporated into similar student support activities. In Pilsen, the programme for supporting the entrepreneurial spirit in students BoostUp ZČU remains operational as part of the Department of Technology Transfer (BoostUP, 2022). BoostUp is like the activities in Hradec Králové linked to the local business breakfast networking club Pilsen Business Network (run by a private company Dare2, s.r.o.). At the same time individual faculties and departments run their own projects and the Faculty of Economics even have their own Centre for Sustainability and Entrepreneurship (Cepeucko, 2022).

From our research observation, there is a need for synergy and cooperation among the teaching supervisors of the courses. Practice often overlaps with courses because practice is not yet foreseen in the timetable. In the best case, it is usually an elective subject that the student can incorporate into his/her timetable. A format that is not yet applied at selected by Czech universities is the spin-off company. The interviews show that a balance has not yet been found between the joint shareholding of a private company and a university. Furthermore, the interviews revealed that the technology vouchers announced by the Czech national agency are an interesting opportunity for postdoctoral students to collaborate with the commercial sector. Unfortunately, the setup of vouchers and the subsidy issue rather increases the administrative and economic burden on companies. In our interviews, we encountered opinions from company owners that it is easier for them to pay for technology developments directly from their own resources. After two pilot projects in two regional cities and the immediate results of the cooperation, the Student Business Breakfast certainly ranks as a very simple and at the same time very successful and effective format. Each of the stakeholders as described in Table 1 gains many opportunities. The students get to see a different environment, get to know each other and at the same time get to know the business owners. Students can validate their business plan in practice well before they start their business and invest time and money. The university establishes and strengthens relationships with potential partners or deepens relationships with existing partners, also the credit of the university itself rises in the eyes of the students. Business owners gain the opportunity to fill their staffing needs and establish a relationship with the local university.

We believe that there is a large amount of high-quality collaboration with the commercial sector on the market that universities can also include in their activities. Also, there are already several inspiring ideas and best practice formats that can be outsourced for the specific needs and disciplines of individual universities. There certainly also are many formats that are yet to be developed and applied in the fields. The Czech Republic can strive to be inspired by European as well as global best practices and already existing examples of collaboration. Some of them are not applicable on the global scale but can be adopted in versions and forms adapted to the conditions of the Czech Republic. This topic will be further developed and discussed in future articles, and, at the same time, further applied in practice.

When comparing the websites of both universities, it appears that the University of West Bohemia has a much faster and clearer way to access information about cooperation with the commercial sector. Both from the side of students, companies, and the public. At the University of West Bohemia, right on the homepage you can click on cooperation and the options will expand. The University of Hradec Kralove has these activities available on a triple click from the main menu. So, collaboration is very hidden and difficult to find. Collaborations such as the student breakfast have proven to be a two-way innovative technology transfer.

As can be seen from the research, each university develops a more different area of collaboration with practice. The University of West Bohemia focuses more on entrepreneurship and business opportunities such as the already mentioned BoostUp operated by the rectorate, or the Centre for Entrepreneurship and Sustainability operated by

the Faculty of Economics. University of Hradec Kralove connects students more with potential employers through activities such as the already mentioned JobStart. The University of West Bohemia also offers this opportunity for students to meet with potential employers – Veletrh pracovních příležitostí (Job opportunities trade fair), however, after interviewing both the university employee and a former student of the university it was discovered that is activity is not listed on the university website and is in fact organised by a separate legal entity, another private company, in collaboration with the student organisation IAESTE. Šárka Trapp from BoostUP explains: "The job opportunities trade fair is not in fact organised by us, we only provide our premises and visibility to the event, however companies are not aware of this and often expect more support on our part, yet we are also only involved as one of the exhibitors." The research shows that it is certainly possible to share these activities between universities through best practice, which answers one of our research questions. These activities could be shared through simple online conference calls. Alternatively, in-person visits to universities by specific members of staff, which is the answer to research question number two. We want to return to the selected universities with the research over time and see the evolution of these activities over time. The ideal situation would be a one-day conference of the universities that would be dedicated specifically to good practice in collaboration with the commercial sector. It would be beneficial to also invite representatives from a foreign university and thus share best practices and know-how from abroad and at the same time this would ensure that the participants from different regions do not perceive each other as competitors when attracting potential students and their future employers as well as looking for commercial partners for their research and technology transfer.

Conflict of interest: none

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Assessment of Coordinated Development of Economic Development, Public Services and Ecological Environment in the Yellow River Basin

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Abstract: Ecological protection and high-quality development of the Yellow River Basin has become an important national strategy. As the economic development, public services and ecological environment in the Yellow River Basin are increasingly complicated, the quantitative evaluation of their coupling coordination is therefore of great significance for high-quality development of the Basin. Based on the synergy effects of economy, public service and ecology in the Yellow River Basin, this paper firstly constructed a comprehensive evaluation index system of coupling synergy in the Yellow River Basin. Then discussed the spatial-temporal differences of the synergetic development of the Yellow River Basin by using 2 kinds of quantitative methods, which are entropy method coupling coordination degree model, spatial autocorrelation model. And the following conclusions are drawn: (1) The prefecture-level cities "coupling coordination degree" of economic development, public services and ecological environment in the Yellow River Basin are generally stable, with little fluctuation within years, however, there are huge differences among cities, and the overall coordination remain to be improved. (2) There is spatial autocorrelation in the coupling coordination degree among cities within the basin, and it shows a spatial club convergence with the characteristic of high-high and low-low aggregation. Therefore, it is vital to strengthen the linkage of development within the basin, reinforcing the financial support, and optimizing the industrial structure, thus ultimately make good use of the aggregation effect and "siphon effect" of urban agglomeration in promoting the coordinated development of the Yellow River Basin.

Keywords: Yellow River Basin; coupling coordination degree model; spatial autocorrelation model

JEL Classification: Q56; F63

1. Introduction

The coordinated development of the Yellow River Basin has become an important strategy. The National Development and Reform Commission (NDRC) recently unveiled the National Standard for Basic Public Services (2021 edition), which covers elderly care, education, medical care, employment, housing and transportation, and calls for ensuring people's livelihood and improving their sense of well-being. This shows that high-quality development means that on the basis of not damaging the environment, we should constantly improve the level of

economic development and provide better public services to the people. Economy, public service and ecology are three important subsystems in evaluating regional coordinated development. The economic development level of the Yellow River Basin is affected by whether the ecological environment is fragile or not, and the level of the ecological environment is also affected by the quality of public service supply, which largely depends on the level of economic development. Therefore, under the background of high-quality development of the Yellow River Basin as a new national major strategy, it is of great significance to discuss the coordinated development level, spatial and temporal differences of economic development, public services and ecological environment in the Yellow River Basin.

At present, many achievements have been made in the field of high-quality development of the Yellow River basin, mainly including two aspects. First, scholars have discussed the connotation and realization path of high-quality development in the Yellow River Basin from the macro level (Chen & Jin, 2019; Guo, 2020). An and Li (2020) believe that the key points of high-quality development in the Yellow River Basin are ecological governance, industrial division of labor and regional connection. Ren (2020) believes that the high-quality development of the Yellow River Basin can be guided by green development and integrated with coordinated development, linkage development, classified development and cooperative development. Second, scholars further measure the high-quality development level of the Yellow River Basin from different dimensions. Shi et al. (2021) measured the high-quality development level of cities in the Yellow River Basin from three aspects of economic fundamentals, society and ecology. Xu et al. (2020) measured the high-quality development level of the Yellow River Basin from the five development concepts of innovation, coordination, green, openness and sharing. The study found that the development of the Yellow River Basin varies greatly among provinces, and there are still many problems in the high-quality development of the Basin.

To sum up, there have been abundant achievements in the high-quality development of the Yellow River Basin, but there are few articles on the evaluation and measurement of prefecture-level cities. In addition, it can be seen that there are many literatures on the relationship between economy, public service and ecological environment in the academic circle, but there is a lack of research on the synergistic relationship among the three, especially considering the synergistic level of the three at prefecture-level and city level in the Yellow River Basin. Therefore, the coupling coordination degree of research on the three is conducive to promoting the high-quality development of the Yellow River Basin.

2. Methodology

2.1. Indicator System

The Yellow River flows through nine provinces and regions of Qinghai, Ningxia, Sichuan, Gansu, Inner Mongolia, Shanxi, Shaanxi, Henan and Shandong. In order to ensure the integrity and availability of data, 71 prefecture-level cities in the Yellow River basin were selected as the research objects from 2012 to 2019. This paper constructs an economic index system from the three dimensions of economic aggregate, economic quality and development

Table 1. Comprehensive evaluation index system of coupling coordination of economic development, public services and ecological environment in the Yellow River Basin

system	level	index	unit	pointer type
Comprehensive economic evaluation	economic aggregate	gross regional production	Wan Yuan	Are indicators
		Public revenue	Wan Yuan	Are indicators
	economic quality	Gross regional product per capita	Yuan	Are indicators
		Per capita retail sales of consumer goods	Yuan	Are indicators
		Average salary of employees on the job	Yuan	Are indicators
		Regional GDP growth rate	percent	Are indicators
	developmental level	Average home sales price	Yuan	Are indicators
		Population urbanization rate	percent	Are indicators
		Proportion of output value of tertiary industry	percent	Are indicators
Comprehensive evaluation of public services	educational level	Number of primary and secondary school teachers per 10,000 people	person	Are indicators
		Number of students in institutions of higher learning	person	Are indicators
		Proportion of financial expenditure on education	percent	Are indicators
	medical level	Number of hospital beds per 10,000 people Number of doctors in hospitals	quantity	Are indicators
	cultural development	The number of books in public libraries per 10,000 people		Are indicators
	infrastructure	Per Capita Domestic Electricity Consumption of Urban and Rural Residents (Municipal districts)	kilowatt-hour	Are indicators
		Per capita Household Water Consumption (Municipal district)	ton	Are indicators
		Per Capita Household Gas Consumption (artificial and natural gas) (municipal districts)	stere	Are indicators
		Number of broadband Internet access users	object	Are indicators
	social insurance	Basic endowment insurance participation rate	/	Are indicators
		Basic medical insurance participation rate	/	Are indicators
		Unemployment insurance participation rate	/	Are indicators
Comprehensive evaluation of ecological environment	surroundings	Per capita garden green area	Ha/ten thousand people	Are indicators
		Green coverage rate of urban built-up area	percent	Are indicators
	pollutant discharge	Discharge of industrial wastewater	Ten thousand tons of	Negative indicators
		Industrial sulfur dioxide emissions	ton	Negative indicators
		Industrial dust emission	ton	Negative indicators
	environmental governance	Domestic sewage treatment rate	percent	Are indicators
		Harmless treatment rate of household garbage	percent	Are indicators
		Comprehensive utilization rate of solid waste	percent	Are indicators

level under the new normal (Ren, 2021), taking into account public financial revenue, per capita retail sales of consumer goods, urbanization rate, housing price and average wage of on-duty employees. In addition, the main development indicators of basic public service in the 13th Five-Year Plan period (Ren, 2019; Li, Li, & Zhu, 2015; Xin, 2019). As a reference, five partial indicators including social security, medical and health care, education level, cultural construction and infrastructure are selected to measure the level of basic public services.

Secondly, reference to previous studies (Zhao, Liu, & Zhu, 2020; Liu, Huang, & Zuo, 2021), measure the level of ecological environment from three dimensions of living environment, pollution discharge and environmental governance.

The data used were from China Urban Statistical Yearbook, the provincial statistical yearbook of the provinces involved, and the national economic development bulletin of prefecture-level cities from 2012 to 2019. For missing data, interpolation method is used to interpolate.

2.2. Assessment Model

1. System comprehensive level evaluation model

For the processing of raw data, dimensionless standardization is first used

$$For\ positive\ indicators: Y_{ij} = \frac{X_{ij} - Min\ (X_{ij})}{Max(X_{ij}) - Min\ (X_{ij})} \tag{1}$$

$$For\ the\ inverse\ index: Y_{ij} = \frac{Max(X_{ij}) - X_{ij}}{Max(X_{ij}) - Min\ (X_{ij})} \tag{2}$$

where, i represents the system, j represents the measure index, X_{ij} and Y_{ij} represents the original data and standardized value of the index respectively. Then the entropy method is used to calculate the index weight W_{ij} one by one.

The composite level index for each system can be calculated by:

$$U_i = \sum_{j=1}^{n} W_j Y_{ij} \tag{3}$$

where, U_i represents the comprehensive level index of each system, and n represents the number of indicators in each system.

2. Coupling coordination degree model

Referring to existing studies, the specific calculation formula for the coupling coordination degree of economic development, public services and ecological environment in the Yellow River Basin is as follows:

$$T = \alpha U_1 + \beta U_2 + \gamma U_3 \tag{4}$$

$$C = \sqrt[3]{\frac{U_1 * U_2 * U_3}{\prod_{i \neq j}(U_i + U_j)}} \tag{5}$$

$$D = \sqrt{CT} \tag{6}$$

where, T represents the comprehensive coordination index; U_1 、 U_2 and U_3 are the comprehensive level indexes of the three systems respectively; α , β , γ each value 1/3; C is the coupling degree; D is the coupling coordination degree; I and j=1, 2, 3. According to the method of uniform distribution, the coupling coordination degree is divided into ten levels.

Formula (3) is used to calculate the comprehensive level index of economic development, public service and ecological environment in the Yellow River Basin.

Table 2. Classification of coupling coordination degree

Coupling coordination degree value	Coordination level	Coupling coordination degree value	Coordination level
0-<0.1	Extreme imbalance	0.5-<0.6	Barely coordination
0.1-<0.2	A serious imbalance between	0.6-<0.7	Primary coordination
0.2-<0.3	Moderate disorders	0.7-<0.8	Intermediate coordinate
0.3-<0.4	Mild disorder	0.8-<0.9	Good coordination
0.4-<0.5	On the verge of disorder	0.9-<1.0	Good coordination

3. Results

3.1. Time Series Evolution Analysis of Economic Development, Public Service and Ecological Environment

From 2012 to 2019, the coupling and collaborative evolution of economic development, public services and ecological environment in the Yellow River Basin generally tended to be stable. The coupling coordination degree of most cities did not change much in recent years and the coordination degree was generally low. Most regions were barely coordinated, and the coordinated development level still needs to be improved. Specifically, the system coupling index increased year by year from 2012 to 2016, indicating that the level of coordinated development of economy, ecological environment and public services is gradually improving. The fluctuation decreased from 2016 to 2018, indicating that the prefecture-level cities in the Yellow River Basin are facing great pressure and challenges in economic transformation and ecological protection, and the synergy of development has decreased, but the range of change is not big. And then in 2019, the coupling and synergy gradually improved.

Table 3. Comprehensive Level Index of Economic Development, Public Services and Ecological Environment in the Yellow River Basin (2012-2019)

year	economic development	public service	ecological environment
2012	0.292277	0.214533	0.641721
2013	0.305645	0.217581	0.649694
2014	0.293235	0.212344	0.668589
2015	0.310404	0.227369	0.637867
2016	0.391103	0.22437	0.626255
2017	0.353737	0.191147	0.619577
2018	0.327904	0.233762	0.675592
2019	0.330687	0.22881	0.629832

In terms of economic development, the level of economic development in the Yellow River Basin varies from place to place. The level of economic development is generally stable in recent years and shows a slight upward trend with an average value of 0.3256. The economic development is in good condition. Industrial transformation and upgrading drive the economic development of each region. The central city also plays its aggregation effect

and radiation effect to drive the development of surrounding areas. Developed cities such as Qingdao, Jinan, Zhengzhou, Xi 'an and so on can give full play to their talent quality, and the development of strategic emerging industries can promote transformation and upgrade the high-tech enterprises.

In terms of public service, the public service level of prefecture-level cities in the Yellow River Basin was generally stable from 2012 to 2019, with an average value of 0.2187. It showed a trend of slow rise, with only a slight decline in 2017, and then gradually increased. The public service level of different prefectural cities is different, among which the public service level of Qingdao, Yantai and other cities are higher, while the public service level of Zhongwei, Tianshui, Guyuan and other cities are relatively lower. In comparison, the allocation of public resources such as education, medical care and social security is more reasonable in areas with high economic level. The level of public resource allocation in economically backward areas still needs to be improved.

In terms of ecological environment, the comprehensive ecological level of prefectural cities in the Yellow River Basin fluctuated from 2012 to 2019, gradually increased from 2012 to 2015, and fluctuated and declined from 2015 to 2017. In 2018, it recovered slightly, and then declined slightly in 2019, with an average value of 0.6436. The reason is related to the changes of economic policies and environmental policies at this stage, but compared with the level of economic development and public service, the level of ecological environment is generally higher, indicating that governments at all levels in the Yellow River Basin have strictly implemented environmental protection policies in the Yellow River Basin to promote green development.

3.2. Spatio-temporal Difference Analysis of the Coupling Coordination Degree of Economic Development, Public Services and Ecological Environment

The overall coupling coordination degree of the Yellow River Basin from 2012 to 2019 increased from 0.5703 in 2012 to 0.5992 in 2016 and then to 0.585 in 2019, but the overall coordination degree fluctuated. In the 71 prefecture-level cities in the Yellow River Basin, the number of cities with the coupling coordination degree less than 0.5 decreases in fluctuation, and the number of cities with the coupling coordination degree greater than 0.6 also increases in fluctuation, indicating that the coordinated development level of economic development, public services and ecological environment in the Yellow River Basin is improving.

As a whole, the coupling coordination degree is related to urban economy development condition. According to the coupling coordination degree 71 cities 2012-2019 average, three cities including Jinan, Qingdao and Xi 'an are in good coordination. Those cities have convenient transportation, good education and other services, therefore overall coordination development level is higher. Taiyuan, Hohhot, Baotou, Zhengzhou, Lanzhou and Yinchuan are at the intermediate level of coordination. There are 13 cities in the primary coordination category, including Ordos, Zibo, Yantai, Xining and other cities. Datong, Yangquan, Changzhi, Jincheng and other 34 cities are barely coordinated. While there are thirteen cities, including Xinzhou, Linfen, Luliang, Zhoukou, Shangluo and so on are on the verge of disorder. Compared with these cities, they are relatively backward in economy, blocked in

development, slow in the development of livelihood undertakings, and low in overall coordinated development.

3.3. Global Space Autocorrelation of Economic Development, Public Services and Ecological Environment in the Yellow River Basin

Geoda software was used to construct a spatial weight matrix to measure the global Moran index of the coupling coordination degree of the three systems of 71 prefecture-level cities in the Yellow River Basin from 2012 to 2019.

Table 4. Global Moran's I index of coupling coordination degree in the Yellow River Basin (2012-2019)

year	2012	2013	2014	2015	2016	2017	2018	2019
Moran's I	0.173	0.202	0.215	0.211	0.194	0.176	0.132	0.143
P value	0.012	0.004	0.012	0.006	0.008	0.013	0.033	0.032

From 2012 to 2019, the global Moran index of 71 prefecture-level cities in the Yellow River Basin was all greater than 0, and all passed the significance test (P < 0.05), indicating that the spatial distribution of coupling coordination degree in the Yellow River Basin was positively correlated. The global Moran index showed an upward trend from 2012 to 2014, rising from 0.173 to 0.215. From 2015 to 2018, it decreased year by year from 0.211 to 0.132. In 2019, it rose to 0.143. The coupling coordination degree of economy, public service and ecology in the Yellow River Basin showed a trend of agglomeration, dispersion and agglomeration.

3.4. Local Spatial Autocorrelation of Economic Development, Public Services and Ecological Environment in the Yellow River Basin

The global Moran index can only reflect the overall correlation trend of the coupling coordination degree of the three systems. To compensate for this deficiency, the local spatial autocorrelation is carried out to measure the aggregation and spatio-temporal evolution of the coupling coordination degree in the Yellow River Basin.

According to the Moran scatter diagram, the spatial clustering type of coupling coordination degree in each region can be divided into four regions: high-high indicates that the coupling degree of itself is high and the coupling degree of adjacent regions is high; High-low indicates that the coupling degree of itself is high and the coupling degree of adjacent areas is low. Low-high indicates that the coupling degree of itself is low but the coupling degree of adjacent area is high; Low-low indicates that the coupling degree of itself is low and that of adjacent areas is low.

First of all, most prefecture-level cities are in high-high and low-low regions, accounting for 69% in 2012 and 64.8% in 2019, both greater than 50%. The results show that the prefecture-level cities with high coupling coordination degree of economic development, ecological environment and public service and the prefecture-level cities with low coupling coordination degree have agglomeration effect, which has a positive spatial correlation. Specifically, high-high zones include most prefecture level in Shandong and Henan part level city. Those cities' economic development level is high, while education, health care, and social security levels are relatively high.

Table 5. Spatial variation classification of coupling coordination degree in the Yellow River Basin

Spatial correlation model	2012	2013	2014	2015	2016	2017	2018	2019
High-high	Qingdao, Dongying and other 18 cities	Jinan, Baotou, Qingdao, Yinchuan and other 17 cities	Qingdao, Jinan, Zibo and other 17 cities	Qingdao, Weihai, Yantai, Zaozhuang and other 15 cities	Qingdao, Weihai, Yantai, Tai 'an and other 20 cities	Yinchuan, Qingdao, Shizuishan, Tai 'an and other 17 cities	Qingdao, Baotou, Weifang and other 16 cities	Jinan, Dongying, and other 16 cities
High-low	Xi 'an, Tongchuan, Zhengzhou and other 7 cities	Xi 'an, Xianyang, Baotou, Taiyuan, Jining and other 11 cities	Luoyang, Lanzhou, Tongchuan, Xi 'an, Xianyang and other 11 cities	Taiyuan, Xi 'an, Tongchuan, Lanzhou and other 11 cities	Taiyuan, Xi 'an, Zhengzhou and other 9 cities	Lanzhou, Xi 'an, Tongchuan, Zhengzhou and other 8 cities	Taiyuan, Xi 'an, Tongchuan, Yinchuan and other 12 cities	Zhengzhou, Baotou, Yinchuan, Xi 'an and other 10 cities
Low-high	Luoyang, Jiaozuo, Pingdingshan, and other 15 cities	Jinzhong, Zaozhuang, Shangluo, Haidong and other 13 cities	Jiaozuo, Pingdingshan, Shangluo, Weinan and other 11 cities	Jiaozuo, Pingdingshan, Haidong, Shangluo and other 14 cities	Jiaozuo, Pingdingshan, Haidong, Shangluo and other 10 cities	Jiaozuo, Kaifeng, Pingdingshan, Haidong and other 16 cities	Shizuishan, Liaocheng, Yangquan and other 14 cities	Jiaozuo, Shizuishan, Liaocheng and other 15 cities
Low-low	Pingliang, Baoji, Xianyang, Zhongwei, Guyuan and other 31 cities	Longnan, Pingliang, Tianshui, Weinan and other 30 cities	Longnan, Pingliang, Qingyang, Tianshui and other 32 cities	Zhongwei, Guyuan, Shangqiu, Tianshui and other 32 cities	Zhongwei, Weinan, Shangqiu, Xinxiang and other 32 cities	Guyuan, Yan 'an, Yulin, Pingliang and other 30 cities	Longnan, Pingliang, Tianshui, Zhoukou and other 29 cities	Shangqiu, Zhoukou, Zhongwei and other 30 cities

In addition, low-low zones mainly include Qinghai, Ningxia and Gansu province. The main reason is that these areas are sparsely populated, and economy is relatively backward. While education, health care, social security and other public utilities supply there are large space of ascension. The unreasonable industrial structure there makes the consumption of energy and water larger and the pollution to the ecological environment larger.

Secondly, there are fewer cities in low-high and high-low coupling coordination areas and they are scattered, which is due to the significant difference between the coupling coordination degree of this area and the surrounding areas.

In general, the spatial coupling coordination degree of prefecture-level cities in the Yellow River Basin presents high-high aggregation and low-low aggregation, showing aggregation effect. In 2012, these cities with low concentration were Yulin, Guyuan, Tianshui, Longnan and so on. In 2019, low-low clustering cities include Yulin, Yan 'an, Linfen, Qingyang, Guyuan and so on, while high-high clustering cities include Weifang, Laiwu, Zibo, etc.

4. Discussion

Based on the influencing mechanism of the synergy of economy, public service and ecology in the Yellow River Basin, this paper constructed a comprehensive evaluation index system of coupling synergy in the Yellow River Basin, and discussed the spatio-temporal differences and driving factors of the synergy development level of the Yellow River Basin by using entropy method, coupling coordination degree model, spatial autocorrelation model and grey correlation model. There are big differences among cities, and the overall coordination level needs to be improved. There is spatial autocorrelation in the coupling coordination degree between cities within the basin, and it shows the spatial club

convergence characteristics of high-high aggregation and low-low aggregation. Therefore, it plays an important role in promoting the coordinated development of the Yellow River basin to strengthen the linkage of development within the basin, increase financial support, and optimize the industrial structure. In this paper, representative index data of 71 cities are adopted. If possible, more indicators can be used for systematic research.

5. Conclusions

General Secretary Xi pointed out that ecological protection and high-quality development of the Yellow River Basin require concerted and long-term efforts of all parties. In order to realize the coordinated development of economic development, public service and ecological environment in the Yellow River Basin, it is necessary to establish the support system of coupling coordination between economic development, public service and ecological environment. The enlightenment of the above analysis on the establishment of support system is as follows:

First, we should improve the quality of the population and promote scientific and technological innovation. We will comprehensively improve the physical, intellectual and cultural quality of the population and enhance its capacity for scientific research and technological innovation. Comprehensively we should promote use of the internet and new technology means. For example, artificial intelligence can assign ecology and so on various aspects of production and life, and we should make good use of the new digital economy development pattern, promoting the fusion of artificial intelligence and the real economy. It is important to promote green industrial transformation, to improve the level of environmental protection and to improve residents' happiness of life, making the Yellow River Basin into an important link connecting east and west.

Second, we should increase financial input to improve the allocation capacity of public infrastructure. It is important to bear in mind that people's livelihood is the most important political issue, and earnestly solving the interests of the people most concerned is important. Governments at all levels should, in light of local conditions, formulate economic development systems suited to their respective regions and provide corresponding preferential policies and support. Poor areas in the River Basin, in particular, should also seize the development opportunity, get on board the express train of national development strategy so that they can improve local public infrastructure, service level, and people's livelihood.

Third, we should optimize the industrial structure and promote the development of tertiary industry. Emerging and high-tech industries should be developed in the basin to promote the development of digital economy. While it is important to construct new infrastructure, and new pension institutions and new business models to improve local development.

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Use of Twitter as an Effective Communication Tool – Case Study on EU Politicians

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Abstract: Social media are being increasingly used for political campaigning. US presidential elections have shown, that well-targeted messages (both true or false) on social media can significantly influence elections results. Our study analyzes Twitter accounts of 188 high European politicians (such as heads of state, premiers, chief ministers, as well as leading opposition politicians) in the year 2020 and compares the number of their tweets, followers, followings and likes. We have used F and t-test for the comparison of politicians' activity of high and low GDP per capita countries (over and under USD 36,000). We have also used single factor Anova analysis for the regional comparison of politicians' activity on Twitter. We have been able to prove our hypothesis, that rich countries' politicians are more active (more tweets, likes, followers and following) on Twitter in comparison with countries with lower GDP per capita. Also statistically significant differences between regions in the number of followings and likes have been found.

Keywords: Twitter; usage; politicians; EU; GDP

JEL Classification: H70; O35; O33

1. Introduction

The era of the rise of new media changed the perception of exchange of information. In the day to day life people seem to get used to use electronic devices instead of traditional pen and paper. But with that comes the question, if it concerns all parts of men's interaction or sometimes people still tend to come for traditional medias for answer. The part of interest for us now is political aspect of life.

An integral element of political motivation is ideological interest, which is an indicator of the ability to conceptualize ideas, a key to participation in a democracy. Every politician must do everything he can to engage citizens of his country in politics if the political interest is considered important.

The political situation in the world is changing almost every day, the tension between countries and continents can be felt easily. That's why it may be important for those who are in charge to make sure the situation inside their countries is intact. One of the strategies in order to do so is to keep people well informed.

Furthermore, a functioning democratic system is based on the intelligent and well-informed choice of power representatives. It has been shown, that Swedish politicians view social media platforms – and especially Twitter – as one of the best modern democratic tools,

since they broadcast well the voice of people /vox populi, vox dei/, improve transparency and promote the freedom of speech.

Research amongst college students have shown as early as 2009 "significant positive relationships between attention to traditional Internet sources and political self-efficacy and situational political involvement. Attention to social media was not significantly related to political self-efficacy or involvement." (Rebenstorf, 2004) Since then, new media platform such as Twitter has established themselves as a key players in the information spreading environment and become a gateway through which people tend to fulfill their information needs.

Different so called influencers arose on Twitter – from actors, musicians, businessmen, celebrities all the way to the high-ranking politicians. Rather than prepared and sterile interviews in traditional media, modern influencers are more free to express their opinions on social media – mainly Twitter – an American online news and social networking service. Tweets are typically short messages (up to 280 characters) that express an opinion concisely. Using this method, politicians are able to interact with voters and society on rather personal level. Especially Swedish politicians are known to be first to employ this method extensively (Gustafsson, 2012).

Another aspect of social media use in politics, as pointed out by Alcot and Getzkow's study (2017) is the fact, that "the fixed costs of entering the market and producing content are vanishingly small." This low entry barrier allows new and fresh politicians to start their individual private account regardless the rank or political expertise.

On the other hand, according to Lee and Oh's study (2012) personalized tweets do not automatically lead to immediate success.

Only more affiliative individuals felt a greater bond with personalized messages, while the less affiliative ones were less likely to vote for such politician. Further, Lee & Oh (2012) proved that by personalizing tweets politicians benefited only with those voters, who did not strongly identify with a particular group.

Our study tries to answer this question also – this is why we have analyzed Twitter activity only of high-ranked politicians in EU.

2. Academic Literature

In the age of new media, politicians increasingly rely on social networks to communicate with their constituents. To analyze where people and voters tend to get news and information about politics, whether they do so on social media (primarily Twitter) or through more traditional means (newspapers, journals, radio, TV) is vital. How Twitter became popular with politicians is explained in Politics and Twitter Revolution. This book argues that the world of politics has changed significantly since Twitter made its debut. The politics of today are more influential than peer influences because people are more involved in politics. (Parmelee & Bichard, 2013)

However, what matters more is whether politicians in different countries are willing to engage in those more modern methods of communication with their voters. It is imperative that parties stimulate media buzz on social networking sites (Twitter) to increase their ability to win more parliament seats. (Safiullah et al., 2017)

The study of the 2011 Swiss national elections found that politicians used Twitter as a complementary tool for campaign distribution. Also, the voters' opinions and judgments were affected only marginally by Twitter's presence.

Broersma and Graham (2012) analyzed the usage of candidate's tweets in tabloids and newspapers in the 2010 elections in the Netherlands and the United Kingdom. They discovered that in the United Kingdom, contentious postings were more popular, but in the Netherlands, facts were more popular. It's also intriguing from the standpoint that material may be recovered and exploited by representatives of old media on new media platforms.

Other research of the parliament elections in the United Kingdom in 2010 found that some parties utilized social media platforms like Twitter to communicate with and directly influence journalists. Journalists used Twitter extensively to learn about campaigns and exchanges between politicians. (Effing et al., 2011).

When comparing two social media platforms, Twitter and Facebook, a Norwegian research found that Twitter had a more hostile climate than its competitor, Facebook. According to the authors, "Use of Social Media does not always result in a more effective political campaign. It is very dependent on how it is used, governed, understood – emphasizing the need for further study."

Some research, but in the other hand, imply that Twitter opinion leadership has a major impact on people's political participation, despite the fact that social media platforms like Twitter do not genuinely facilitate people's political participation. This information demonstrates that political leaders have the ability to influence their potential voters. (Park, 2013)

Furthermore, Gustafsson (2012) has shown that social media sites alone may not always motivate previously passive respondents to engage and start to participate in politics. It argues that there is a spectrum of those who actively share and engage in political debates against others who are more inactive.

Lastly, interesting opinion is presented by Kim, Park, and Rho (Kim et al., 2015) that trust in government actually depends on well managed communication through social media channels.

According to the findings, the level of Twitter's 'promotional' usage is also influenced by the size of the 'Twitter market,' which is linked to the country's overall internet culture. Furthermore, we are happy to analyze the differences in "Twitter markets" among nations with GDP in each EU country. (Redek & Godnov, 2018)

However, according to another study, participation in the twitter politics arena is also dependent on the country's political structure.

Therefore – in our paper we are going to analyze the differences in different "Twitter markets" controlling for GDP in each EU country.

3. Methodology

3.1. Data Collection

We have identified EU countries with high (over USD 36,000) GDP per capita: *Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Ireland, Italia, Luxembourg, Malta, Netherlands, Spain, Sweden, United Kingdom.*

And also countries with low (under USD 36,000) GDP per capita: *Bulgaria, Croatia, Czech Rep, Estonia, Greece, Hungary, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia, Slovenia.*

For differences between regions from geographical point of view, we have taken regions defined by OSN for statistical purpose.

Northern Europe: *Lithuania, Denmark, Finland, Sweden, Estonia, Latvia, Ireland, United Kingdom.*

Southern Europe: *Cyprus, Italy, Malta, Croatia, Greece, Slovenia, Spain, Portugal.*

Western Europe: *Austria, Germany, Belgium, France, Luxembourg, Netherlands.*

Central and Eastern Europe: *Czech Republic, Slovakia, Hungary, Poland, Romania, Bulgaria.*

Lastly, we have chosen a representative sample of politicians from each EU nation. We decided to collect Twitter information on the country's official leader (e.g., the president, the King, the Queen...), the Premier, the Minister of Finance, the Minister of Foreign Affairs, the Minister of Culture, the Minister of Education, the Chief of the Constitutional Court, the Speaker of Parliament, and two major opposition politicians. In total we collected N= 188 accounts.

From this sample of politicians, we have then collected the key characteristics of their Twitter accounts in the year 2020 (e.g. number of followers, likes, number of published tweets, etc.) in an automated way (we used tool foller.me). Additionally, we collected the number of retweets for each politician in their last 100 tweets.

We proposed two basic research questions:

- Are there statistically significant differences in activity of the politicians on Twitter for countries with high and low GDP per capita?
- Are there statistically significant differences in activity of the politicians on Twitter for countries taken geographically?

3.2. Statistical Methods

The politics are independent, so we could use a t-test to compare the mean values. We need not to differentiate the politicians (The Head of the Country, Prime Minister…), but to take all the data together, than we have enough data in one category for t-test using. All t-test calculations were made using Excel's data analysis tool (Excel 365 desktop version).

We used a t-test to compare whether politicians have the same value of tweets, followers following and likes, in all cases we have alternative that the value is not the same, so we use variant with two-tails. Everything was calculated at a significance level 0.05. Of course, at first we used F-test for comparing variances.

3.3. Statistical Hypotheses

For exact test our research questions, we had set eight statistical hypotheses corresponding to the research questions – each activity we test using number of tweets, likes, followers and following for both cathegories using GDP and geographical location.

H1: Senior politicians of countries with higher GDP have the same number of tweets on Twitter as senior politicians of countries with lower GDP. Against alternative that they have different number of tweets.

H2: Senior politicians of countries with higher GDP have the same number of followers on Twitter as senior politicians of countries with lower GDP. Against alternative that they have different number of followers.

H3 & H4: Similarly, with following and likes.

H5: Number of tweets of senior politicians on Twitter does not depend on geographical location of the country against alternative that at least one of the geographical locations (north, south, east, west, center) has statistically different number of tweets.

H6 – H8: Similarly for the geographical location and for followers, following and likes.

4. Results

4.1. Descriptive Statistics

There were 188 politicians in 28 countries. From countries with higher GDP there were 119 politicians, from countries with lower GDP there were 69 politicians. If we take data geographically, there were 59 politicians from north, 47 politicians form south, 46 from west and 36 from east. It is important that all countries from west are in the group with higher GDP and all countries from east are in the group with lower GDP.

There are two countries with more than 1 million followers of their politicians on Twitter – France (Emmanuel Macron, Marine Le Pen) and United Kingdom (Jeremy Corbyn). The results about mean values for all differentiation and all together are in Table 1.

Table 1. Mean values for groups

	Differentiation by GDP		Differentiation by region				All together
	High GDP	Low GDP	North	South	West	East	
Tweets	8,099	3,084	9,853	6,827	5,225	946	6,259
Followers	212,401	56,818	119,944	175,706	270,198	39,782	155,299
Following	1,083	333	866	630	1,423	157	808
Likes	1,391	633	1,854	1,096	941	139	113

4.2. Distribution by GDP

For hypothesis H1, H2, H3, H4 mentioned in the chapter Methodology about the same mean of countries with higher and lower GDP per capita we have to start with two sample F-test for variances for to confirm whether there are equal or unequal variances. In Table 2 we can see that in all cases there are unequal variances on significance level 0.05.

Now we can do two sample t-test assuming unequal variances. We have to take two tail variance (the alternative hypothesis is non-equal variant). As we can see in Table 2 we can reject hypothesis about the same mean for states with high and low GDP for all the monitored data – tweets, followers, following and likes (on significance level 0.05). As a result, we can say that politicians in the countries with higher GDP are more active on Twitter.

Table 2. P-values of the F-test and t-test for hypothesis H_1, H_2, H_3 and H_4 – differentiation countries by GDP per capita

	F-test p-value	t-test p-value
Tweets	$1.49*10^{-15}$	0.032
Followers	$4.54*10^{-35}$	0.003
Following	$7.08*10^{-19}$	<0.001
Likes	$6.54*10^{-08}$	0.020

4.3. Distribution by Region

In this part we would like to look, if there are significant differences between European regions. We have taken hypothesis H_5: Number of tweets of senior politicians on Twitter do not depend on geographical location of the country against alternative that at least one of the geographical location (north, south, east, west, center) has statistically different number of tweets. And similar hypothesis H_6, H_7 and H_8 with followers, following and likes, as was mentioned in the chapter Methodology. We have used Simple factor Anova test.

In Table 3, we can see that we can reject the hypothesis (on significance level 0.05) for following and for likes. We can´t reject the hypothesis for number of tweets and number of followers.

So we can say that there are significant differences by using Twitter of politicians in different region in how they follow and how many likes they have.

Table 3. P-values of the Single factor Anova test for hypothesis H_5, H_6, H_7 and H_8 – differentiation countries by regions

	Single factor Anova p-value
Tweets	0.159
Followers	0.114
Following	<0.001
Likes	0.011

5. Discussion and Conclusions

Our research has indeed confirmed our hypotheses in the first place. It turns out that politicians in wealthy European countries are indeed statistically significantly more active on the Twitter platform. They post more, they comment more, they respond more. Politicians in richer states are indeed more active on Twitter, in all 4 categories - i.e. they post more Tweets of their own, have more Followings, have more Followers themselves, and last but not least, they give and receive far more Likes. It corresponds with one aspect found in the academic literature – there are abundant studies about Twitter influence on the elections in "rich" countries (e.g. Sweeden, Netherlands), but not so much about the countries with lower GDP.

Looking at it from a regional perspective, the general differences in the number of "Followings" and "Likes" was demonstrated, while the regional variability in the number of Tweets and the number of Followers is inconclusive – has not been proven. We can say that politicians in the Western Europe have more likes and followings than politicians in the Central & Eastern Europe. South European politicians are somewhere in between. It points

out to the one of the limitations of the study – Western Europe have more rich states, while Eastern Europe have states with lower GDP, so this results are probably GDP dependent.

Further - confirmatory - research in this area would be useful to repeat next year, so that the time gap between observations does not exceed 4 years (the usual length of a legislator's mandate).

Conflict of interest: none

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Vehicle Routing Problem with Choice of Nodes

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Abstract: Vehicle Routing Problem (VRP) consist in the problem of delivery of the items from depot to the other nods of the communication network. Nodes represent the recipients of the item delivery, items are transported by vehicles or any other means of transport. In a lot of applications of this problem, the requirements for the transport of items from depot come continually in time and they allow to delay the delivery. Therefore, there is no need to deliver this packet immediately at the time the requirement arrives. In this case (except for searching for the optimal routes) we need to decide which nodes will be in these routes and which not. The optimization will be related to the choice of nodes and minimization of routes containing these nodes. The objective function is the average length of the route to a unit of transported items. It is a linear-fractional function. In the article there are, except for the model with this objective function, suggested alternative methods including heuristic methods. Everything is illustrated on the numerical example.

Keywords: vehicle routing problem; integer programming; linear-fractional object function

JEL Classification: C44

1. Introduction

At the standard VRP there is given a set of nodes, a matrix of distances and requirements on the transfer in nodes (Laporte, 1992; Braysy & Gendreau, 2005). The set of nodes might not be obligatory at some applications – some nodes can be omitted, if it is not effective according to the creating of the routes. This route can be then formulated as a VRP with the choice of nodes. Objective function representing total cost (or total length of all routes) doesn´t solve the problem, because the optimal solution doesn´t contain any non-obligatory nodes. Neither the objective function with the total amount of transport is not eligible, because all the nodes are included in the optimal solution.

The problem was solved with a constraint that the requirements on the transport into the nodes were divided into the urgent requirements, which had to be realized immediately, and others, non-obligatory, which might not be in a solution if it caused a decrease in the efficiency of the solution (Pelikán & Jablonský, 2020; Pelikán, 2019). The goal was to minimize costs to a unit of transported items (further I_c). The model with this non-linear objective function was transformed by using the Charles-Cooper method into the linear model with binary variables. The condition for using the Charles-Cooper transformation is to have the positive denominator in the objective function for all the acceptable solutions (Barros, 1998; Martos, 1975). This can be achieved by the fact that every acceptable solution will contain at least one node (except for a depot).

There will be suggested these three models in this article:

a) a model with obligatory and optional nodes;
b) a model with given maximal limit of the efficiency index;
c) a model with given number of nodes included in the solution.

2. Mathematical Model of VRP with Obligatory and Optional Nodes

At first, we introduce the mathematical model of the problem.

Parameters of the model:
n number of nodes,
m number of optional nodes, nodes 2,3,…,m are optional nodes, nodes $m+1,m+2,…,n$ are compulsory, node 1 is depot,
d_{ij} distance between node i and node j,
q_i demand of node i,
W capacity of vehicle.

Variables of the model are:
x_{ij} binary, equals 1 if a vehicle travels from node i to node j,
u_j variables in anti-cyclic constraints.

The object function I_c (1) is ratio with denominator total amount of loads of all routes and numerator total length of all routes. Equation (2) ensures that compulsory nodes will be entered and its demand q_j is covered. Equation (3) means condition: if vehicle enters a node it has to leave it. Anti-cyclic conditions are in (4). Inequality (5) assures that capacity of vehicles is not exceeded.

$$f(x) = \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} d_{ij} x_{ij}}{\sum_{i=1}^{n} \sum_{j=1}^{n} q_i x_{ij}} \qquad \rightarrow min \tag{1}$$

$$\sum_{i=1}^{n} x_{ij} = 1 \quad i = 1,2,…,m \tag{2}$$

$$\sum_{i=1}^{n} x_{ij} = \sum_{i=1}^{n} x_{ji} \quad i = 1,2,…,n \tag{3}$$

$$u_i + q_j - W(1 - x_{ij}) \leq u_j \quad i = 1,2,…,n, j = 2,3,…,n, i \neq j \tag{4}$$

$$u_j \leq W \quad j = 2,3,…,n \tag{5}$$

$$x_{ij} \quad i,j = 1,2,…,n, \quad i \neq j \ binary \tag{6}$$

Nonlinear model is solved using the Charles-Cooper method (see Pelikán and Jablonský (2020)).

The proposed mathematical model was verified on an illustrative example. Consider 11 nodes where node 1 is a depot and $m=6$. Capacity of each vehicle is $W=100$. The requirements of the nodes are $q = (0, 5, 20, 10, 20, 85, 65, 30, 20, 70, 30)$. The distance matrix D is in Table 1.

Table 1. Distance matrix D

0	13	6	55	93	164	166	168	169	241	212
13	0	11	66	261	175	177	179	180	239	208
6	11	0	60	97	168	171	173	174	239	209
55	66	60	0	82	113	115	117	117	295	265
93	261	97	82	0	113	115	117	118	333	302
164	175	168	113	113	0	6	7	2	403	374
166	177	171	115	115	6	0	8	7	406	376
168	179	173	117	117	4	8	0	3	408	378
169	180	174	117	118	3	7	3	0	409	379
241	239	239	295	333	403	406	408	409	0	46
212	208	209	265	302	374	376	378	379	46	0

Optimal solution is:
1. route 1-3-2-4-1 with transport volume 73 and length of the route 138.
2. route 1-5-7-9-6-1 with transport volume 100 and length of the route 381.
The total length of all route is 519, total load is 173, so length on one unit of load is $I_c= 3$.

If we have to put optional nodes into the solution, then their choice is considerably influenced by the given obligatory nodes. In the optimal solution there will be chosen those nodes that are close to these obligatory nodes while creating the routes, where won´t be increased the total length of routes a lot by including them into the routes. On the other hand, the amount of transfer will increase.

3. Linear Model with a Restraint on the Amount of the Efficiency Index I_c

It is possible to show experimentally that by adding the optional nodes into the solution the efficiency index I_c might not only decrease, but it can increase as well. While minimizing the efficiency index I_c, there are not many or even no optional nodes in the optimal solution. In praxis it won´t be necessary to insist on the minimal value of the efficiency index and therefore it will be possible to allow a tiny increase such as the number of optional nodes would consequently increase.

Vehicle routing problem with optional nodes can be solved by the linear objective function, if there is an upper bound I_c^{max} of the total costs per volume unit I_c (costs can be represented e.g. by the length of all routes). Objective function might be e.g. the total volume of transport with its maximization. The constraint for upper bound of the efficiency index I_c

$$\sum_{i=1}^{n} \sum_{j=1}^{n} d_{ij} x_{ij} \ \leq \ I_c^{max} \sum_{i=1}^{n} \sum_{j=1}^{n} q_i x_{ij} \tag{7}$$

(which is given) will be transformed into the linear inequation in the form of (7).

4. Model with Given Number of Optional Nodes

In the previous chapter there was suggested a model, where we have given upper bound of costs to the unit of transport I_c. Therefore, it is difficult to determine the upper bound. We can go on so that we set the number of optional nodes that have to be included into the solution (their concrete choice will be solved by mathematical model). After that we can compare optimal values of the efficiency index I_c for different given numbers of optional nodes included into the solution. Mathematical model is (1)-(6) and (8).

The equation (8) assures that exactly n_0 nodes will be in the optimal solution.

$$\sum_{i=2}^{n} \sum_{j=1}^{n} x_{ij} = n_0 \tag{8}$$

Table 2. Optimal solution depending on given number of optional nodes

Solution				
n_0	C	L	I_c	Routes
1	12	20	0.60	1-3-1
2	30	25	1.2	1-3-2-1
3	344	115	2.99	1-3-1; 1-4-6-1
4	362	120	3.01	1-2-3-1; 1-6-4-1
5	375	120	3.12	1-2-3-1; 1-4-9-7-1
6	704	215	3.27	1-3-2-1; 1-6-4-1; 1-8-7-1
7	888	235	3.77	1-4-6-1; 1-5-3-2-1; 1-7-8-1
8	1203	315	3.81	1-2-3-1; 1-6-4-1; 1-7-8-1; 1-11-10-1
9	1387	335	4.14	1-2-3-5-1; 1-4-6-1; 1-7-8-1; 1-10-11-1
10	1571	355	4.425	1-5-7-1; 1-6-1; 1-8-9-4-2-3-1; 1-11-10-1

Optimal solution is shown in Table 2 where column C contains total length of routes, column L total load.

5. Heuristic Method

The VRP is NP-hard, so it is suitable to propose and use a heuristic method. One of them is nearest neighbor method (NNM), which has to be modified tor our problem. NNM is easy to implement and executes quickly, but it does not yield the optimal solution. The solution is created by gradually adding another node to the sequence of nodes obtained so far until stop rule is met.

Stop rule is: the prescribed number of nodes n_0 in the solution is reached or it is no possible to reduce the cost index I_c by adding another node.

The solution consists of one o more routes which are created gradually by adding nodes not yet included in routes. A load on each route must exceed the capacity of the vehicle.

Notation:

n' number of nodes included in some route,

s the last node of the last created route,

L' load of the last route,

N' a set of nodes yet not included in routes,

L, C the total load and length of yet created routes.

These are steps of NNM algorithm:

Step 1: Put $n':=0$, $L':=0$, $s:=1$, $N':=\{2,3,\ldots,n\}$, $L:=0$, $C:=0$.

Step 2: If $n' = n$ then stop.

Find k such that:

$$\frac{C - d_{s1} + d_{sk} + d_{k1}}{L + q_k} = \min_j \quad \frac{C - d_{s1} + d_{sj} + d_{j1}}{L + q_j} \text{, where } j \in N', L' + q_j \leq W.$$

If k does not exists then a new route starts and put $s:=1$, $L'=0$, otherwise put

$s:=k$, $L':= L'+ q_k$, $L:= L+ q_k$, $C := C - d_{s1} + d_{sk} + d_{k1}$, $N' := N' - \{k\}$.

Go to Step 2.

Use of NNM is shown on the Table 3.

Table 3. Solution of NNM depending on given number of optional nodes

NNM				
n_0	C	L	I_c	Routes
1	12	20	0.60	1-3-1
2	30	25	1.2	1-3-2-1
3	138	35	3.94	1-3-2-4-1
4	364	100	3.64	1-3-2-4-7-1
5	692	185	3.75	1-6-1; 1-3-2-4-7-1
6	886	205	4.32	1-5-1; 1-6-1; 1-3-2-4-7-1
7	1070	235	4.55	1-5-8-1; 1-6-1; 1-3-2-4-7-1
8	1074	255	4.2	1-5-8-9-1; 1-6-1; 1-3-2-4-7-1
9	1495	285	5.24	1-5-8-9-11-1; 1-6-1; 1-3-2-4-7-1
10	1587	355	4.47	1-10-1; 1-5-8-9-11-1; 1-6-1; 1-3-2-4-7-1

6. Conclusions

Topic of the paper is modification of vehicle routing problem in which part or all nodes are optional. It solved problem which nodes choose and include into optimal routes. A nonlinear object function I_c is minimized. Function I_c represents costs index: total costs per unit load of all routes. Two alternative approaches are proposed and illustrative example is presented.

Conflict of interest: none

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Local Firms' Strategies and Cluster Cooperation in the Czech Republic: The Case of the Packaging Manufacturers Cluster

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Abstract: Cooperation between enterprises is the basis for local clusters' existence and developments. Local clusters are some of the tools which support performance and competitiveness. This article analyses the influence of the existence of a cluster in the packaging industry on the financial performance of its member companies. This paper addresses the impact which the membership of some enterprises in a cluster could have on their financial performance. The research file consists of founding enterprises from the Packaging Manufacturers Cluster. Enterprises that create the core of the cluster do business in industries with the following statistical classifications: CZ-NACE 162400, 172100 and 222200. ROE, ROA and EVA/sales indicators were used as a criterion for evaluating financial performance. For the assessment of financial performance the Malmquist index is applied with two inputs and one output. The aim of the research was to verify the statement that business entities' membership in the local cluster translates into improved financial performance in a time series. The research has shown an improvement in financial performance in companies in the local cluster.

1. Introduction

Globalisation is an important phenomenon today. It is one of the most important factors that started the development of business networking, business associations and also the creation of clusters. Businesses are increasingly gathering to create a competitive advantage. If SMEs want to become competitive and survive, they need to learn how to cooperate more, interconnect, connect to chains, networks and, where appropriate, continue to join clusters.

In today's globalised world, local contexts and clusters are becoming an integral source of international competitive advantage. Cluster initiatives provide companies with an environment in which they can interact effectively with each other and with other institutions, collaborate and learn (Osarenkhoe & Fjellström, 2017).

Cooperation and competition, such as organizational relationships or interactions between two or more organizations, have traditionally been seen as opposites. Business behavior is changing and it can be noticed that more and more organizations are involved in these two types of relationships at the same time. This paradoxical phenomenon is called cooperation. This paper focuses on the cooperation of companies in local clusters. The aim of

the paper is to evaluate the influence of the Packaging Manufacturers Cluster on the financial performance of member businesses and subsequently, using the Malmquist index, verify the assumption that the membership of businesses in the cluster is reflected in increasing their financial performance over time.

2. Cooperation Strategy

Cooperation strategy is a model that includes a network of stakeholders and competitors who work together to obtain the highest possible value. This strategy will make it possible to generate value for companies that cooperate and at the same time compete with other competitors. Thanks to cooperative relationships, competitors are also able to increase their financial and innovative performance.

In the last few years, this phenomenon has become very important among various business entities. It leads to mutual benefits for the participating companies, enables them to build favorable relationships, expand their business into new horizons and increases their knowledge and information levels in the corporate world. In this way, companies stay in touch with their competitors, communicate with them, share their ideas and work together to achieve better performance and make the most of their success.

The cooperation strategy strengthens the competitive advantage of companies (Rademakers & McKnight, 1998) and provides a number of other benefits, including improved productivity, access to raw materials and reduced risk (Meyer, 1998).

Relationships between individual entities can be vertical (forming a value chain) or horizontal, if companies offer products or services using similar inputs, technologies, etc. Creating such a link should bring benefits to the participants involved. These can take the form of cost savings, gaining new markets or customers in existing markets, increasing the influence of government and regional structures, etc.

Networking or cooperation can take the form of a formal or informal exchange of information and knowledge. In the field of human resources, cooperation can take the form of raising the qualifications of employees through the organization of joint seminars, conferences, training courses but also joint training centers. Funding for such activities can be sourced from their own resources or funds from public projects can be used. Innovation maintains the viability and prosperity of companies in the market and research and development is a prerequisite for future development, so joint research and innovation is no less important. Companies can jointly build research infrastructure or cooperate with research institutions that have the necessary material and technical equipment and, last but not least, human capital. The area of marketing and trade offers a number of opportunities for the implementation of joint activities, for example: joint purchasing, joint production, more efficient logistics, etc. Access to finance may be easier for cooperating companies than for stand-alone companies.

Cooperation can take various forms, from tight forms such as mergers, acquisitions and joint ventures to looser forms, where individual cooperating entities do not lose their own economic independence and do not have to be capital-linked. In connection with the latter form of cooperation, network business, strategic alliances or clusters are most often mentioned.

Czech companies are used to cooperating, but only in recent years have these cooperations been formalized and become a potential source of competitive advantage. The development of clusters comes not only with the offer of support for these forms of business by the state, but also with the need to withstand the current competition (Studeníková, 2011).

3. Local Clusters

In economic literature, considerable attention is paid to the study of the causes of greater success of some geographical regions (Brenner & Mühlig, 2007). According to Nicolini (2001), local groups of companies such as industrial districts or local clusters are considered a source of regional competitiveness. In the literature focused on local clusters, it is generally argued that the success of such clusters is due to the existence of positive local externalities (Brenner & Mühlig, 2007). This concept follows Alfred Marshall and his theory of industrial districts (Marshall, 1920). Marshall argues that small businesses can benefit from their co-location as they develop a common workforce, benefit from knowledge exchanges and rely on the emergence of a large population of service and supply companies in the region.

According to Delgado et al. (2014), a local cluster can be defined as a regional concentration of related industries and associated institutions in a certain geographical area. According to Porter (1998), the cluster consists of specialized companies, suppliers and service providers, government agencies, financial institutions, companies in related fields and institutions that provide specialized education, information, research and technical support. According to Lindqvist et al. (2008), a local cluster is defined as a cluster in a local labor market region. According to US Cluster Mapping (2018), local clusters are a group of businesses operating in the same or related industries that serve the local market.

Local clusters have recently received a great deal of attention in economic and geographical literature. Emphasis was placed primarily on identifying the conditions essential for the formation of local clusters (Brenner & Mühlig, 2007). Another goal of these studies was to determine which prerequisites are needed for the development of local clusters and to identify the factors behind their economic success (Brenner, 2006). Michael Porter, for example, dealt with the importance of the development of local clusters in his work (Porter 1998; Porter, 2000). The literature below addresses the reasons for the existence of local industrial clusters, how they arise and why they are successful in comparison with other localities (Brenner & Mühlig, 2007).

A prerequisite for the creation of a local cluster is the availability of all local factors and resources in the region. Brenner and Mühlig (2007) summarise the assumptions needed for the formation of a local cluster in their work. The first prerequisite for the creation of a local cluster is the existence of a sufficiently qualified workforce in the region. Some studies state (Latham, 1976) that a skilled workforce is a crucial factor in the development of industry in a particular region. Another assumption, according to Brenner and Mühlig (2007), is the presence of an existing network of intercompany relations.

The literature (e.g. Stoicovici et al., 2017) further states that the presence of universities and public research organizations is a fundamental prerequisite for the development of local clusters. Examples include the local Silicon Valley and Cambridge Boston area clusters (local

cluster of leading universities, hospitals and private-sector companies). Some case studies (van den Berg et al., 2001) also state that regional traditions play an important role in the development of local clusters. Storper (1993) also further emphasizes the impact of the region's history on its further development. Another assumption is the current industrial structure of the region, which according to (Brenner & Mühlig, 2007) also has a relatively strong impact on the future technological development of the region. The literature dealing with industrial districts in northern Italy has begun to address the influence of local culture on the emergence of local clusters (see, for example, van der Borg & Russo, 2005). Another prerequisite is the geographical location. This assumption includes the presence of natural resources, access to transport infrastructure, the geographical specificities of the region and location in relation to other regions. Natural resources are considered one of the important initial conditions for the formation of a local cluster. An example is the metalworking industry in the Ruhr area of Germany (Orsagh, 1974; Kibele, 2012). Other articles state that local clusters also formed in regions that had no specific resources, a typical example being Silicon Valley (Saxenian, 1994). It can therefore be stated that the existence of natural resources has played a role mainly in the past, but in recent years it has lost its importance. The literature does not yet present many important studies that would prove that the presence of suppliers is a necessary prerequisite for the emergence of local clusters. Nevertheless, there are some views (Brenner & Mühlig, 2007) that support this argument. The literature usually considers poor transport infrastructure to be a factor preventing the formation of a local cluster (van den Berg et al., 2001; Viederytė, 2018). Transport infrastructure can therefore generally be considered an important factor in the economic development and attractiveness of the region. The quality of life in the regions also contributes to supporting the emergence of local clusters. An example is Munich, which is considered the best place to live in Germany. This fact has supported the emergence of a number of industrial clusters. Van den Berg et al. (2001) argues that a highly skilled workforce prefers living in high-quality regions. Porter (1990) states that war conflicts, historical events, political and economic uncertainty also play an important role in the formation of a local cluster.

Brenner (2006) also deals with the identification of local industrial clusters. In his article, he presents a method that makes it possible to identify local industrial clusters and then applies it to the example of Germany. Based on this method, Brenner (2006) succeeded in compiling a list of all local clusters that existed in Germany in 2001. Brenner (2001; 2004) also further developed a mathematical model that describes the development of local industrial clusters. In their work, Brenner and Gildner (2006) compare selected German regions in which local clusters have long been present with all other German regions and statistically examine the main factors that characterize these regions.

Local clusters are also discussed by Nicolini (2001), who applies an econometric model to identify factors affecting the size and performance of local clusters. Lindqvist (2008) researches clusters in Sweden under the auspices of the Swedish National Program for Innovation Systems and Clusters. In his research, he finds that industry clusters and regional and local clusters play an important role in the Swedish economy. In his research, Lindqvist (2008) identified about 100 local clusters that are or could become leaders in the local

industrial environment in the future and are able to compete with their goods and services in international markets.

Examples of successful local clusters include Silicon Valley – a high-tech and information technology center, or southwestern Germany in the field of car manufacturing (Meyer, 1998). Local clusters are also widespread in Italy, especially in the central part and in the north (OECD, 2014). In 2014, ISTAT identified about 156 clusters in the country, which were usually concentrated in economically strong regions: 42 in the northeast, 39 in the northwest, 49 in the center and 26 in the south. Some of the local clusters have a significant share of world markets, such as Sassuolo with a 27% share of world exports of ceramic tiles, Prato with a 4% share of the world textile market and Arezzo with a 3.5% share of worldwide jewelry sales.

4. Methodology and Data

The Cluster of Packaging Manufacturers, which was established in 2005 in the legal form of a cooperative and with its registered office in Jaroměř, was selected for the evaluation of financial performance. This cluster is also known as the Omnipack cluster. The cluster brings together companies engaged in the design and manufacture of industrial packaging and other entities in the field of packaging technology, logistics, service organizations and educational institutions. It operates mainly in the Hradec Králové and Pardubice regions with the aim of strengthening the competitiveness and economic growth of entrepreneurs in the field of packaging and logistics services by supporting their innovative activities (Klastr Omnipack, 2021).

The main sources of data were publicly available information on the official Omnipack cluster website, ARES (Ministry of Finance, 2021), the Public Register and the Collection of Documents in the Commercial Register (Department of Justice, 2021) and the Magnusweb database (Bisnode, 2021). The period 2012-2017 was chosen for the research, which was chosen in terms of the development of the cluster and the beginning of its activities, while also taking into account the fact that the effects of cluster membership can be expected with a certain time lag. The availability of financial results in the Commercial Register has decreased significantly in recent years, so the time series ends in 2017. The research process can be divided into the following phases:

1. **Creating a list of evaluated companies**

In the first step, a database of member entities of the Packaging Manufacturers Cluster was created. In the analyzed period, the cluster had a total of 56 members. As the research focused on the evaluation of financial performance, only business entities were included. In the analyzed period, the Packaging Manufacturers Cluster had a total of 46 member business entities. Of these companies, 10 were in the legal form of a joint stock company and 36 companies were in the form of a limited liability company. Only companies that have been members of the cluster for the same length of time can be compared in the research, only these companies can be considered the so-called consistent core of the cluster. The core of the Packaging Manufacturers Cluster consists of a total of 25 business entities in the CZ-NACE 162400, 172100 and 222200 sectors.

2. Collection of financial statements

For the above-mentioned business entities, it was necessary to obtain the necessary data from the financial statements for the years 2012-2017. The success rate in obtaining financial statements was 84%. Financial statements were obtained from 21 business entities for all years.

3. Calculation of financial performance indicators

For the above research sample, selected ratios were subsequently calculated. These indicators should provide a basic picture of the financial situation of companies in the Packaging Manufacturers Cluster. The first ratio chosen was the return on equity (further) ROE (see Equation 1). ROE is one of the basic indicators that provides an overview of the total return on equity. The second ratio was return on assets ROA (see Equation 2). This indicator measures how profitable a company is in relation to its total assets. A high return on investment means that the company's management effectively uses the company's assets to generate its profits. The third indicator was the share of EVA/sales. The EVA indicator (see Equation 3) can take on both positive and negative values. The methodology of the Ministry of Industry and Trade of the Czech Republic was used to calculate the EVA. This is an equity-based procedure in which EVA is defined as the product of equity and spread (i.e. return on equity minus the alternative cost of equity). In the case of a positive EVA, the company creates value for its owners. If the EVA value is negative, the company's value decreases.

$$ROE = EBIT/Equity \tag{1}$$

$$ROA = EBIT/Assets \tag{2}$$

$$EVA = (ROE - r_e) \cdot Equity \tag{3}$$

The CAPM method was used to estimate the cost of equity (see Equation 4). Where r_f is the risk-free rate of return, often taken as the rate of return on treasury bills, β is a quantity used to measure the systematic risk of a given asset and its values were obtained from the website of prof. Damodaran (2019) and r_m represents the expected rate of return on the market.

$$r_e = r_f + \beta(r_m - r_f) \tag{4}$$

Although EVA is considered an excellent measure of performance, it also has its limitations. According to the chosen methodology, the EVA indicator can be determined only for companies with a positive equity value. Therefore, companies that had zero or negative equity value in at least one year had to be excluded from the research. In the case of the Packaging Manufacturers Cluster, it was one company.

4. Determination of inputs and outputs of DEA model

The number of employees and long-term capital were selected as inputs for the DEA model. Long-term capital is given by the sum of the following balance sheet items: equity, issued long-term bonds and long-term bank loans. The output is economic value added.

5. Calculation of Malmquist index

For each company in the file, the technical efficiency score was calculated in the MaxDEA 7 Ultra software environment and the values of the Malmquist index and its individual components were determined according to equations (5) and (6). Finally, the value of the Malmquist index was calculated by (7).

$$E_q \frac{D_q^{t+1}(x^{t+1}, y^{t+1})}{D_q^t(x^t, y^t)} \tag{5}$$

$$T_q = \sqrt{\frac{D_q^t(x^{t+1}, y^{t+1}) D_q^t(x^t, y^t)}{D_q^{t+1}(x^{t+1}, y^{t+1}) D_q^{t+1}(x^t, y^t)}} \tag{6}$$

$$MI_q(x^{t+1}, y^{t+1}, x^t, y^t) = E_q T_q \tag{7}$$

$MI_q > 1$ means increased productivity; $MI_q = 1$ means that there was no change in productivity; and $MI_q < 1$ means a decrease in productivity (Caves et al., 1982).

5. Results

The first part presents the results of the development of selected financial performance indicators, which provide a basic picture of the financial situation of companies in the Packaging Manufacturers Cluster. The second part contains knowledge from the application of the Malmquist index.

Figure 1 compares the development of the median values of the ROE indicator of member business entities in the Packaging Manufacturers Cluster for the period 2012-2017. Figure 1 shows that the companies in the Packaging Manufacturers Cluster achieved positive accounting profitability in the monitored years, as measured by the ROE indicator. It is clear from the results of the return on equity that in 2017 the companies in the Packaging Manufacturers Cluster recorded the best return on equity result in the period under review. Figure 1 also shows that the return on equity showed a predominantly increasing trend in the Packaging Manufacturers Cluster in the period under review, with the exception of 2015. The average ROE growth rate calculated by the geometric mean was 7.29%.
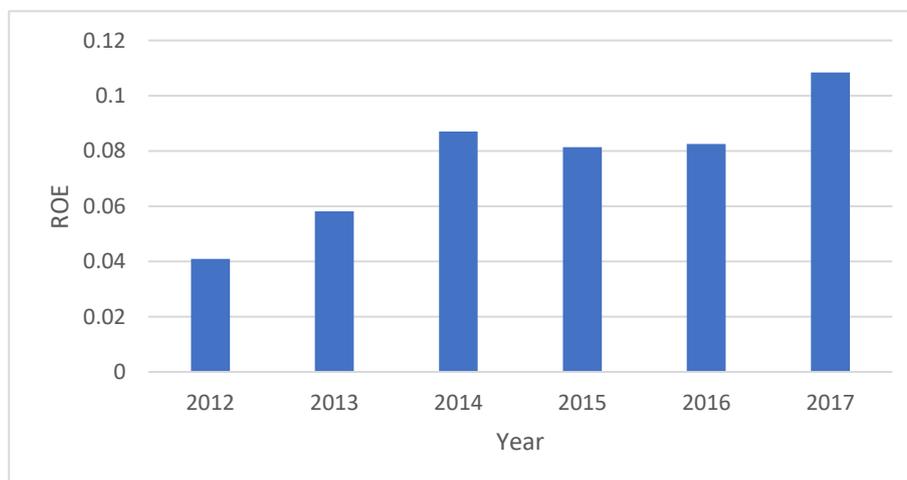
Figure 1. Development of the median values of the ROE indicator in 2012-2017

Figure 2 compares the development of the median values of the ROA indicator of member business entities in the Packaging Manufacturers Cluster for the period 2012-2017. The return on total invested capital showed an increasing trend in the Packaging Manufacturers Cluster during the period under review. The companies in the Packaging Manufacturers Cluster achieved the best appreciation of the invested capital in 2017. The average ROA growth rate calculated by the geometric mean was 4.73%.

Figure 3 compares the development of the median values of the EVA/sales indicator of member business entities in the Packaging Manufacturers Cluster for the period 2012-2017. The EVA indicator used, which, in contrast to the accounting profit, also includes implicit cost of equity, was negative in the Packaging Manufacturers Cluster throughout the period under review. This means that, as a whole, the member companies did not create any value for their owners, on the contrary, they consumed the invested equity. From Figure 3 it can be stated that the profitability of sales expressed by the EVA/sales share was also negative in the Packaging Manufacturers Cluster. However, Figure 3 shows a trend of gradual slight improvement. Profitability of sales expressed by the share of EVA/sales reached more favorable values in 2017 (it is less negative).
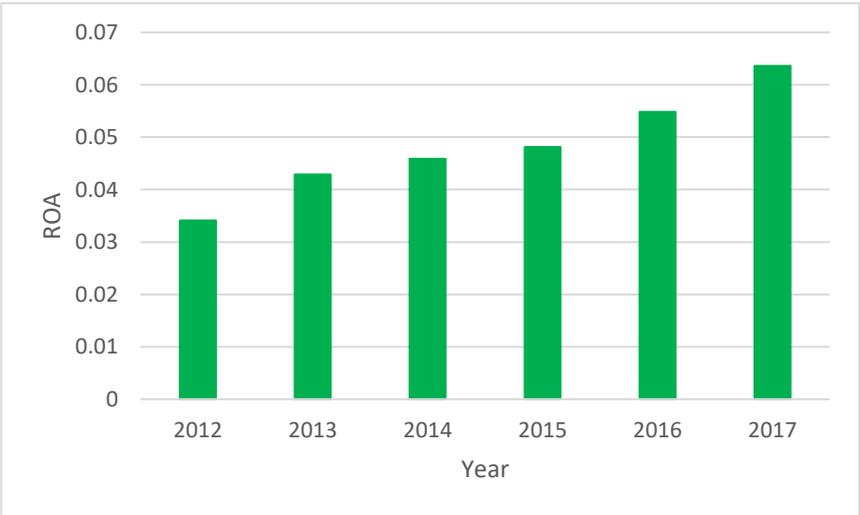
Figure 2. Development of the median values of the ROA indicator in 2012-2017
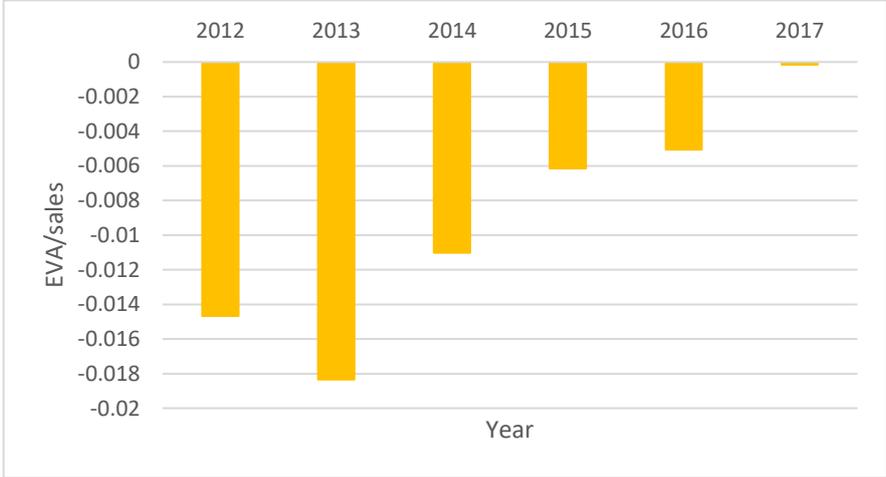
Figure 3. Development of the median values of the EVA/sales indicator in 2012-2017

The aim of this research was to evaluate the potential impact of the cluster on the financial performance of member businesses and use the Malmquist index to verify the assumption that the membership of businesses in the cluster affects their financial performance and manifests itself with increasing financial performance over time.

Table 1 gives an overview of the development of the average value of the Malmquist index (hereinafter MI) and its components – changes in technical efficiency (E) and technological changes (T) for the Packaging Manufacturers Cluster in individual years. Due to the construction of the MI (multiplicative indicator), a geometric mean was used to calculate these average values. The value located at the bottom of the MI column represents the average annual change in financial performance for the reference period 2012-2017 (calculated as a geometric average of the geometric averages of individual years) and is referred to in the text as the total change in financial performance. The E and T values represent the average annual change in technical efficiency and technological change for the observed period 2012-2017. The last two columns of the tables then show selected macroeconomic characteristics. The first selected characteristic is the GDP growth rate of the Czech Republic. The last column then contains the Industrial Production Index (further IPP).

Table 1. Malmquist index for the Packaging Manufacturers Cluster

Period	MI	E	T	GDP	IPP
2013/12	0.8987	0.6548	1.3725	0.9952	0.9992
2014/13	0.9582	0.9680	0.9898	1.0272	1.0428
2015/14	1.2352	1.2695	0.9730	1.0531	1.0428
2016/15	1.0801	0.9273	1.1648	1.0245	1.0343
2017/16	0.9516	1.0677	0.8912	1.0435	1.0648
Geometric mean	1.0180	0.9556	1.0653	1.0285	1.0366

At the beginning of the period, between 2013/12, the MI value was 0.8987, which means a 10% decrease in the average performance of cluster members. An analysis of the MI components showed that a negative change in internal technical efficiency (35%) had a larger share in the decrease, while technological progress of 37% had taken place. There was also a decline in performance in the following period. The largest year-on-year increase in the value of MI occurred between 2015/14, 24%. The breakdown of the index shows that in this period the index grew by an average of 27%, mainly due to improved internal technical efficiency of cluster members. The last significant changes in efficiency occurred between 2016/15, when the MI value also increased by 8%, but this growth was, on the contrary, caused only by a positive change in technology. The total MI value shows the overall change in the financial performance of the member companies. Overall performance grew only slightly by an average of about 2% per year. Table 1 also shows that the companies' performance was driven mainly by technological progress (an improvement of 6.5%), while the value of technical efficiency fell by an average of 4% year-on-year.

6. Discussion

The results of the research confirmed the impact of cluster membership on improving financial performance, as also reported by Lei and Huang (2014). According to the results,

the research agrees with Skokan and Zotyková (2014), who believe that the impact of the cluster on the performance of a member company and its business results is highly individual and depends on a number of factors. It is also important to recall that during the period under review, a financial crisis occurred in 2012-2013, which may have negatively affected the economic performance of some companies and thus of the cluster as a whole. It is also important to mention that the economic crisis of 2012-2013 affected each industrial area with a different force.

The reasons for the fluctuations of MI and its components are not entirely clear. The economic situation in the Czech Republic may have contributed to changes in financial performance. Until 2014, the Czech Republic was in recession, which may have affected the individual member companies of the cluster with some delay. The Czech Republic has been showing economic growth since 2014, and the development of MI has also shown an improvement in the financial performance of member companies since this year. A relatively surprising finding was the decline in financial performance in the last monitoring period 2016–2017. Another possible reason for fluctuations in MI values are individual changes in the performance of individual member companies, which could affect the performance of the entire cluster.

7. Conclusions

The paper deals with the evaluation of the development of financial performance of 20 members of the Packaging Manufacturers Cluster in the reference period 2012-2017. In addition to ratios, the Malmquist index was also used. The number of employees and the amount of long-term capital were chosen for the inputs, and the EVA indicator for the output. First, an analysis of the development of selected ratios of cluster members was performed, then a performance evaluation was performed using the Malmquist index and possible causes of significant changes in development were discussed.

It can be concluded that the financial performance of the companies in the Packaging Manufacturers Cluster increased in the period 2012-2017. The cluster underwent technological change and innovations, with an increase in innovation performance of 6%. A relatively surprising finding was the decline in financial performance in the last monitoring period 2016-2017, despite the continuing economic growth in the Czech Republic.

Compared to previous research (Pelloneová & Štichhauerová, 2019), it can be stated that there is a different impact of the cluster organization across sectors and a different impact on individual components of MI. In the aviation industry, research has not shown a positive impact of cluster membership on their financial performance. The reference period of this study ends in 2017, however, the author of this paper will continue the research in order to include other years and other industries in the research.

Conflict of interest: none

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Employment in the Agriculture and Forestry in the European Union, V4, and the Czech Republic in the period 2000–2019

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Abstract: Ways are currently being sought to smoothly replace a linearly functioning economic system with a more sustainable one. Globally, pressure is increasing on the demand side for food, feed, biomaterials, and bioenergy resources, putting more pressure on natural resources. Globally coordinated cooperation is essential. Currently, the global challenge is to unlock the potential of the bioeconomy. The main aim of this paper is to evaluate the improvement of the employment in the agriculture and forestry in the European Union, V4, and Czech Republic in the period 2000–2019. According to main target, the sectoral approach will be applied, and the statistical data collected. Dealing with methodology, the literature review, desk research, and time series analysis, the sectoral comparative analysis will be used. Focusing on the results, the share of employed people in the bioeconomy sectors, such as agriculture and forestry in the period 2000–2019 in the European Union, V4, and the Czech Republic displayed a slightly declining trend.

Keywords: employment; forestry; agriculture; Czech Republic

JEL Classification: J21; Q57

1. Introduction

Ways are currently being sought to smoothly replace a linearly functioning economic system with a more sustainable one. The transformation to a circular economy and bioeconomy that respect the planet's natural borders is beginning.

The circular economy contrasts with the linear economy. The current economic system based on linear flows of materials and energy can be imagined in a simplified model in which raw materials are extracted, products are made, and after a very short time, the products are thrown away. The circular economy is trying to close the loops of materials and energy into never-ending closed flows. The circular bioeconomy is then an economy based on biological materials and is a renewable segment of the circular economy. The main sectors of the bioeconomy are typically agriculture, forestry, aquaculture, food and chemical industries.

The circular bioeconomy has a significant impact on the environment. Globally, pressure is increasing on the demand side for food, feed, biomaterials, and bioenergy resources, putting more pressure on natural resources. Globally coordinated cooperation is essential. Currently, the global challenge is to unlock the potential of the circular bioeconomy.

Based on scientific literature (Ronzon et al., 2015), national bioeconomies of the EU states can be divided into four groups of countries, such as agricultural bioeconomies (Slovenia,

Greece, Romania), agro-food industry and bio-based chemical industries (Italy, France, Germany), forestry bioeconomies (Finland, Sweden, Estonia), and non-specialised bioeconomies (the Czech Republic, Slovakia, Hungary).

According to the European Union calculations (European Comission, 2018), the bioeconomy employment is around 18 million persons and by 2030, up to a 2 million new jobs could be created. Study performed by Hetemäki (2016) emphasizes, that there is a lack of studies that develop an area such as the forest labor market.

Bioeconomy is a key sector of the European Union employment, and the highest number of employees refers food, beverage and tobacco industry. The article (Drejerska, 2017) summarized that more than 40% of employment in mentioned sectors seem in the United Kingdom, Germany, Belgium, Malta, and Luxemburg. Regarding employment, the sector with the majority shares of employment in the EU Member States bioeconomy is represented by the agriculture sector. The same applies to the Czech Republic. Agricultural employment accounts for nearly 36 percent of total employment in bioeconomy. Drejerska (2017) also highlights three dominant sectors as the main suppliers of biomass in the economy, such as agriculture, forestry, and fisheries. The high employment numbers in the individual subsectors of bioeconomy are the result of natural and geographical conditions.

Philippidis and his team (Philippidis et al., 2014) focused on profiling of the EU clusters. Regarding geographical scale, the results present six potential groups. Namely, (1) Northern EU (Denmark, Finland, Lithuania, Latvia, Poland, Sweden, United Kingdom, Belgium, Netherlands), (2) Luxembourg (Luxembourg), (3) Mediterranean Islands (Cyprus, Malta), (4) Mediterranean and Eastern EU (Spain, France, Greece, Italy, Portugal, Bulgaria, Romania, Hungary), (5) Central EU (Austria, Czech Republic, Germany, Slovakia), and (6) a Mixed cluster (Estonia, Ireland and Slovenia). Based on the results, the employment multipliers for the EU-27 represent 14 new jobs for every million euros of additional output value in the bioeconomy. The results show that the bioeconomy drivers of job creation are the forestry, fishing, and wood sector.

In the study (Ronzon et al., 2018), authors concluded that the bioeconomy employment represents more than eight percent of the EU-28 total employment. Over time, we observe the opposite development of indicators, while employment decreased, added value increased. Focusing on the agriculture restructuring, bioeconomy employment decreases by 2.5 million jobs in the reference period 2008–2015. In the observed period, added value increased by 23 percent.

In the Czech Republic, we can find studies focused on bioeconomy. For example, Hájek et al. (2020) offers the current condition of bioeconomy in the Czech Republic. The results indicate intensive research activities in the field of biology and chemistry. The developed forestry, agriculture and food industries provide the basis for the improvement of the locally oriented circular economy.

Based on the literature review, it is obvious that there is an opportunity for improvement. There is still significant knowledge gap in the field of labor market in the European circular bioeconomy. This research will add the statue of the bioeconomy employment in the European

Union, V4, and Czech Republic. For achieving the main target, two hypotheses were established, namely:

H1: The development of employment in agriculture and forestry in the years 2000–2019 in the Czech Republic is the same as in the V4 countries.

H2: Employment in agriculture and forestry in the European Union fell between 2000 and 2019.

2. Methodology

The main aim of this paper is to evaluate the improvement of the employment in the agriculture and forestry in the European Union, V4, and Czech Republic in the period 2000–2019. According to main target, the sectoral approach will be applied, and the statistical data collected. Dealing with methodology, the literature review, desk research, and time series analysis, the sectoral comparative analysis will be used. The analysis will be focused on the period 2000–2019, to observe possible changes and transformation processes of the employment in the agriculture and forestry.

This research is based on various resources. The key data sources are data published in scientific studies (databases WoS, Scopus, Research Gate, etc.). The main data sources for the employment in number of persons and bioeconomy sectors shown in the figures are Eurostat (Eurostat, 2021). Searched data will be divided into several categories. Materials and data focus mainly on the bioeconomy and employment in two subsectors of the bioeconomy, namely agriculture and forestry.

3. Results

In Figure 1, we can observe several categories of Member States. Countries such as Latvia and Lithuania show lower employment numbers in agriculture and forestry in 2000 and 2019. On the other hand, the share of employees in agriculture and forestry in total employment in 2000 and 2019 seems to be high.

Countries such as Bulgaria, Germany, Greece, France, and Italy show roughly the same employment numbers in agriculture and forestry in 2000 and 2019. Regarding the share of employees in agriculture and forestry in total employment in 2000 and 2019, Bulgaria and Greece display a higher share of employees, especially in agriculture. On the other hand, countries such as Germany, France and Italy show a lower share of employees, especially in agriculture, in total employment in 2000 and 2019.

The highest share of employees in agriculture in 2000 and 2019 displays Romania and Bulgaria and the highest share of employees in forestry in 2000 and 2019 displays Croatia and Slovakia.

For an overall comparison of employment in 2000 and 2019, figure 2 shows the share of agriculture and forestry employees in total employment in the EU in 2000 and 2019. We can observe a declining trend in the period 2000–2019. The highest share of employed persons in agriculture and forestry in 2000 displays Romania (44.87%), Bulgaria (24.05%), Poland (20.18%), Lithuania (18.36%), and Greece (15.35%). To consider year 2019, the highest share of employed persons in agriculture and forestry refers Romania (22.25%), Bulgaria (16.85%), Greece (10.18%), Poland (9.04%), and Portugal (7.49%).
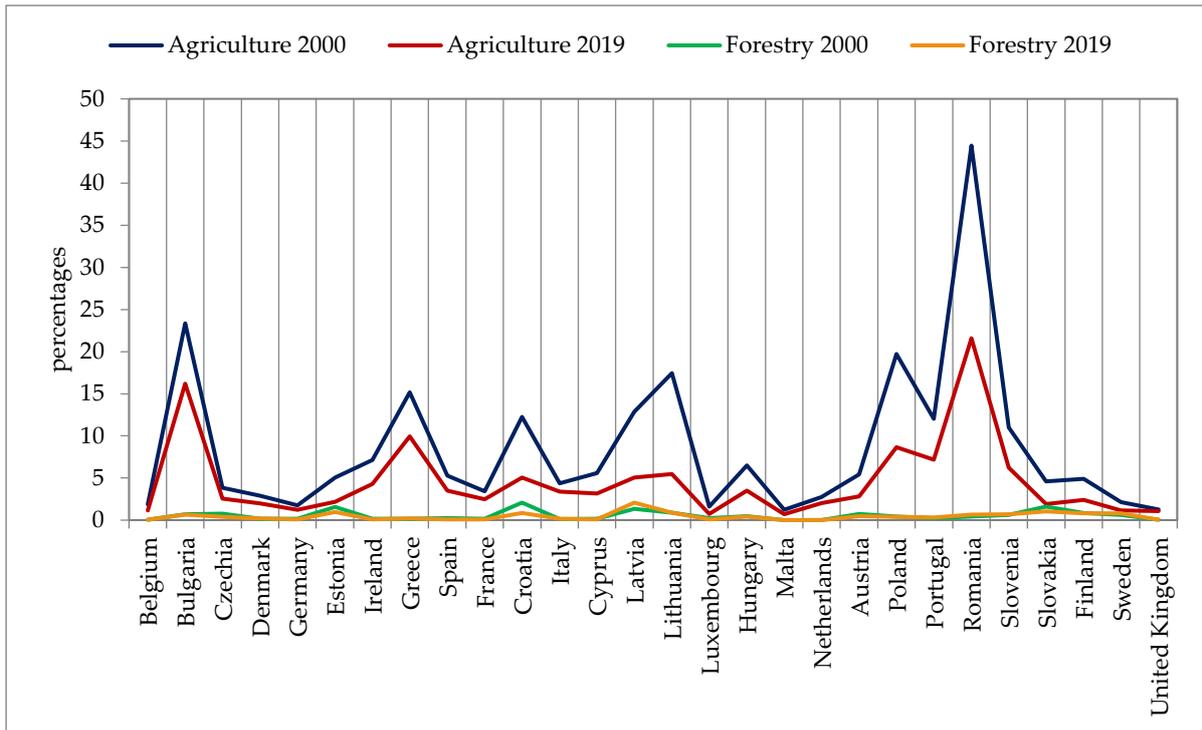
Figure 1. The share of employees in agriculture and forestry on total employment in the EU-28 in 2000 and 2019 (%)
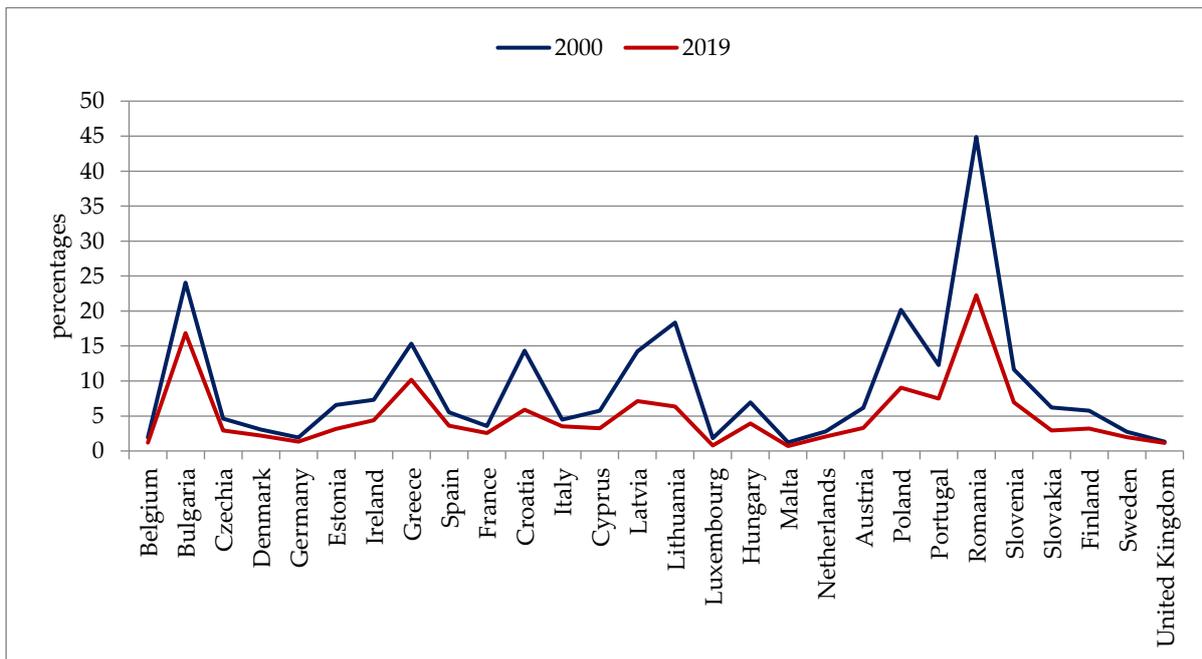
Figure 2. The share of employees in agriculture and forestry in total employment on the EU-28 in 2000 and 2019 (%)

Figure 3 compares the employment in agriculture and forestry in the years 2000 and 2019 in V4 countries. Dealing with the figures, the total number of people employed in the bioeconomy sectors, such as agriculture and forestry has been declining over the years. In total, in the V4 countries, more than 3,566 thousand persons worked in agriculture and forestry in 2000 and more than 1,897 thousand persons in 2019. We see a declining trend in

the period 2000-2019. Compared to 2000 and 2019, we observe a decrease in the number of persons employed in the agriculture and forestry sectors by almost 47%.

The highest number of people employed in the forestry sector displays Poland in both years. In more detail, more than 64 thousand persons in the year 2000 and 63 thousand persons in the year 2019. Further follows Czech Republic, Slovakia, and Hungary. Only in Hungary, we observe higher number of people employed in the forestry sector in 2019 (20.57 thousand persons) than in 2000 (18.61 thousand persons).

On the other hand, the highest number of people employed in the agriculture sector refers Poland. Further follows Hungary, Czech Republic, and Slovakia. In all V4 countries we can observe a declining number of people employed in the agriculture sector.
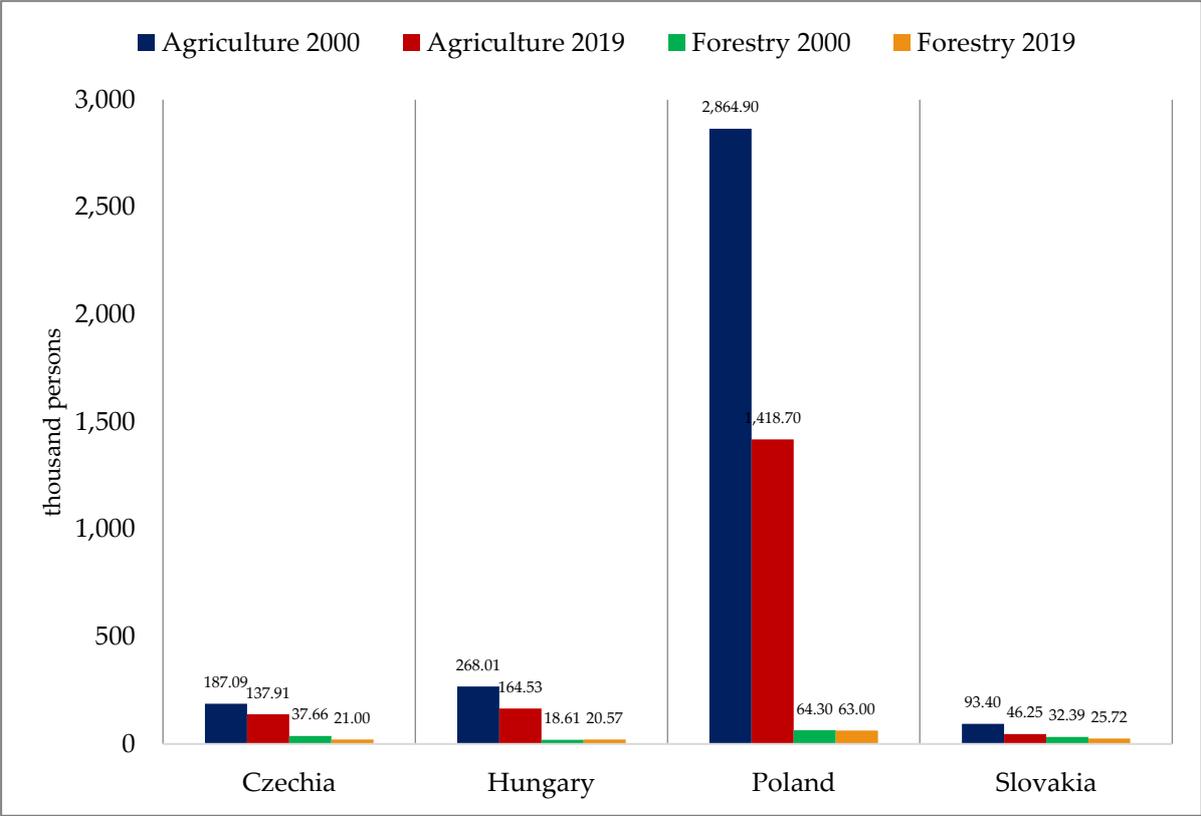
Figure 3. Employment in agriculture and forestry in V4 in 2000 and 2019 (thousand persons)

In Figure 4, we observe the share of employees in agriculture and forestry in total employment in the V4 countries in 2000 and 2019. Given the number of employees in agriculture and forestry in 2000 and 2019, the Czech Republic shows higher numbers in each sector and each year compared to Slovakia. Only in forestry in 2019, we can observe higher number of employees in Slovakia compared to the Czech Republic.

On the other hand, focusing on the share of employees in agriculture and forestry in total employment in the Czech Republic and Slovakia in 2000 and 2019, Slovakia shows higher share in each sector and each year compared to the Czech Republic. Only in agriculture in 2019, we see higher number of share in the Czech Republic compared to Slovakia.
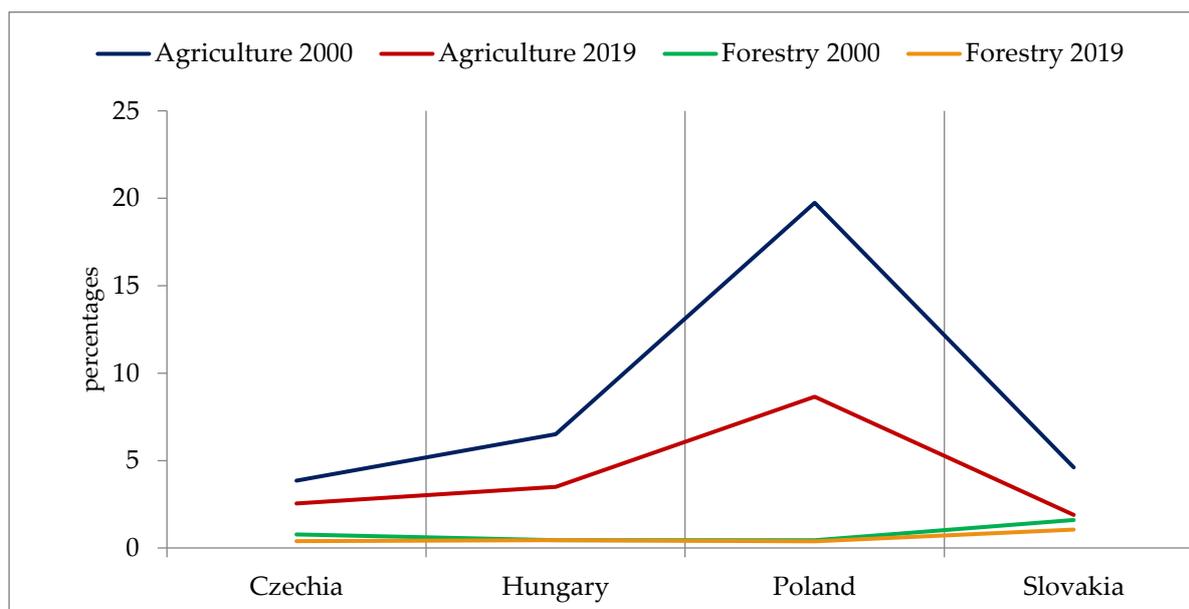
Figure 4. The share of employees in agriculture and forestry in total employment in the V4 in 2000 and 2019 (%)

If we consider the share of employees in agriculture and forestry in 2000 and 2019 in V4 countries, the highest share of employees in agriculture in 2000 and 2019 displays Poland and the highest share of employees in forestry in 2000 and 2019 displays Slovakia.

Figure 5 focuses on the development of the number of employees in agriculture and forestry in Czech Republic in the years 2000–2019. Regarding the results for the Czech Republic, we can observe the highest number of employees in agriculture in 2001 (189.67 thousand persons) and the lowest number of employees in agriculture in 2010 (128.39 thousand persons). Between 2000 and 2019, we see a decrease in the number of employees in agriculture in the Czech Republic by 49.18 thousand persons. In the previous year (2020), approximately 137 thousand persons worked in agriculture in the Czech Republic.

With focus on the development of the number of employees in forestry in Czech Republic in the years 2000–2019, we can see a gradual slightly declining trend. Regarding the results for the Czech Republic, the highest number of employees in forestry in 2000 (37.66 thousand persons) and the lowest number of employees in Forestry in 2019 (21 thousand persons) are displayed. Between 2000 and 2019, we see a decrease in the number of employees in forestry in the Czech Republic of 16.66 thousand persons. In the previous year (2020), approximately 21 thousand persons worked in forestry in the Czech Republic.

Figure 6 shows the share of employees in agriculture and forestry in total employment in the Czech Republic in 2000–2019. We can observe a declining trend in the period 2000–2019. The highest share of employees in agriculture and forestry in the Czech Republic displays in 2001, 2000 and 2002. In contrast, the lowest share of employed persons in agriculture and forestry in the Czech Republic shows in 2019. Between 2000 and 2019, we see a decrease in the share of employed persons in agriculture and forestry in total employment in the Czech Republic by almost 1.70%.
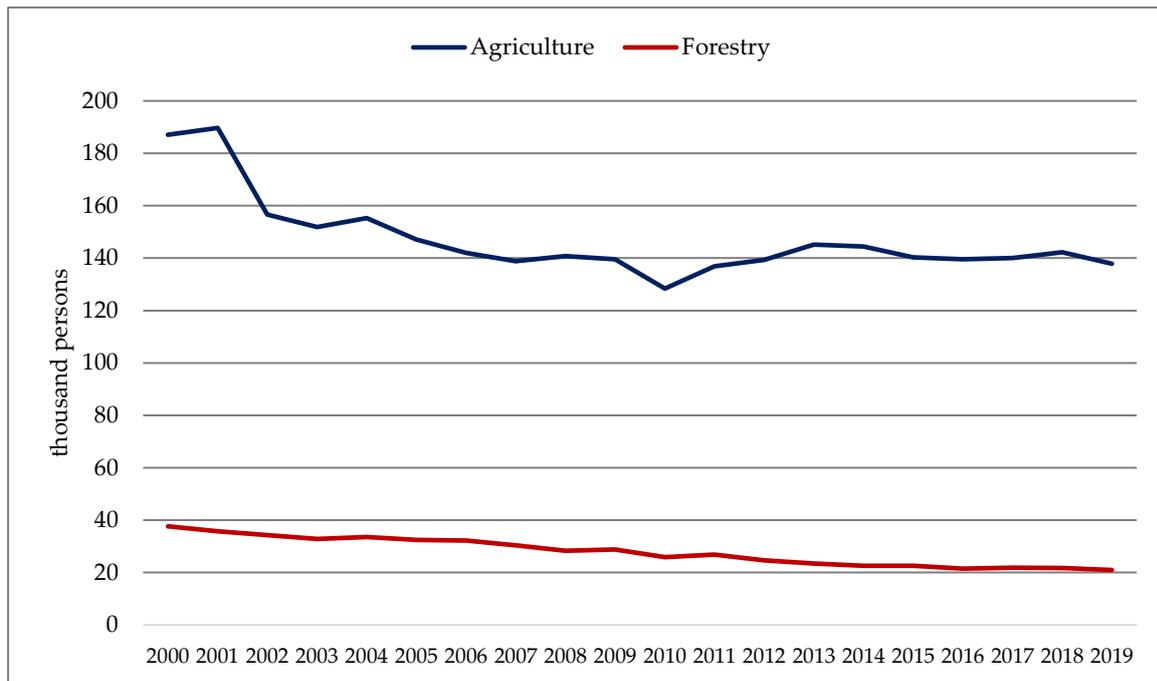
Figure 5. Development of the number of employees in agriculture and forestry in the Czech Republic in the years 2000–2019 (thousand persons)
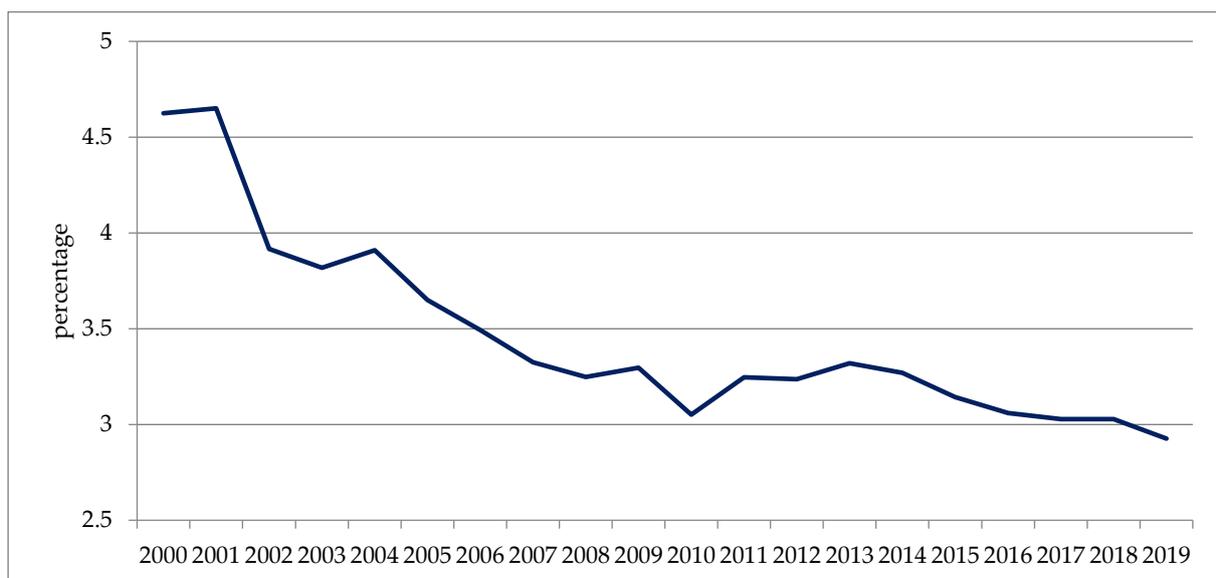
Figure 6. The share of employees in agriculture and forestry in total employment in the Czech Republic in 2000–2019 (%)

4. Discussion

The main aim of this paper was to evaluate the improvement of the employment in the agriculture and forestry in the European Union, V4, and Czech Republic in the period 2000–2019. According to main target, the sectoral approach was applied, and the statistical data collected. Dealing with methodology, the literature review, desk research, and time series analysis, the sectoral comparative analysis was used.

Focusing on the results, we can conclude that the number of people employed in the agriculture and forestry and the share of employed people in the bioeconomy sectors, such

as agriculture and forestry in the period 2000–2019 in the European Union, V4, and Czech Republic showed a slightly declining trend.

According to data for the EU-28, the highest share of employees in agriculture in 2000 and 2019 displays Romania and Bulgaria and the highest share of employees in forestry in 2000 and 2019 displays Croatia and Slovakia. With focus on the share of employees in agriculture and forestry in 2000 and 2019 in EU-28 countries, the highest share of employees together in agriculture and forestry in 2000 and 2019 displays Romania and Bulgaria.

Based on the figures for V4 countries, we see a declining trend in the period 2000–2019 in the total number of people employed in the agriculture and forestry in the V4 countries. Compared to 2000 and 2019, we observe a decrease in the number of persons employed in the agriculture and forestry sectors by almost 47%. Only in Hungary, we can observe higher number of people employed in the forestry sector in 2019 (20.57 thousand persons) than in 2000 (18.61 thousand persons).

If we consider the share of employees in agriculture and forestry in 2000 and 2019 in V4 countries, the highest share of employees in agriculture in 2000 and 2019 displays Poland and the highest share of employees in forestry in 2000 and 2019 displays Slovakia.

Regarding the results for the Czech Republic, between 2000 and 2019, we see a decrease in the number of employees in agriculture by 49.18 thousand persons and in forestry by 16.66 thousand persons. Between 2000 and 2019, we see a decrease in the share of employed persons in agriculture and forestry in total employment in the Czech Republic by almost 1.70%.

According to study performed by Ronzon et al. (2015), four groups of the EU Member States are identified, especially (1) agricultural bioeconomies, (2) agro-food industry and bio-based chemical industries, (3) forestry bioeconomies, and (4) non-specialised bioeconomies. The Czech Republic belongs to a non – specialised bioeconomy, together with V4 countries, namely Slovakia and Hungary.

Changes in the development of employment in bioeconomy (Ronzon et al., 2022) are influenced not only by modernization and innovation, but also by structural changes between sectors in the economy, employment reallocation.

Focusing on the development of the bioeconomy employment, changes in the market are conditional on the perception of the environment in a national economy. We can observe the emergence of green jobs (Dordmond et al., 2021). Both agriculture and forestry sector face current challenges. As regards agriculture, the greening process has begun. On the other hand, the forestry sector in the Czech Republic (Purwestri et al., 2020) should meet the demand for sustainable forest biomass and high value-added products.

Dealing with scientific studies presented in the introduction chapter, all the research found points to the opportunity that the development of sectors of the bioeconomy can bring new jobs across the European Union. For example, Drejerska (2017) concluded that the agricultural sector, as one of the bioeconomy sectors, has the highest share of total employment in the European Union and high employment numbers in the individual subsectors of bioeconomy are the result of natural and geographical conditions. Agricultural employment in the Czech Republic accounts for nearly 36 percent of total employment in bioeconomy. Another study (Philippidis et al., 2014), highlights that the bioeconomy drivers

of job creation are the forestry, fishing, and wood sector. Another results (Hájek et al., 2021) show, that the developed forestry, agriculture and food industries in the Czech Republic provide the basis for the improvement of the locally oriented circular economy.

Study performed by Hetemäki (2016) emphasizes, that there is a lack of studies that develop an area such as the forest labor market. Therefore, this study has tried to fill this gap.

As it was mentioned, ways are currently being sought to smoothly replace a linearly functioning economic system with a more sustainable one. The European Union (European Commission, 2018) is currently making an intensive and significant effort to support and develop the concept of circular economy and bioeconomy at both European and local levels. The main targets are established, such as environment protection, the EU's long-term competitiveness, and a climate neutrality by 2050. We can speak of this issue as highly topical and with a global impact.

The European Green Deal (European Commission, 2019) is currently one of the European Union's key policies and addresses the global challenges of climate change. The sustainable economy policy package is complemented by the EU Bioeconomy Strategy (European Commission, 2018), and the New EU Circular Economy Action Plan (European Commission, 2020). Further, the US Sustainable Development Goals (United Nations, 2015), the European Forests for biodiversity, climate change mitigation and adaptation (Science for Environment Policy, 2021), and the New EU Forest Strategy for 2030 (European Commission, 2021) have already developed.

In the Czech Republic, the first strategic framework for the circular economy has been approved since the end of 2021. The Circular Czech Republic 2040 (Ministerstvo životního prostředí, 2021) should create new jobs across the Czech Republic.

All these initiatives have a common vision, namely, to ensure the sustainable development of society and ensure well-being for current and future generations. And it is precisely the concept of circular bioeconomy that represents the link between the above-mentioned concepts. At the same time, it is an area of the economy with huge potential to meet a set of global challenges. The circular bioeconomy represents an opportunity to increase the efficient use of biological resources. It is a promising way to mitigate the effects of climate change and kick-start a sustainable economic system that respects the planet's natural limits. Currently, the global challenge is to unlock the potential of the bioeconomy.

Conflict of interest: none

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The Impact of COVID-19 on the Digital Transformation in Organizations: A Quantitative Analysis

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Abstract: The COVID-19 pandemic disrupted all aspects of life. To stop uncontrollable virus spread, the Governments declared lockdown in many countries. The economic and social consequences of the pandemic had a significant impact on organizational development. In response to the crisis, organizations had to accelerate the strategy of digital transformation to adapt to unprecedent situation. The purpose of the contribution is to measure the magnitude of the impact of COVID-19 on digital transformation in organizations. The article presents results of research dedicated to the situation in selected areas. Primary quantitative data were obtained using a questionnaire survey taking place before and after the beginning of the pandemic. The selected outputs compare the results of the digital transformation in organizations in two periods, before 2020 and after. The sample contains thousands of respondents. The results confirm the rapid transfer of organizations to become more digital toward interacting with customers and suppliers through digital technologies. The rate of adoption of digital initiatives is higher than before the crisis. Therefore, is an indisputable output of the questionnaire survey focused on the role of CIO, number of information systems, ICT investments, user comfort, and the will of managers to listen to user request.

Keywords: COVID-19; coronavirus; digital transformation; digitalization; information and communication technology

JEL Classification: M15; M21; O33

1. Introduction

In response to the worldwide COVID-19 crisis, there was a fundamental change in the way organizations are doing their business across different industries (McKinsey, 2020). Dramatic government restrictions led to inequalities in economic and social areas. Lockdown was imposed in many countries and has caused social distances mainly due to reduced mobility (Rahman et al., 2020). These drastic circumstances, leading to reduction in virus transmission, improved the pandemic situation, but not for a long period. Although the lockdown also had a positive effect, especially on the environment (Fu et al., 2020), the poor economic situation resulted in a decline of several organizations in numerous sectors. Concerns about future developments increased proportionally in response to the uncertain government range of measures and the lack of virus experience. Organizations switched to digital environment from day to day, faster than excepted and found out that the inexorable

shift to digital resources began a new business path to keep connection with customers, suppliers, and employees. The disruption of pandemic situation has emphasized the adoption of a holistic approach to digital transformation in organizations with the aim of offering an enhanced customer centricity (KPMG, 2020). Leaders were forced to align an overall strategy with the digital strategy and develop and implement new creative digital solutions. The organizations accelerated the digital transformation process and adopted technologies that strengthen relationships with customers, suppliers, and employees and continue to function remotely. Thus, they also face to need to strengthen online collaboration. According to Mitchell (2021), it includes four major parts: flexibility and productivity, social connectedness and organizational culture, technology support, management, and leadership. This affected many organizations and working teams. According to Wu (2021), 47% of teams that were used to working based on one location together decreased to 15% because of the effect of COVID-19.

Organizations rethought business priorities and began investing in digital initiatives with an emphasis on competitiveness in the new economic environment (Klimková & Hornungová, 2011). The importance of technological strategy has become a critical component of the business and not just a source of cost efficiencies. The circumstances of COVID-19 indicated the importance of executive mindsets on the role of technology in business (McKinsey and Company, 2021). Technology had become an important part that helps manage the constant risk environment, particularly cyber security, and allows workplace flexibility. The shift to digital technologies such as Artificial Intelligence (AI), blockchain, Internet of Things (IoT), Internet, robotics, smart manufacturing, machine learning, predictive, and data analytics allows automation and flexible reaction on new requirements of maintaining business activities due to unprecedent situations (Soto-Acosta, 2020). Using advanced technologies speeds up experimentation and innovating during the pandemic (Chesbrough, 2020).

As of today, the COVID-19 outbreak is still a global threat, and through digital transformation, organizations can maintain business activities. The term 'digital' has begun to be increasingly bowed in several industries. Globalization and digitalization are phenomenon that can significantly contribute to the economic sustainability of organizations.

According to the study by McKinsey (2020), respondents adduced that their organizations are able to implement digital initiatives 20–25 times faster than they would have expected. Almost 50% of the respondents indicated that their organizations were the first to the market with innovations during the coronavirus pandemic and experimented with new digital technologies. Comparison the survey in 2017, half of leaders consider cost savings as the most important factor in digital strategies and in 2020 only 10% of leaders denote it in the same way. At the same time, more than half of respondents declare they are investing in technology to increase the competitiveness.

To assess the magnitude of the impact of COVID-19 on the digital transformation in organizations, we provide research focused on many aspects of digital transformation. Data analyses were undertaken in two periods to compare them, before 2020 and after. The data were obtained through the questionnaire survey using the ZEFIS portal, which provides

consultancy of the effectivity of organization with the comprehensive survey. Exploring how COVID-19 has impacted digital initiatives in organizations can help people understand how organizations can embrace the digital transformation process. Assessment of the impact of the pandemic will be more relevant to the acquisition of collected data with course of given time frames.

2. Methodology

The article deals with the research focusing on the magnitude of the impact of COVID-19 on digital transformation in organizations. The paper presents results of the research question – what is the influence of the COVID-19 pandemic on the digital transformation of organizations? Primary data were obtained through the online questionnaire survey at the ZEFIS portal that evaluates the efficiency of information systems in organizations. Its strength is the ability to compare results with other companies of similar size. Due to the fact that it is a managed portal with the need to create and verify an account, the data can be considered reliable. The data were collected from the survey taking in the period 2010–2019 and 2020–2021 (except the question relating to the significant information systems operated in the organization where are observed data are compared in periods 2018–2019 and the 2020–2021) and questions are related to the digital transformation in organizations. The sample mostly comprises more than a thousand respondents in each question (except the questions in paragraphs 3.2 and 3.3 where the sample comprises about 300 respondents) and the largest representation of the company size is 10–49 employees. Most of the respondents come from manufacturing, trade and business, provision of services, information and communication technologies sectors. Descriptive research investigates the characteristics of the sample and helps to derive the attitude about the phenomenon.

Regarding the purpose of this study, we compare the results from five questions of the survey before 2020 and after that to evaluate the impact of COVID-19 on digital transformation in organizations. Questions are developed to analyse the current status of information system in organization, especially the role of CIO, number of information systems, ICT investments, user comfort and the will of managers to listen to user requests.

The ZEFIS portal analyzes the efficiency of information system in organization in relation to information strategy, consistency of compliance with defined rules, and perception of end users of IS from various viewpoints on different levels of difficulty (Chvatalova & Koch, 2015). The portal uses questionnaire and focuses on seven aspects of efficiency: hardware, software, orgware, peopleware, dataware, customers, and operations (ZEFIS, 2021). The ZEFIS system reflects the complex view of information system in organization based on the 7 subsystems and detects the most inefficient subsystem. This developed system assesses the level of the balance of information system and determines the recommendations for balancing the weakest part. ZEFIS strives for a balance of the information system, achieving the minimal costs and maximum benefits (Koch & Chvatalova, 2017).

The results of the questionnaire survey are limited geographically and time-wise – the study is based on the answers of the respondents from Czech and Slovak companies collected between years 2010–2020. This can be considered as a great advantage of this study because

this means that more than 92% of the responses were collected before the beginning of the pandemic in 2020. It increases an accuracy of the research results due to the inability of the respondents to be affected by their experience with the pandemic.

3. Results

The objective of the article is assessment of the impact of COVID-19 on the digital transformation in organizations. How do organizations approach digital transformation initiatives in response of COVID-19? Do they prioritize investments in digital technologies? What barriers inhibit new digital strategies? For the purposes of the research, five questions related to the purpose of this paper was included in the ZEFIS portal survey. The data analysis relates to the digital transformation and is taken in November 2021.

Due to quantitative observation, we conducted an in-depth analysis of variables. Descriptive research reveals the prevailing respondent´s underlying patterns and behaviour. The research was conducted in two periods, before 2020 and after, to ascertain differences.

The following part provides a concise result from defined survey areas related to the digital transformation. We focus on the sample of respondents answering these survey questions:

1. Is in your organization established a responsible manager for information systems (CIO)?
2. How many significant Information Systems are operated in the organization?
3. How many percent of the annual turnover your organization invests in Information Systems?
4. Is it true that workers lack some Information System´s data or functions?
5. Do managers react to initiatives of their employees, which new functions of IS are necessary?

Given the scope collected data in the period 2010-2019 and to acquire an objective view of data we examine relative frequency of answers comparison two periods and visualize numerical outputs in percentage in histogram. Key results in the tables are highlighted in italics.

3.1. Is in Your Organization Wstablished a Responsible Manager for Information Systems (CIO)?

In Table 1 are presented results of respondents who answered the question about a responsible manager for information systems in their organization. According to the results in the period 2020–2021, the number of respondents who allege that the position is accumulated with another has increased and it can be the response to the ongoing pandemic situation and managers probably expanded the competences of an existing employee and assigned him responsibility for the information system. Comparing the results of these two periods, the observed data in the period after COVID-19 don´t clearly determine that there are more responsible managers in organizations than before the pandemics. This status can be influenced by the medium to a long-term recruitment process. To determine whether COVID-19 has influenced the increase in the number of employees responsible for information systems in the organization can be reflected in an extended interval.

Is in your organization established a responsible manager for information systems (CIO)?	2010–2019 n_i	2020–2021 n_i	2010–2019 p_i	2020–2021 p_i
No	902	118	31%	33%
Yes	1,197	126	41%	35%
Yes, but the position is accumulated with another	818	114	28%	32%
Total	2,917	358	100%	100%
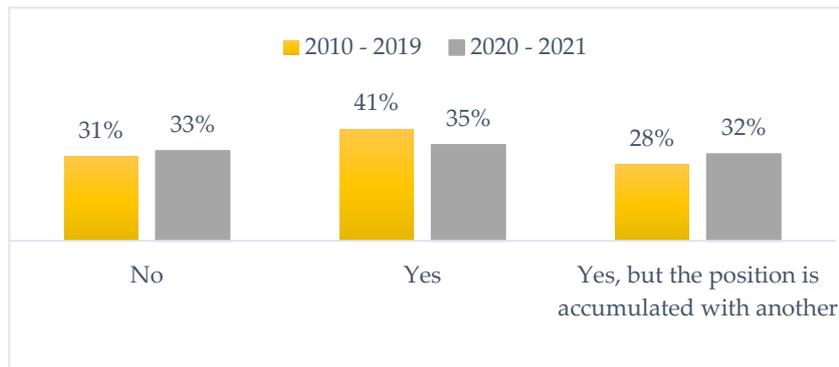
Figure 1. Number of respondents reacting to the responsible manager for IS in organizations (ZEFIS, 2021)

3.2. How Many Significant Information Systems Are Operated in the Organization?

This following model approximately copy the trend of responses from preceding model. Therefore, observed periods depict results for the question "*How many significant Information Systems are operated in organization?*" and identify that there is no substantial growth. In particular, this can be attributed to the fact that the implementation of the information system is a long-term process with the involvement of many employees and a thoughtful strategy.

Table 2. Number significant Information System operated in organization (ZEFIS, 2021)

How many significant Information Systems are operated in the organization	2018–2019 n_i	2020–2021 n_i	2018–2019 p_i	2020–2021 p_i
1	104	111	30%	32%
2–5	182	180	52%	51%
6–10	41	36	12%	10%
11–20	19	10	5%	3%
More than 20	5	13	1%	4%
Total	351	350	100%	100%

3.3. How Many Percent of the Annual Turnover Your Organization Invests to Information Systems?

Table 3 summarizes organizations´ investments into Information Systems as a percentage of their annual turnover. Obtained results allow to deduce that before the crisis, organizations invested less than 10% of their turnover to IS, whereas from the

COVID-19 disruption, 30% of organizations invested between 21–30% of their turnover to IS. Although investments were rather a declining trend before the crisis, in contrast, investments since 2020 have had a gradual increase as a result of pandemic.
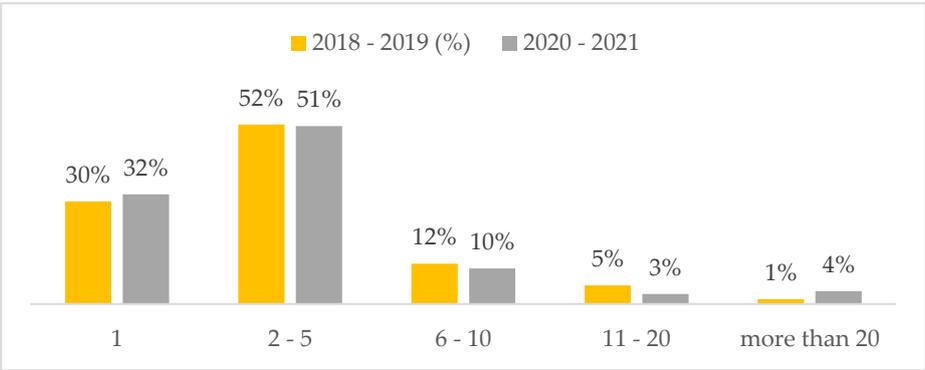
Figure 2. Number of significant Information System operated in the organization (ZEFIS, 2021)

Table 3. Number of respondents reacting to the percent of annual turnover invested in IS (ZEFIS, 2021)

How many percent of the annual turnover your organization invests to Information Systems	2018–2019	2020–2021	2018–2019	2020–2021
	n_i	n_i	p_i	p_i
0–10%	174	23	50%	7%
11–20%	102	70	29%	21%
21–30%	29	102	8%	30%
31–40%	22	68	6%	20%
41–50%	6	72	2%	21%
51–60%	5	0	1%	0%
61–70%	6	0	2%	0%
71–80%	3	0	1%	0%
81–90%	0	0	0%	0%
91%–100%	0	0	0%	0%
Total	347	335	100%	100%
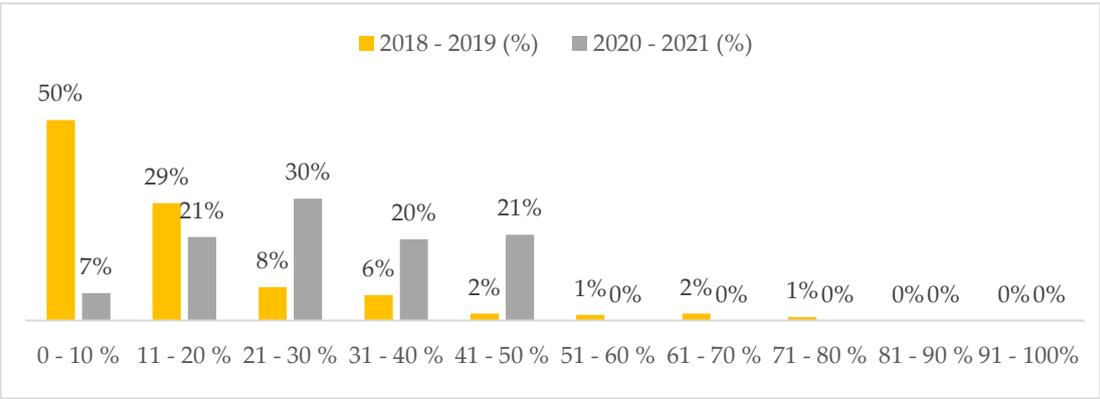
Figure 3. Number of respondents reacting to the percent of the annual turnover invested to IS (ZEFIS, 2021)

3.4. Is It True that Workers Lack Some Information System´S Data or Functions?

Investigation whether respondents lack some function of the information system indicates that in the response of COVID-19, employees confirm desideration some information systems´ data or functions. Frequent homebased working increases the claims of information systems functionality, and employees expect the high reliability of data. Inaccuracy and inconsistency of data in certain fields may cause erroneous or ambiguous decisions that lead to organizing activities improperly (Wang et al., 2011).

Table 4. Number of respondents reacting to lack some information systems' data or functions (ZEFIS, 2021)

Is it true that workers lack some Information System´s data or functions?	2010–2019	2020–2021	2010–2019	2020–2021
	n_i	n_i	p_i	p_i
Yes	198	53	13%	*16%*
Rather yes	306	69	20%	*21%*
Rather not	769	148	49%	44%
Not	295	65	19%	19%
Total	1,568	335	100%	100%
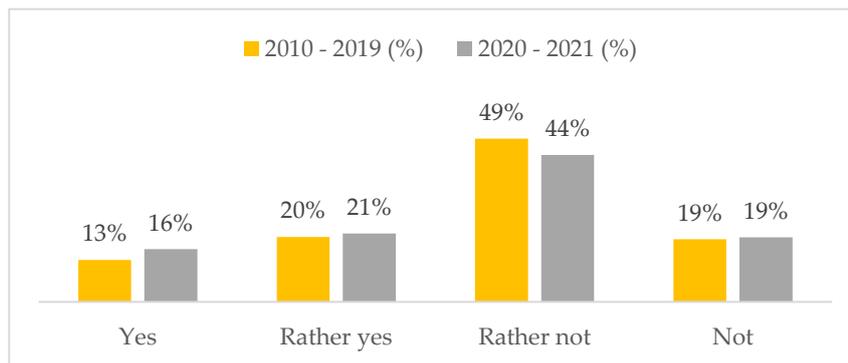
Figure 4. Number of respondents reacting to lack some Information Systems' data or functions (ZEFIS, 2021)

Table 5. Number of respondents reacting to the willingness of managers to support new functions of IS that are necessary (ZEFIS, 2021)

Do managers react to initiatives of their employees, which new functions of IS are necessary?	2010–2019	2020–2021	2010–2019	2020–2021
	n_i	n_i	p_i	p_i
Yes	404	69	27%	*31%*
Rather yes	697	124	47%	*55%*
Rather not	322	29	22%	13%
No	47	4	3%	2%
Total	1,470	226	100%	100%

3.5. Do Managers React to Initiatives of Their Employees, Which New Functions of IS Are Necessary?

The results visualize options of answers to questions about the willingness of managers to react to initiatives of their employees. The comparison of two observed periods, we can

see a similar trend as with the previous two questions that COVID-19 is causing. Respondents more evaluate managers´ efforts to react to employee stimuli regarding new IS functions of IS that are necessary in the COVID-19 period.
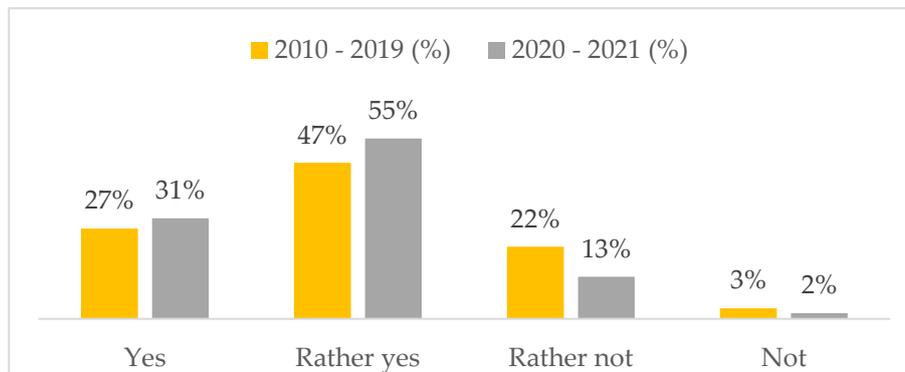
Figure 5. Number of respondents reacting to the willingness of managers supporting new functions of IS that are necessary (ZEFIS, 2021)

Barriers in the form of inhibition of implementation of digital instruments to support competitiveness and innovations that appeared in the past are slowly disappearing. Employees are more open to new digital initiatives to embrace the survival of the organization.

4. Discussion

The study is aimed on results of the survey research that assess the impact of COVID-19 on the digital transformation of companies and other organizations. The field this of study is becoming increasingly important. According to Nagel (2020), there is an increase in home office and remote collaboration, and it is believed that the digital transformation process accelerated in response to the COVID-19 pandemic. To identify the behaviour of organizations, quantitative research has been performed based on questionnaire survey through ZEFIS portal. Within the survey, five particular questions were asked. The study is based on the comparison of the survey answers in two reference periods – before and after the beginning of the pandemic. Due to the fact that the questions have been collecting since 2010, the outputs are reliable and with a high degree of validity.

Questions that are part of the research can be divided into two categories. The results of the first category are similar in the first and also in the second observed period. These outputs are related to long-term changes in the organization or sensitive issues such as human resources. These are assumed not to change within two years 2020 and 2021, which can be considered a too short period. This can be seen in the results of questions number 1 (Is in your organization established a responsible manager for information systems (CIO)?), number 2 (How many significant Information Systems are operated in the organization?) and number 4 (Is it true that workers lack some Information System´s data or functions?). In the first case, the occupation of the CIO position is supposed to be a significant interference within the corporate hierarchy that cannot be done hastily. Rahman et al. (2020) in their paper speak about HR development during COVID-19 crises, but their study is focused on

examination of performance efficiency in human resource management which can be done in a short-term period. Secondly, the implementation of an information system or fundamental changes in the ICT ecosystem is a long-term project that needs to be well-planned, financed, and supported by professional team. Thirdly, optimization of the system functionalities and new automation of processes require comprehensive analysis and it also can be considered as a small or medium-sized project. These facts are assumed to play a key role in why the results of such questions did not change much before and after the beginning of the pandemic. Also, Mahmud (2021) claims that the largest transformations need to be observed in a long-term period when significant changes take some time to become apparent.

On the other hand, there are several actions that the management of the companies can arrange quite quickly. The first one is to agree on a higher budget of investments in ICT technologies that can be used in easier steps of the digital transition. There is a need to take into consideration potential state programs supporting ICT equipment during the pandemic, as mentioned by Khai et al. (2020) in the contribution of Malaysia. Except for ongoing EU subsidies, no extraordinary national grants were found within Czech and Slovak Republic. Secondly, managers and team leaders can change their mindset and be more open to the requests and wishes on how to make the use of the system use more comfortable. This can speed up some processes but also improve a teamwork among its members which can be an important aspect during unprecedented situations such as pandemic or long-lasting remote collaboration from home.

The limits of the research are determined by time-series and geographical point of view – participants of the survey are employees of Czech and Slovak organizations. An important fact is that the responses of participants come from different organizations in observed periods. It means that the survey is not based on asking the same questions to the same participants in different periods. It is recommended to repeat the survey in the course of time to confirm the short-time aspects and examine the long-term factors that have not been shown so far.

5. Conclusion

In recent two years, information systems acquire value and importance as a consequence of the pandemic situation. Research provides results related to digital transformation that is a crucial factor for effectiveness to maintain business activities. To determine the influence of COVID-19 on digital transformation, a survey of five questions was conducted aimed to the digital transformation. To ensure a reliable and valuable sample of data, the ZEFIS portal was used. By comparison of the results (representing by thousands of respondents), we have concluded that organizations pay more attention to ICT ecosystem development. The main result of the study is that organizations are aware of the need of ICT innovations driven by the accelerated situation of COVID-19. All aspects that may be reflected in a short time such as increased investments (question number 3) and a will to make some new changes and functionalities in the system (question number 5) register a noticeable increase after the beginning of the pandemic in spring 2020. Remaining factors related to HR changes,

implementation of information systems and applications, or analysis of processes that can be optimized and automated have not changed in any significant way so far.

It is important to point out that organizations emphasize the importance of increasing investments in information systems as a percentage of their annual turnover.

This research contributes to the identification of how companies and other types of organizations of every size approach the specifics of the current situation. It shows which aspects are easy to change in the short-time period and, on the other hand, points out those factors that cannot be readily changed or are not suitable to be responsibly changed in short time.

To verify the research, it is appropriate to repeat the study in long term perspective to reveal the trends and prevailing conditions that have impact on the process of digital transformation. It would help to clarify those questions that were identified as long-term changes and also confirm the trend of increasing investments in ICT as a whole.

Conflict of interest: none

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Knowledge and Sources of Information on the Energy Efficiency of Devices in Farms in Poland

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Abstract: The paper presents the results of empirical research on the sources of information on the energy efficiency of electrical devices used by farmers, both in economic and living activities. The study was conducted using the questionnaire method in Poland, and the research sample consisted of 480 farms. As the research shows, there is a clear diversification of the sources of knowledge with regard to the purchase of equipment for living and production purposes. The most important source of information is the advisor at the point of sale of devices (indications of 78.8% of respondents in relation to home electronics and appliances and 58.9% in relation to agricultural equipment). The Internet, as a source of knowledge on the subject matter under study, was more often indicated in relation to equipment used for living purposes. The research shows that a significant part of the respondents did not know the energy efficiency class of electrical equipment used in both household and agricultural equipment.

Keywords: energy efficiency; equipment; farmers' households; farms; sources of knowledge

JEL Classification: Q12; Q49; R20

1. Introduction

Improving energy efficiency, which, apart from significant economic benefits, brings measurable environmental effects, should be a priority in modernizing the economy (Ayres et al., 2007; Brockway et al., 2021). Improving energy efficiency should concern various spheres and areas of the economy, ranging from the energy system, through the sectors of agriculture, industry and construction, to activity at the household level (Piwowar & Dzikuć, 2019; del Mar Solà et al., 2021; Chen et al., 2021).

In this paper, the main area of interest are farmers' households in the context of equipping them with technical equipment/devices and sources of information on the effectiveness of devices used for production (agricultural) and living (in the farmer's household) purposes. The importance of the topics results from the existing research gap in the spatial scope of research. There are not many items in the scientific literature regarding the sources of knowledge of buyers/users about the energy efficiency of devices, especially farmers' knowledge. Most often, the subject of agricultural (agronomic) knowledge sources is taken up and in this context the importance and role of individual sources is characterized, including traditional ones – press, television, etc., and modern ones – the Internet (Kalinowski & Prymon, 2011; Janc, 2013; Solon, 2014). There is also little research in the literature on the equipment of farmers' households with electrical equipment. The analyses mainly concern the equipment of farms with plant production equipment (Maciulewski & Pawlak, 2014; Pawlak, 2018). Secondly, the studied

issue is an important point of contact between the issues of energy efficiency and consumer behaviour (Gaspar & Antunes, 2011; Umit et al., 2019). In this context, learning about the determinants of behaviour and taking action to change consumer behaviour can significantly contribute to reducing environmental degradation (Stern, 1999; Pawaskar et al., 2018; Kácha & van der Linden, 2021). As emphasized by Pizło and Mazurkiewicz-Pizło (2010), farmers' households constitute a specific group of households due to the relatively free flow of funds allocated for investment and consumption. In this context, the analysis in this group is particularly interesting from the cognitive point of view.

The constant increase in the demand and use of electricity in rural areas in Poland is confirmed by many years of research conducted, among others, by the Central Statistical Office. Tab. 1 presents data on the number of consumers and electricity consumption in Poland in 2018-2020, broken down into urban and rural areas.

Table 1. Electricity consumption in Poland in 2018-2020 (Statistics Poland, 2020; 2021)

Specification	2018	2019	2020
Electricity consumption (annually) in GWh	30,506.20	30,613.20	31,534.80
cities	17,953.40	17,936.00	18,499.00
rural areas	12,552.80	12,677.10	13,035.80
Electricity consumers in thous. (as of December 31)	15,398	15,588	15,799
cities	10,244	10,400	10,556
rural areas	5,154	5,188	5,243

As can be seen from the data in Table 1., in 2018-2020, both the number of electricity consumers in rural areas (by 55 thousand) and electricity consumption (by 483 GWh) increased in Poland. Electricity consumption (per year) per capita in rural areas in Poland in 2020 amounted to 849.1 kWh and was 44.8 kWh higher than in cities.

Therefore, rural areas in Poland are particularly important from the point of view of analyses in the area of energy efficiency (Piwowar, 2021; Bielski et al., 2021). The studied issue is an important element of the economization of agricultural production and the sustainable development of agriculture. The improvement of energy efficiency is associated not only with the reduction of energy consumption for generating a production unit in agricultural activity, but also savings made in the context of energy consumption for living purposes in farmers' households (Kaya et al., 2021). Technical equipment, especially qualitative aspects, are an important element of the sustainable economic and social development of farms and farmers' households (Stępień et al., 2021).

The main purpose of this study was to learn about the sources of information on the energy efficiency of electrical devices used in agriculture, both in economic and living activities. Additionally, the results of research on the equipment of the surveyed farms with electrical equipment used for household and agricultural purposes are presented.

2. Methodology

The study was conducted among farmers' households in Poland in the period: October 2019 – March 2020. The size of the group was 480 people, including agricultural producers from six voivodeships in Poland (Figure 1).
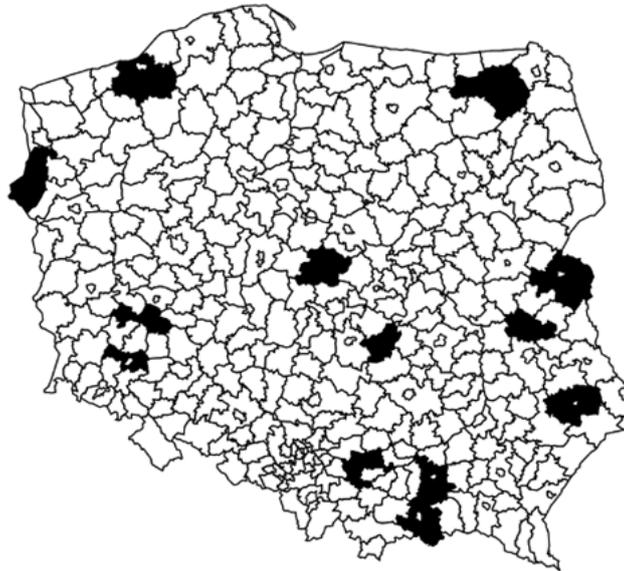
Figure 1. Spatial scope of empirical research

A two-stage survey was conducted. The first-degree research was carried out among households with a user of an individual farm. The size of the research sample was 480 farms where one of the members is a user of a farm with an area of at least 5 ha of agricultural land. The study was performed in three randomly selected counties in the area of six randomly selected voivodeships (80 questionnaires from each of the six voivodships). The second stage of the research involved an extended survey of 10 farmers in each voivodeship who participated in the basic research. In this paper, selected results from basic research were analysed.

Research on the condition of equipment and sources of knowledge regarding the energy efficiency of electronic equipment was carried out using the questionnaire method supported by the proprietary questionnaire. The survey was anonymous and included socio-economic and technical questions. This paper analyses some of the questionnaire questions concerning household and agricultural equipment of the respondents, as well as sources of knowledge on the energy efficiency of household and agricultural devices (machines). The novelty in this study is not only the quantitative analysis (the issue of having the selected type of equipment on the respondents' farm), but most of all the qualitative characteristics (the issue of energy efficiency of the equipment owned). The research was carried out before the entry into force of the regulations changing energy classes for selected product groups (European Commission, 2021). From 2021, the "pluses" used in the energy efficiency class "A" have been abandoned in the European Union. Currently, the A energy class is the highest, and the G class is the lowest.

3. Results and Discussion

An important area of research under the project (indicated in Acknowledgment) was the material resources of households and farms, conditioning the fulfilment of basic living, social and production needs that affect the formation of energy poverty. In the area of the household, these include goods directly related to household work (refrigerators, microwave ovens, vacuum cleaners, washing machines, etc.). In the survey, respondents answered questions about household equipment with the following household appliances and audio/video devices: boiler, central heating furnace; refrigerator; freezer; fridge-freezer; automatic washing machine; washer-dryer; an electric heater; vacuum cleaner; dishwasher; microwave; oven and electric cooker; oven and gas-electric stove; electric kettle; iron; air conditioner. Table 2 presents the results of analyses with regard to the equipment provided by at least half of the surveyed farms' households.

Table 2. The respondents' declarations regarding the age and energy class of electrical appliances owned by the household (own study based on questionnaire surveys (N = 480))

Specification		1*	2*	3*	4*	5*	6*	7*	8*
		[%]							
Equipment age	Up to 5 years	20.4	26.4	44.4	42.9	57.9	31.1	64.0	49.2
	5-10 years	40.2	54.0	40.3	39.5	38.2	42.9	28.6	38.1
	Over 10 years	39.2	19.6	15.3	17.6	3.9	26.0	7.4	12.7
Energy class	A+++	2.4	7.6	16.0	7.7	9.7	4.8	7.1	5.9
	A++	5.8	22.1	27.6	19.9	34.0	19.2	18.7	19.5
	A+	7.1	25.0	20.8	20.9	24.3	15.1	22.9	20.1
	A	7.1	9.2	10.0	11.1	6.5	10.9	11.1	10.0
	Other	13.6	2.4	2.0	2.6	3.1	14.1	7.1	3.3
	I do not know	64.0	33.7	23.6	37.8	22.4	35.9	33.1	41.2

Note: 1* boiler, central heating furnace, 2* fridge-freezer, 3* automatic washing machine, 4* vacuum cleaner, 5* dishwasher, 6* oven and gas-electric stove, 7* electric kettle, 8* iron

According to the research, the three most popular devices among those mentioned in the survey were: an iron (owned by 478 households, i.e. 99.6% of respondents); a vacuum cleaner (468 households, i.e. 97.5% of the surveyed) and an automatic washing machine (457 households, i.e. 95.2% of the surveyed). The least frequently indicated equipment was an air conditioner (indicated by only 3 respondents, i.e. 0.6 of the research sample). The respondents also indicated the age of the equipment and the energy efficiency class. The highest percentage of indications of relatively new equipment (up to 5 years) was recorded in the case of the electric kettle (64% of responses), while the boiler and central heating furnace were often indicated in the "oldest" category (over 10 years). With regard to the energy efficiency class, it is worth noting that in the entire study (all product categories), the percentage of respondents who did not know the energy efficiency class of these devices on their farm was 37.9%. Taking into account individual appliances, a high percentage of respondents who indicated "I do not know" in this question was recorded in the following products: stove, boiler (64%). The respondents' knowledge in this area was the most complete

in the following categories: automatic washing machine and dishwasher. In these two categories, there were also declarations of having equipment with the highest energy efficiency classes (A+++ and A++).

The respondents were also asked to indicate the age and energy efficiency of selected electrical devices directly related to agricultural production (milking machines, coolers, dryers, irrigation devices). The respondents could also add and evaluate three other categories indicated by them. The results of this part of the analyses are presented in Table 3.

Table 3. The respondents' declarations regarding the age and energy efficiency assessment of electrical appliances owned by the farm (own study based on questionnaire surveys (N = 480)

Specification		Milking machines	Coolers	Other	Dryers	Irrigation devices
		[%]				
Equipment age	Up to 5 years	7.7	10.8	9.1	17.4	41.7
	5-10 years	37.6	34.2	30.9	34.8	41.7
	Over 10 years	54.7	55.0	60.0	47.8	16.6
Energy efficiency assessment	Very good	5.1	3.6	10.9	21.7	0,0
	Good	44.4	38.8	25.4	26.1	33.3
	Hard to say	41.0	42.3	41.8	39.1	58.3
	Rather bad (energy-consuming)	8.6	14.4	16.4	4.4	0.0
	Bad (highly energy-consuming)	0.9	0.9	5.5	8.7	8.4

The analyses show that more than half of the selected equipment used on farms in the categories of milking machines, coolers, dryers was over 10 years old. A high percentage also concerned the category "other", in which the respondents indicated, among other things, grinders, saws, welders, mixers, blowers, coolers, heaters, crusher. As in the case of household goods, respondents had difficulty in determining the energy efficiency of the appliances. The most frequently given answer was "hard to say". Negative responses (rather bad and bad – i.e. energy-consuming and highly energy-consuming) concerned coolers and equipment from the "other" category.

One of the research threads taken up in the survey were the sources of knowledge about the energy efficiency of devices (machines) used in households and farms of respondents. The results of these analyses are presented in Figures 2 and 3, with regard to household equipment (washing machines, refrigerators, etc.) and production needs in agriculture (milking machines, coolers, etc.), respectively.

The research shows that the most important source of information on energy efficiency (both household appliances and audio/video devices as well as devices used in agricultural production) is that provided by advisers at points of sale. In the following places, taking into account the importance of information sources, the respondents indicated other categories, depending on whether it concerned devices used for living purposes or for production purposes. A significant percentage of the respondents, considering household goods, indicated information obtained from family members, friends and acquaintances. The

respondents indicated magazines and newspapers as the least important sources of information in both categories of electrical equipment.

1 Advisers at sale points of devices
2 Family members, friends, acquaintances
3 Internet
4 Sales representatives in direct contacts
5 TV programs
6 Agricultural advisers
7 Other farmers
8 Specialist agricultural press
9 Magazines, newspapers
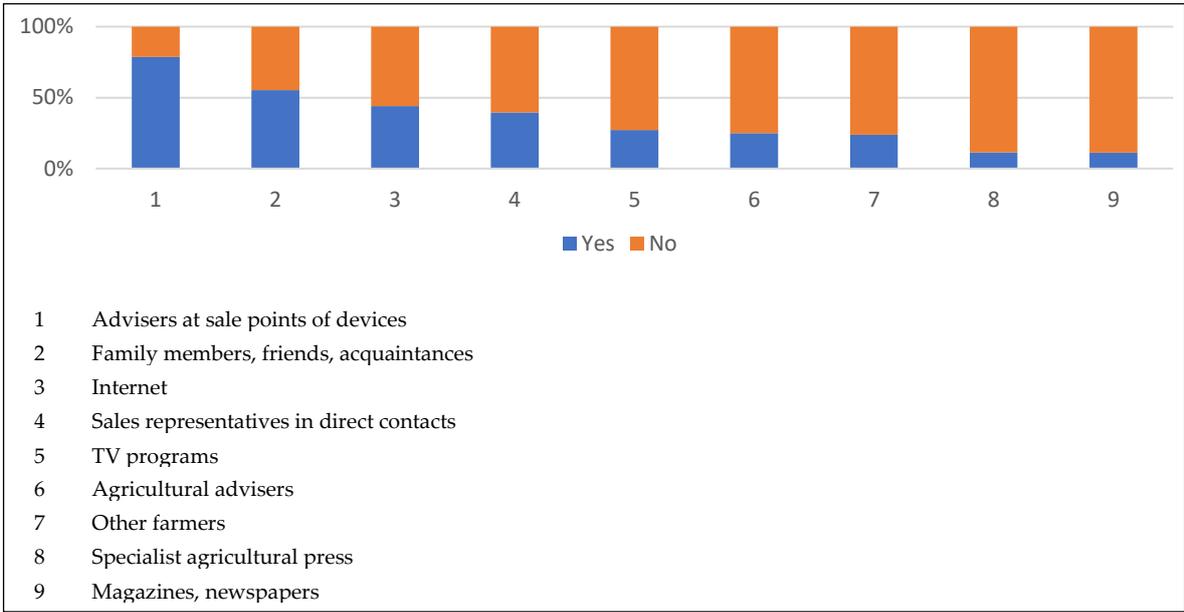
Figure 2. The respondents' declarations regarding the most important sources of information on the energy efficiency of devices (machines) used in the household (own study based on questionnaire surveys (N = 480))

1 Advisers at sale points of devices
2 Agricultural advisers
3 Sales representatives in direct contacts
4 Other farmers
5 Family members, friends, acquaintances
6 Internet
7 Specialist agricultural press
8 TV programs
9 Magazines, newspapers
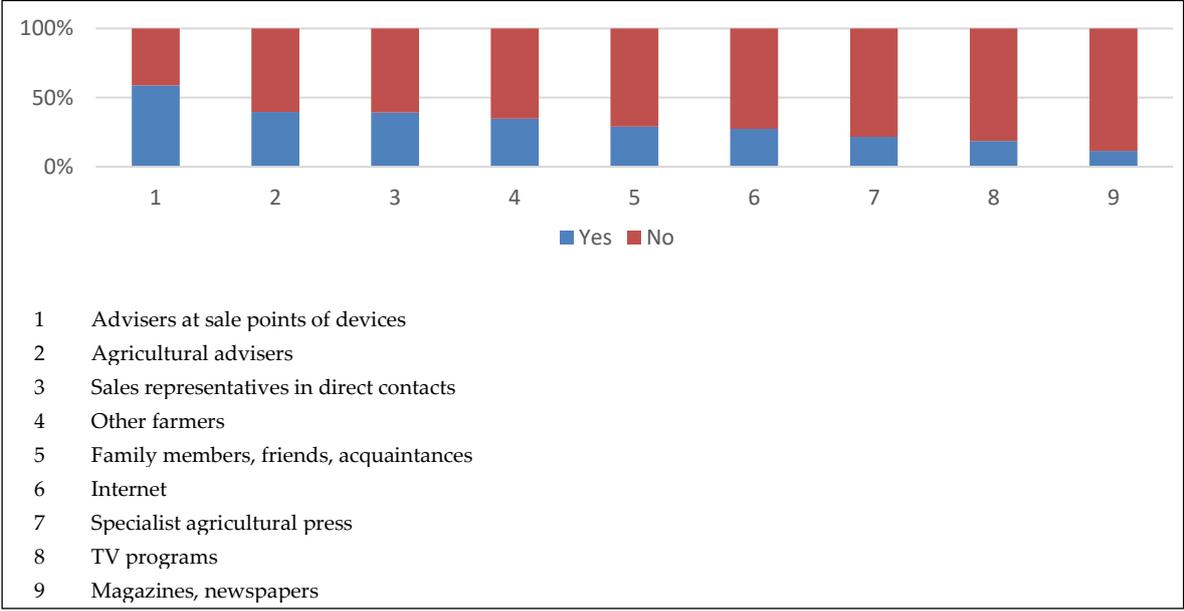
Figure 3. The respondents' declarations regarding the most important sources of information on the energy efficiency of devices (machines) used in the farm (own study based on questionnaire surveys (N = 480))

4. Conclusions

In the era of changing farming conditions, including strong pressure in the area of reducing negative externalities related to agriculture, requiring adaptation and innovation, the agricultural community needs easy access to knowledge and information on effective, pro-environmental farming practices in farming and appropriate, pro-ecological behaviour

as part of running a household. One of the key aspects, important both at the farm and household level, is the use of highly energy efficient appliances.

The author's own research shows that the equipment improving the performance of household activities was characterized by medium and high saturation in the researched farms' households. The research shows that the respondents hardly know the energy efficiency class of household appliances. Similarly, the respondents assessed the energy efficiency of equipment used in agriculture. The most common answer was "hard to say". The respondents' current knowledge of energy efficiency should be assessed negatively. There is a significant information gap between farmers and producers of durable goods, which are the equipment of farmers' households. As the financial situation of these farms improves, technologically obsolete equipment will be gradually replaced with equipment with higher technical values. With the passage of time and the persistence of the epidemic situation (Covid-19), the importance of the Internet as a source of knowledge on the subject matter may increase. Currently, this source of information is relatively rarely indicated, especially in relation to equipment used for production purposes. Nevertheless, internet sources still dominate traditional media, especially magazines and newspapers.

Conflict of interest: none

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Unemployment Benefits Calculation Using Knowledge Systems

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Abstract: The knowledge system is a more general type of expert system, but nowadays both terms are taken as synonyms. It is one of the most successful applications of artificial intelligence. They have flourished since the first demonstration in the 1980s and are now used in many areas where complex task decisions need to be simulated based on detailed and directly expressed expertise or judgment. The aim of our article is to create a knowledge system that will be able to insert, delete and edit individual knowledge and choose between different knowledge bases. The knowledge of this system will be applied to issues related to decisions on inclusion in the register of job seekers. In the event of an entitlement to unemployment benefits, the system calculates its amount in accordance with the Employment Act No. 435/2004 Coll. The system will make decisions based on the questions it asks.

Keywords: Knowledge system; unemployment benefits; decision making; labor market

JEL Classification: Z11; E27; D44

1. Introduction

Comparing Artificial intelligence (AI) is an area used in many disciplines, including neurology, philosophy, psychology, computer science, robotics, and linguistics. It focuses on imitating human behavior and thinking. Prior to interest in commercial applications, they were used only in research centers. Nowadays, popular areas of AI include mainly artificial neural networks, genetic algorithms, knowledge / expert systems and much more. (Provazník, 1999)

Knowledge systems (KS) work on the principle that the user provides various facts and receives expert advice in response to the system. The current KSs can explain the process of their own reasoning and thus the final statement. If the user is an expert, the system serves as a support that can help to find a solution to the problem more effectively. Decision-making, planning, classification, etc. are included in the evaluation. To define a problem in the KS language, it is not necessary to have knowledge of how to program in low-level languages. Only simple "what should happen under what conditions" rules are created. (Provazník, 1999)

The KS is divided into several parts. The most important parts are the knowledge base containing the knowledge and the inference mechanism that takes care of their processing.

It is further divided into an explanatory module, which describes and explains the reasoning process, the knowledge acquisition module, through which new knowledge is entered into the system, and the I / O interface, which is most often represented as a dialog mode where the user answers the system query. By separating knowledge from the mechanism of its use, KS differs from classical programs. The characteristic of KS is the possibility of decision-making under uncertainty and the ability to explain. (Berka, 1998; Dvořák, 2004)

The effect of unemployment benefits has been one of the key issues for most political parties in recent years. High levels of unemployment benefits affect work incentives, and people prefer voluntary unemployment and prefer free employment. Thus, the corresponding number of candidates cannot be found for low-paid jobs. This view is supported by a number of economic studies (Mikael Randrup & Raza, 2018). There is a substitution and pension effect. It can be deduced from this that a reduction in the compensation rate will lead to an increase in the labor supply and thus to a reduction in the unemployment rate (Mikael Randrup & Raza, 2018). Other authors' (Farber & Valletta, 2015) estimates suggest that the next month's extended benefits will increase the unemployment period by about 0.06 months, which is slightly below the lower limit of past estimates (Katz & Meyer, 1990). They found that a one-week increase in the potential duration of benefits increased the average duration of unemployment for AI recipients by 0.16 to 0.20 weeks (Katz & Meyer, 1990).

It is also necessary to monitor what external factors cause unemployment (e.g. trade, technology, recession, supply shocks, changing consumer preferences, economic cycles, etc.) (Guo & Johnston, 2021).

2. Methodology

2.1. Basic Idea

It is impossible without the law to calculate the amount of unemployment benefit or to verify whether a person has the right to be included in the register of job seekers. This application therefore provides expert decisions based on the potential candidate's answers to the questions asked. With each question, the user's answer is kept, as well as the paragraph to which it belongs. As a result, it is not only a decision, but also a list of labor laws for easier orientation or as supporting data for further user action. This application therefore serves every unemployed person who is not sure of the regulations and wants to verify whether in his case there is a possibility of entitlement to support or at least meets the conditions for inclusion in the register of job seekers and with it the payment of health insurance. On the other hand, it also serves for people who work very well in this sector or are familiar with employment laws and all implementing regulations. We will continue to talk about such people as experts. The expert can edit questions and constants for calculation in the knowledge base. Since such numbers change every year and the application would no longer have to be up to date, an editing mode is implemented here.

The proposed knowledge system is designed for a specific example with the possibility of easy extension and built on the calculation of support. If the legislation that changes the way the aid is calculated changes, adjustments must be made to the application. Other changes in legislation do not affect the application, only its knowledge base.

The choice of ways to specifically implement the knowledge system was based on the fact that it will be designed to address the issue of inclusion in the register of job seekers and the granting or non-granting of unemployment benefits. The program's ability to be easily scalable includes the ability to be used for a completely different knowledge system. The program was based on a valid calculation from editable variables, where the last legislative change for the calculation of support is valid from 1 January 2011. The Java object-oriented programming language was chosen for implementation.

Knowledge retrieval was implemented as a binary search over the list. The time average complexity of this algorithm is in this case equal to O ($\log n$).

The user interface is created using JavaFX FXML, an XML-derived markup language. It is a platform based on the Java platform, which creates a graphical interface. The open-source application JavaFX Scene Builder 8.5.0 was used to create the design of the knowledge system. This application allows you to create a graphical interface using the operation "Drag and drop" or dragging components to the displayed window, without the need to write in the above-mentioned markup language.

The system is divided into two interfaces. For the part adapted for the expert and the part for the average user. The transition between these two separate modes is done through the menu in the menu. The menu also contains items such as load another knowledge base or help, which contains an item for a short description of the application and the display of the manual. Expert mode focuses on knowledge-based operations such as editing, deleting, or adding knowledge or variables. The expert sees a statement of the entire knowledge base and for detail he always chooses one knowledge or variable with which he can perform other tasks. The average user has a simpler environment, he only runs evaluation.

3. Data and Results

3.1. Actual Situation on Labour Market in the Czech Republic

The registered unemployment rate was 3.86% in 2021 and increased by 0.35% compared to 2020. The registered unemployment rate is lower than the natural unemployment rate. This situation on the labor market causes an excess of labor demand over labor supply. The increasing nominal wage is based on this. Average gross nominal wages rose to 6.1% in 2021 (Czech Statistical Office, 2022). In 2020, growth was only 3.1% (see Figure 1). However, this decline was caused by the Covid-19 pandemic. However, due to government measures, there has been no significant increase in the registered unemployment rate (Hedvicakova, 2018; Hedvičáková & Svobodová, 2017; Král, 2017).

In December 2021, expenditures related to unemployment benefits reached CZK 725.0 million (see Figure 2). A total of CZK 9,969.5 million was paid in unemployment benefits (approximately 98.9% of the state budget -– 10,080.7 million CZK) in 2021.

The share of unemployed persons in December 2021 increased by 0.2 pp compared to November 2021 to 3.5%, compared to December last year it decreased by 0.5 pp (December 2020 – 4.0%).
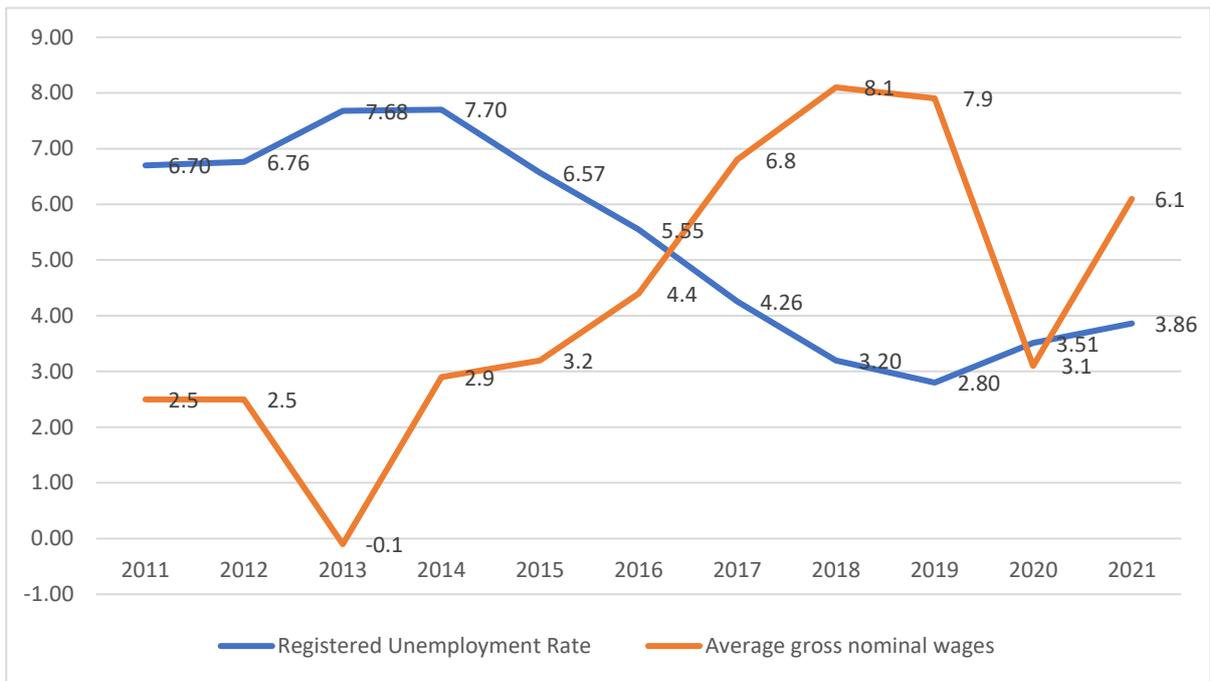
Figure 1. Registered unemployment rate and average gross nominal wages in % (Czech Statistical Office, 2020)

Number of jobseekers who were entitled to unemployment benefits at the end of December 2021 (an indicator that significantly affects the amount of unemployment), reached about 82.3 thousand, i.e. 31.9% of the total number of 258.2 thousand persons kept as of 31 December 2021 in the records of the Labor Office of the Czech Republic. (MPSV, 2022)
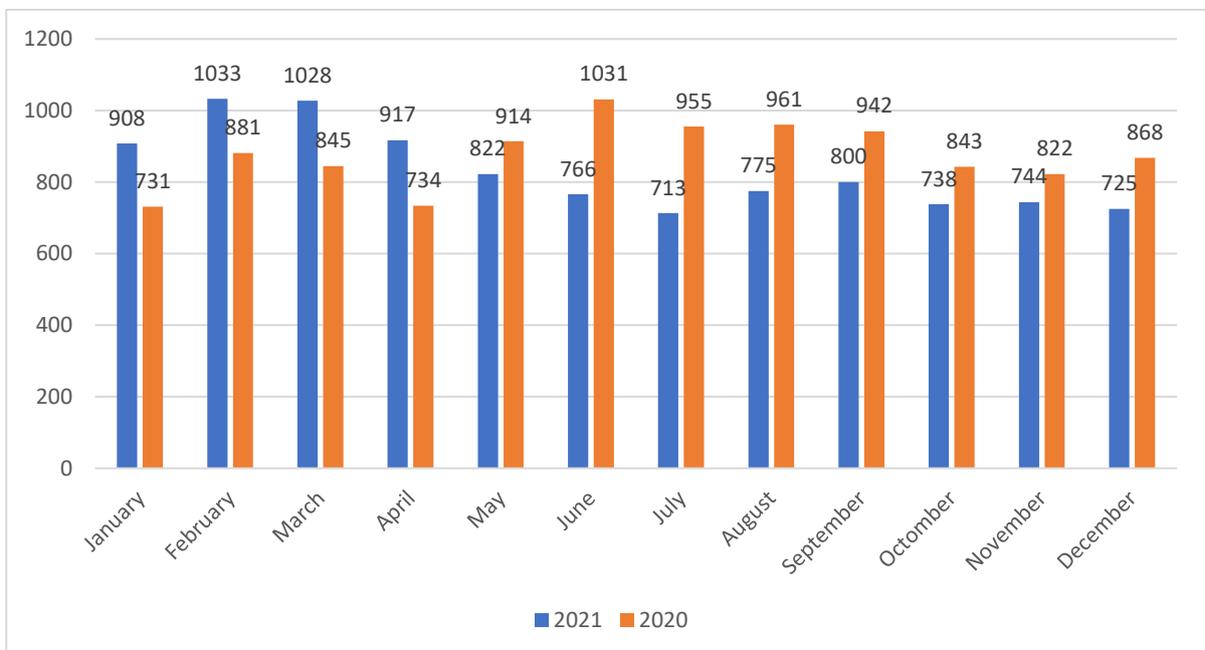
Figure 2. Development of expenditure on unemployment benefits in millions of CZK (MPSV, 2022)

A user who is entitled to be registered must meet certain conditions. He is not a self-employed person and is not in an employment relationship or employment relationship. This condition does not apply to such an employment relationship, employment relationship or employment agreement, where this activity is not rewarded with a monthly salary higher than half of the minimum wage (we speak of so-called non-conflicting employment). Assuming that the earnings are lower, he is entitled to be included, but he is no longer entitled to unemployment benefits compared to the others (this also applies to zero earnings). For the year 2021, this amount is set at CZK 7,600. Furthermore, he may not perform the activities of a compulsory administrator, procurator or liquidator. He is not a member of the council of a territorial self-governing unit that receives remuneration as a dismissed member, a foster parent who is paid a foster parent's remuneration, a judge, a deputy or a senator. If the user is a full-time student, he / she must meet the condition that he / she has been employed or has had another gainful activity with participation in the pension insurance for at least 12 months in the last two years. A natural person who is recognized as temporarily unable to work, receives maternity allowance, is 6 weeks postpartum, is fully disabled in the third degree, is unable to work under completely extraordinary conditions, or is serving a custodial sentence cannot be included in the records, security detention or is in custody.

In order to fulfill the claim, the user must have, during the relevant period, which is set at two years, be employed or have another gainful activity with participation in the period of pension insurance. The spare time is also included in this time. The replacement period is the period during which the user cared for a child under the age of 4, cared for a natural person dependent on the help of others of at least grade II (moderate dependence) or received a full invalidity pension for third degree invalidity. At the same time, the user must not have ended up in his last job due to a breach of an obligation under the labor law applicable to his work or a breach of another duty in a particularly gross manner. (Labor law, 2019)

If the user has received support in the past and meets the requirements see above, then he is entitled to support under the following conditions. He was employed or had another gainful activity with a pension for at least 6 months after the support period. If the entire support period has not expired and he has been active in the pension insurance for at least 3 months after the end of his activity, he is again entitled to the entire support period, otherwise he is entitled to the remaining part of the support period which he did not use in the previous records or previous records. (Labor law, 2019)

The maximum amount of support is derived from the average wage in the national economy for the first to third quarters of the previous calendar year (hereinafter referred to as the "average wage"). For the year 2021, this amount corresponds to CZK 34,611. The maximum amount of support is 0.58 times. The support period, the so-called support period, is determined by the age of the user. It is set at 5 months until the age of 50, it is 8 months for the age between 50 and 55 and 11 months above the age of 55. In the first two months of this period, 65% are taken, the next two months 50% and the rest of the support period 45% of the average monthly net earnings of the last job. There is an exception when the user has

terminated the employment himself or in agreement with the employer, then it is 45% for the entire support period. If he is entitled to a retirement allowance, he is entitled to the difference between that allowance and the aid that would accrue to him. If this difference is inconsistent, he is not entitled to support. If the condition of previous employment is met by counting the replacement period and this period was the last activity performed, the support is 0.15 times in the first two months, 0.12 times for the next two months and 0.11 times the average wage for the remaining support period. The beginning of the payment of support is shifted by the number of times the average monthly earnings of the user from the paid severance pay.

3.3. Model Examples and Results

In this chapter we will show the results of the application on model examples. For the first example, we have a man aged 24 who is a full-time college student. The application for the given example evaluated that the student is not entitled to inclusion in the register of job seekers according to § 25 paragraph 1, letter r) of Act No. 435/2004 Coll., on employment.

In the second case, we have a woman aged 26, a full-time university student with a terminated employment agreement, participating in a pension insurance period of 13 months in the last two years, where she had an average monthly net income of CZK 4,500. She ended this activity by agreement. In this case, this student is entitled according to § 25 paragraph 4 of Act No. 435/2004 Coll., on employment.

For the third example, we have a man who is 56 years old. He worked for the company for 15 years and ended up for organizational reasons (his position was canceled). His average monthly net earnings were CZK 65,450. After leaving the job, he received a three-month severance pay, depending on the length of his employment. This man will receive the maximum possible support for a period of 11 months, which is postponed by 3 months due to the right to severance pay (see Figure 3).
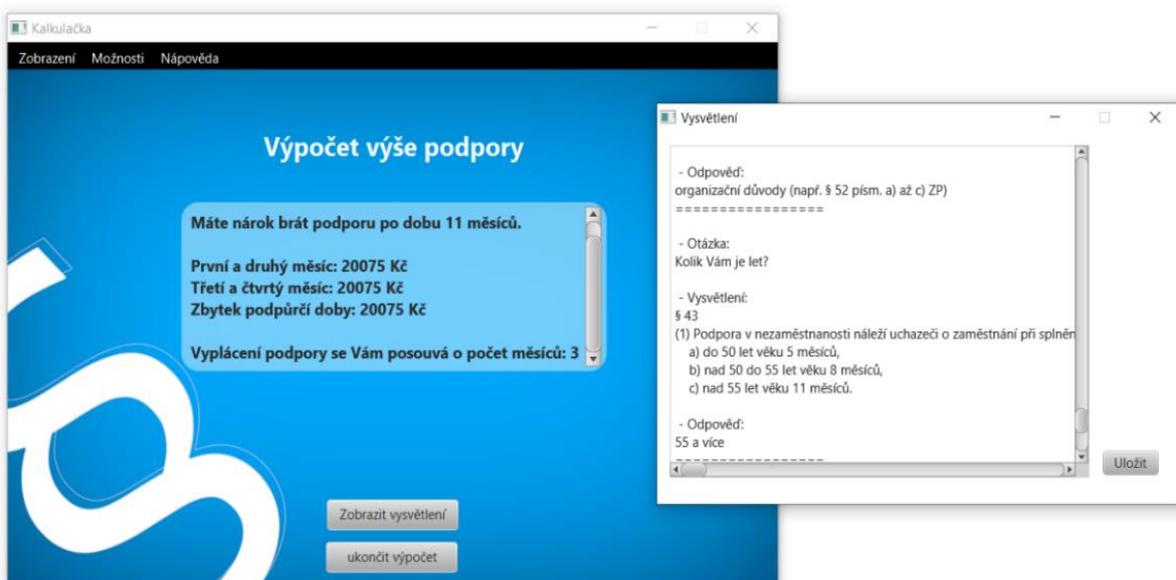
Figure 3. Calculation for 3 example (Letáček, 2021)

4. Discussion

Given the current situation, where there is high inflation in the market and there is a constant increase in the average and minimum wage, it is necessary to have a tool that quickly calculates the current amount of unemployment benefits or whether it is entitled to it at all and for how long. There are already several calculation tools on the market, but not all of them are user-friendly.

The economic literature states that increasing the labor supply does not automatically lead to an increase in employment. The level of employment is also affected by effective demand in the goods market. From this it can be deduced that unemployment is a demand-driven problem and not a function of high real wages or high unemployment benefits (Mikael Randrup & Raza, 2018). Okun's law and its effects on unemployment growth and GDP growth can also be applied. Another study (Marinescu et al., 2021) states that during the COVID-19 crisis, a 10% increase in unemployment benefits due to the Federal Unemployment Pandemic Assistance (FPUC) led to a 3.6% decline in Glassdoor job applications.

Another study (Doris et al., 2020) found that the reduction in unemployment benefits also affects very young people (18- and 19-year-olds), for whom the unemployment period has decreased significantly (especially for 18-year-olds). The knowledge system we have proposed could be beneficial for this age group as well.

The study (Rotar & Krsnik, 2020) analyzed the relationship between unemployment benefits and the length of unemployment with regard to different approaches to social policy between EU countries. The authors conclude that unemployment benefits have counter-effects and prolong unemployment. National governments should take effective action to ensure optimal unemployment benefits. Emphasis should be placed on an active unemployment policy rather than a passive one.

Last but not least, it is necessary to monitor what percentage unemployment benefits contribute to state budget expenditures and how they develop over time and with regard to the phases of the economic cycle.

5. Conclusions

Aim of the article was construction of a knowledge system that we created in the NetBeans environment, where it was programmed using the Java programming language. Once created, we began to fill this empty system with knowledge in collaboration with an expert on labor law. This raised 33 questions concerning the inclusion in the register of jobseekers and the calculation of unemployment benefits. All solved possibilities in the knowledge base are described in the third chapter, where they were subsequently tested with specific examples.

Unemployment benefits are a comprehensive and topical issue for most governments. Governments are trying to find an appropriate level of unemployment benefits that would serve as sufficient social support while stimulating active job search. An active employment policy is a better way than a passive unemployment policy. The proposed application would help job seekers to orientate themselves in this complex issue.

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Reflection of the COVID-19 Pandemic in the Comparability Analysis – a Critical Evaluation of Potential Approaches

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Abstract: The key issues for transfer pricing is performing the comparability analysis with aim to find external comparable companies i.e. companies performing same or similar business activities in the same or similar economic and market conditions. However, during the COVID-19 pandemic, which have been affecting business in a totally new way, there are obstacles and uncertainty how to perform comparability analysis and related comparability adjustments reflecting current economic and market conditions. As the COVID-19 pandemic and crisis has had a significant impact on these conditions and unprecedently changed the economic environment. Moreover, due to the time-lag in commercial databases presenting financial data of potential comparable companies operating in the Europe, taxpayers face a new problem: how to defend their arm´s length position for fiscal years 2020 and 2021 while reflecting current economic and market conditions. The aim of the paper is to evaluate approaches how to reflect the COVID-19 pandemic in the comparability analysis and related comparability adjustments. Based on the results, we are rather sceptical about the practical application of recommended approaches: the taxpayers face a great challenge in how to make adequate comparability adjustments and at the same time be able to properly defend them to the tax administrator.

Keywords: comparability analysis; COVID-19; critical evaluation; transfer pricing

JEL Classification: F23; H21; K33

1. Introduction

There are already many published studies investigating the impact of the COVID-19 pandemic on economies in selected countries from the macroeconomics perspective. For instance Pinilla et al. (2021) describe the situation in Spain or Barbate et al. (2021) in India. McKibbin and Vines (2020) state that "*the COVID-19 crisis has caused the greatest collapse in global economic activity since 1720*". Scientific literature, however, provides a relatively small number of procedures, possible approaches on determining the arm´s length ranges and comparability adjustments for the times of economic downturns. Radolović (2010) partially analysed the Croatian situation in transfer pricing during the last financial crisis (2008-2010) and highlighted the unavailability of financial data that would reliably show profitability in

2009. The main problem area is that the data from previous successful economic years most likely affects the upward trend in used indicators during the recession.

In that perspective, Mori et al. (2009) defined two key issues transfer pricing practitioners are facing: 1) how to secure comparable data for determining and testing transfer prices reflecting the current economic reality (i.e. economic downturns and recessions), and 2) how the tested subject is required to proceed if the controlled party´s financial results drop under the current or forecasted arm´s length range. A possible solution is presented by Nerudová et al. (2017), a proposed panel regression model to estimate the usual profitability (margins) in selected industries for the purpose of determining transfer prices, which could also be used in case of an economic downturn. However, this approach is suitable (was established) just for small and medium-sized enterprises. Solilová and Nerudová (2013) further recommend including a longer period into the comparability analysis when determining the arm´s length ranges during an economic downturn. This approach ensures that the effect of the economic downturn is spread over a longer period. However, this approach may not be sufficient in the event of a global economic collapse due to the COVID-19 pandemic.

Therefore, the paper focuses on possible approaches as presented by researchers and practitioners in the conditions of the Czech and Slovak Republics. The aim of the paper is to research approaches that can be adopted to address issues of comparability analysis and related adjustments during an economic downturn (i.e. reflecting COVID-19 pandemic conditions) and critically evaluate them based on established criteria, namely its practical applicability and explanatory power for the purpose of comparability adjustments.

The OECD TP Guidelines (2017) in Chapter III (comparability analysis), par. 3.69 state that taxpayers should provide a proof in some cases "… *establish transfer pricing documentation to demonstrate that they have made reasonable efforts to comply with the arm's length principle at the time their intra-group transactions were undertaken, i.e. on an ex ante basis (hereinafter "the arm's length price-setting" approach), based on information that was reasonably available to them at that point*". Such an approach contains not only the financial data of comparable transactions from the previous years, but also information about economic and market changes that may have happened between those past years and the year of tested controlled transaction. Furthermore, the OECD TP Guidelines (2017), par. 3.75 – 3.79 (B5 Multiple year data) provide basic guidance on performing comparability analysis over multiple years. Regarding an economic downturn, an important note is under par. 1.129 of the OECD TP Guidelines (2017) (Chapter I – The arm´s length principle, D.3. Losses) that states "… *associated enterprises, like independent enterprises, can sustain genuine losses, whether due to heavy start-up costs, unfavourable economic conditions, inefficiencies, or other legitimate business reasons*". On the other hand, an independent company should not tolerate "*losses that continue indefinitely*". In that perspective, Gelin et al. (2020) recommend acting very carefully when allocating the losses of routine entities even in the time of the COVID-19 recession. Bunn (2020) considers the allocation of losses among subsidiaries as one of the most serious issues during an economic recession.

Currently, many consulting companies and practitioners offer several potential strategies on how to perform comparability analysis and look for comparable entities/transactions during the COVID-19 period (or during an economic downturn in

general). Vincenti and Valente (2020) state that companies can adopt the following four strategies (for more details see Table 1 below).

Table 1. Potential strategies for comparability analysis in the COVID-19 period (based on Vincenti and Valente, 2020)

Strategy	Principles
Including loss-making companies	The elimination of loss-making companies is not appropriate under these circumstances, there is a need to reflect real and actual market conditions.
Choosing an appropriate time period	• The application of a time period of three years before the tax year under review may not be appropriate during the periods of downturn. • Reference to time period 2017-2019 should not be correct; the pandemic COVID-19 is more specific. • In case of using previous recessionary periods, specific adjustments to the search strategy shall be adopted.
Focusing on referenced market	The extend of the economic recession may have a different scope (global, as well as being limited to some areas/countries). There is thus a need to choose the country/countries in which the comparable operate.
Adjusting comparable financial data of comparables	Adjustments made in connection with reflection of the actual economic circumstances.

Cody et al. (2020) provide four attitudes for adjusting comparable data, namely:

• Using information from the last recessionary period (2007-2009);
• Using available public company data on quarter basis of the affected year(s);
• Using microeconomic data or tested party (vertical or horizontal) and
• Using macroeconomic data.

The four-step process in ensuring comparability and reflecting economic and market conditions when continuing to use comparable data (from the previous one or two fiscal years depending on availability in public databases) was presented and used already during the last financial crisis. According to Mori et al. (2009), the use of multiple-year data (including the periods in an economic downturn) may not always necessarily reflect the actual economic and market conditions highlighting the exceptionality of each economic crisis and the adjustment of comparability data represents a challenge. When assessing and adjusting the historical available data, Mori et al. (2009) further describe the following four steps:

• Step 1: rechecking comparable data sets (potential additional screening criteria can be applied to eliminate companies affected differently compared to tested party);
• Step 2: updating comparable data (using interim quarterly data or forecasting their values);
• Step 3: selecting an eligible period for comparables (the sample size of comparable data sets may be decreased e.g. due to bankruptcy as an impact of the economic downturn). The using and relying on single year data is not recommended; and
• Step 4: adjusting comparables' financial data (e.g. adjusting for interquartile differentials, using regression analysis, adjustments for volume effects, variances in costs structure, inventory, etc.).

Orlandi et al. (2020) analyse the methodologies that could be applied in COVID-19 comparability adjustments to comparable entities identified in benchmark analyses. The authors investigate the use of linear regression analyses based on three approaches: (1) costs (divided by variable and fixed) arising from a change in turnover; (2) variable costs arising from a change in turnover with the additional reference of a particular analysis for fixed costs from the perspective of the different operations of specific industries; and (3) turnover and costs (again considering fixed and variable costs) arising from a change in GDP or available selected specific industry statistics. Furthermore, Subramanian et al. (2020) based on their practical experience recognize three main categories of transfer pricing adjustments: (1) adjustments of the tested party financials, (2) adjustments to benchmarking period and (3) adjustments to financial/profitability indicators of comparable companies. The third category consists of adjustments to (a) the range used for benchmarking, (b) comparable company results based on company metrics, (c) comparable company results based on macroeconomic indicators. They further highlight that transfer pricing adjustments may be based on differences between economic conditions of the tested subject and the comparable subjects as indicated by macroeconomics indicators. Such differences may arise because of different historical economic conditions or from the fact that comparable subjects and tested subjects operate in different industries or countries experiencing the economic shutdown of pandemics COVID-19 differently.

Like many other authors (e.g. Nerudová et al., 2017; Mori et al., 2009; Orlandi et al., 2020), Cody et al. (2020) suggest using a mathematical approach and statistical analysis when doing the comparability adjustments. Bunn (2020) based on the complexity of the issue called for the publishing of the OECD guidelines in detail. On 18 December 2020, the OECD published the Guidance on the transfer pricing implications of the COVID-19 pandemic. The guidelines focus on four priority areas when determining transfer prices during the COVID-19 pandemic (comparability analysis, losses and allocation of COVID-19 specific costs, government assistance programs and advance pricing agreements) (OECD, 2020).

2. Methodology

The aim of this article is to research and critically evaluate frequently recommended approaches for comparability analysis and related comparability adjustments reflecting the impact of the COVID-19 pandemic in the conditions of the Czech and Slovak Republic. The methods/attitudes as follows were under investigation:

- Regression analysis,
- Extending search analysis by loss-making companies,
- Extending the time period,
- Extending the arm´s length range,
- Utilization of the data (information) from the last recessionary period (2007-2009), and
- Adjustments to financial/profitability indicators of comparable companies based on tested party metrics.

As many authors (e.g. Mori et al., 2009; Cody et al., 2020; Orlandi et al., 2020; Subramanian et al., 2020) recommend using the regression analysis for the purpose of comparability adjustments, we firstly focused on it and its practical applicability. The key problem facing taxpayers is the unavailability of comparable data. Comparable data is not available in real time as there is a time lag between the closing date of financial statements of comparable companies and their availability in databases. Usually, there is at least a two-year time gap. However, the economic (both professional and scientific) literature provides evidence that there is a correlation between macroeconomic variables and a company's profitability (e.g. McDonald, 1999; Issah & Antwi, 2017; Naruševičius, 2018).

In the study the authors focused only on publicly available data of macro- and micro-economic variables, which could be used for the purpose of comparability analysis and related adjustments. In the Czech and Slovak conditions, different public databases or data and overviews of statistical offices could be used for this purpose. For the purpose of this study, the public database/register CRIBIS was utilized. This database provides detailed information on industry analysis containing many types of indicators about interquartile ranges divided by total assets or turnover. Moreover, this database provides information available sooner than in the case of international databases such as ORBIS, thus it is more suitable for up-to-date analyses. Furthermore, CRIBIS allows the division of observations into three size categories, according to assets. For the analysis, the largest category with the sum of assets above 5 mil. EUR was chosen as we can expect that small companies usually do not have to deal with transfer prices issues.

The study was focused on data spanning 2009 to 2019. The object of the research includes subjects in manufacturing (more than 20 codes between 10-33 NACE codes). The inputs taken into considerations include 18 financial indicators. The data includes both activities that generate significant losses and profits during the COVID-19 pandemic. Regarding the estimation of the impact of economic development on profitability of comparables, it was not possible to use the macroeconomic variables based on GDP and its derivates (GVA etc.) as they were not available in necessary extend. For this reason, the indices of industrial production (IP) that are available sooner after the end of the period in question (i.e. monthly) were utilized. The used IP indices examine the overall industrial production, turnover in industrial production, average wages in the industrial production, employment in the industrial production, hours worked in the industrial production, and producer prices. As a data source we used also the Slovak Statistical Office which provides more detailed data than Eurostat.

As a result, the panel data contains several hundred observations which examined the statistically significant relation of IP indices and other industrial variables received from CRIBIS to the dependent variable in the form of operational profitability. To analyse the data, the authors used the traditional OLS regression to avoid issues with interpretation and enhance possible use by professionals. In the regression, dependent variable is EBIT to turnover ratio, which is explained by several independent variables. The assessment is based on the following equation:

$$\frac{EBIT_t}{turnover_t} = \alpha + \beta_1 \frac{EBIT_{t-1}}{turnover_{t-1}} + \beta_2 IP_t + \beta_a control_{a,t} + \beta_b NACE_{b,t} + \varepsilon \qquad (1)$$

, where $\frac{EBIT_t}{turnover_t}$ is a ratio of EBIT to turnover in time t, α is a constant of the equation, β_n are parameters of the variables, $\frac{EBIT_{t-1}}{turnover_{t-1}}$ is a ratio of EBIT to turnover in the previous year, IP_t is a industrial production variable in time t, $control_{a,t}$ is a set of control variables (financial indicators) describing other ratios of the industry, $NACE_{b,t}$ is a set of dummy variables as a fixed effect for every examined industry and ε is the error term.

The final model contains 220 observations, and from the set of 18 independent measures (financial indicators) available in the database only two of them describing industry performance were identified as statistically significant in relation to the dependent variable. Measures as inventory turnover, payables turnover ratio, financial leverage or other degrees of liquidity were tested, but remained insignificant in most model specifications. The descriptive statistics of the variables used in final model are listed in Table 2.

Table 2. Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
$\dfrac{EBIT_t}{turnover_t}$	253	2.667	6.151	-39.920	46.890
Indices of turnover in industrial production	220	95.032	23.309	38.375	158.467
Immediate liquidity	253	0.096	0.177	0	1.110
Debt-to-asset ratio	253	21.588	27.517	0	93.900

After evaluating regression analysis from the view of its practical applicability, authors focused on other recommended approaches, such as extending search analysis by loss-making companies, extending the time period for the purpose of arm's length range, using information from the last recessionary period (2007-2009) and others.

3. Results

Within the analysis made, the very first attention was paid to regression analysis as an often recommended approach. In all cases, however, it was crucial to deal with the time lag of necessary data that taxpayers face in transfer pricing analysis and related comparable adjustments.

3.1. Regression Analysis

For the regression analysis a set of variables describing industrial performance was used. As a data source the information obtained from the CRIBIS database with the addition of one available macro-economic variable (indices of industrial production). The results reached suggest that only indices of turnover in industrial production from the set of indices describing industrial performance (i.e. the overall industrial production, turnover in industrial production, average wages in the industrial production, employment in industrial production, hours worked in industrial production, and producer prices) are the most

significant and robust. Furthermore, only two control variables describing other ratios of the industry from the analysed set of control variables available in CRIBIS were identified as the most significant in explaining profitability, namely Debt-to-asset ratio and Immediate liquidity. Lagged variable of profitability was also identified as highly significant, which is expected as every industry has some path dependence and differs in profitability from the others. Based on the results mentioned in Table 3, one can assume the relationship between indices of turnover in industrial production and profitability is negative. More precisely, rise of turnover in an industrial sector by 1 would result in a decrease of profitability by 0.016. Additionally, industry fixed effects are also negative and statistically significant for most of the manufacturing industry, although for many other manufacturing industry sectors they were not identified as statistically significant (they are not presented inTable 3).

Table 3. Regression results

Independent variables	Coef.	p-value	95% Confidence Interval
$\dfrac{EBIT_{t-1}}{turnover_{t-1}}$	0.159	0.001***	0.0671; 0.252
Indices of turnover in industrial production	-0.016	0.032*	-0.031; -0.001
Immediate liquidity	7.511	0.000***	4.551; 10.470
Debt-to-asset ratio	-0.084	0.000***	-0.105; -0.064
Constant	0.215	0.841	4.341; 10.219
131 - Preparation and spinning of textile fibres 133 - Finishing of textiles	1.469	0.193	-.0745; 3.683
132 - Weaving of textiles	4.077	0.001***	1.586; 6.568
139 - Manufacture of other textiles	9.823	0.000***	7.358; 12.288
151 - Tanning and dressing of leather; manufacture of luggage, handbags, saddlery and harness; dressing and dyeing of fur	3.524	0.002***	1.303; 5.745
152 - Manufacture of footwear	8.412	0.000***	6.001; 10.822
231 - Manufacture of glass and glass products	8.890	0.000***	6.439; 11.341
232 - Manufacture of refractory products	6.958	0.000***	4.607; 9.309
235 - Manufacture of cement, lime and plaster	7.065	0.000***	4.002; 10.128
236 - Manufacture of articles of concrete, cement and plaster	8.124	0.000***	5.672; 10.576
234 - Manufacture of other porcelain and ceramic products 237 - Cutting, shaping, and finishing of stone	1.322	0.239	-0.880; 3.524
239- Manufacture of abrasive products and non-metallic mineral products n.e.c.	8.537	0.000***	6.018; 11.055
321 - Manufacture of jewellery, bijouterie and related articles 322 - Manufacture of musical instruments 323 - Manufacture of sports goods 324 - Manufacture of games and toys 329 - Manufacturing n.e.c.	1.301	0.247	-0.900; 3.501
325 - Manufacture of medical and dental instruments and supplies	8.824	0.000***	6.315; 11.333

Note: some NACE groups were grouped together in available data.

*** p<0.001, * p<0.05

Although regression analysis is often recommended, authors arrived at a rather sceptical conclusion based on the investigation carried out. Due to the time lag in the availability of necessary comparable data, it is important to focus the regression analysis on other data available at that time. This data is also very limited, especially from the point of view of

services, e.g. no similar indicator is available for services, as is the case for industrial production. However, even from the point of view of the manufacturing industry, the data and the results do not appear to be satisfactory. For example, industrial production indices are not monitored in such a detailed way as individual NACE codes as would be needed for the purposes of transfer pricing analysis – it creates a significant obstacle to create a basis for reliable comparable analysis. Furthermore, for a number of examined sub-industrial sectors, the examined independent variables were not statistically significant, which also limits the use of the results from the regression analysis. However, the biggest drawback is the specific results from the regression factors related to the profitability estimate. The expected result is a reduction (or an increase) in the given profitability of comparable entities, if taxpayer's profitability (a tested party) decreased (or increased) in a giving industry sector and consequently a reduction (or an increase) in the arm's length range, so that the taxpayer will be able to prove that its transfer prices are fulfilling the arm's length principle and a drop (or an increase) in its profitability is related to the economic circumstances. However, the result of the regression provides the opposite effect, i.e. an increase in profitability of comparables in cases where the taxpayer's profitability decreased. Therefore, we consider the use of regression analysis, from the point of view of its practical applicability and informative value, an unsatisfactory approach. This method does not seem to increase taxpayer's certainty for the area of transfer pricing.

3.2. Other Approaches

If the approaches that require access to macroeconomic data or microeconomic data by comparable entities are not taken into account, there are still a few approaches left that the taxpayer can apply, such as extending search analysis by loss-making companies, extending the time period for the purpose of arm's length range, extending the arm's length range, using information from the last recessionary period (2007-2009), and adjustments to financial/profitability indicators of comparable companies based on tested party metrics.

The addition of loss-making companies to the search and transfer pricing analysis may not have the desired effect. In addition, it must be taken into account that loss-making companies from previous years may not be available in the industry for a given comparable transaction / entity and, if they do, may have the missing financial data needed for transfer pricing analysis. Companies running at a loss will be available in databases such as ORBIS again with a time lag when they will reflect the impact of COVID-19 in the economic environment of the industry. This approach will be used mainly in common transfer pricing analyses, search strategies, when data will already be available in databases, and not just in situations where comparability adjustments for 2020 are being addressed, when the pandemic began.

A similar situation can be seen in the case of **extending the period** considered for the purpose of establishing the arm's length range. A 3-year period is commonly used, which can be extended to 5 years or longer, which would include the period of the previous recession. The effect of this approach is that the fluctuations in the examined profitability are diluted or, if necessary, given greater weight just for the period of recession. However, the COVID-19

pandemic which has caused the greatest economic collapse and the previous economic crises have a different nature. Therefore, if data from the last recessionary period is used, then this approach must carefully consider industry and other factors and conditions affecting the setting of the arm's length range. This is especially needed if we only consider the last recessionary period as a period for establishing the arm's length range.

Another option is to automatically **extend the acceptable arm's length range** from the current transfer pricing documentation, specifically from the original interquartile between first and third quartile to the range between the zero and fourth quartile, i.e. the whole range of profitability of all accepted comparables. This approach is the simplest but is only applicable under certain conditions. Namely, it is applicable only in those sectors where there have been only limited restrictions and a partial reduction in business activities with a slight impact on their profitability. It is not suitable for loss-making entities. Furthermore, the set of comparables must be highly comparable.

The last approach is to realize **the adjustments to financial/profitability indicators of comparable companies based on tested party metrics**. This approach requires the basic assumption that comparable entities will be impacted by a pandemic in the same way as the tested party. Therefore, the sales decrease of the tested party should be simulated on the operating costs for each comparable company. However, it is important to distinguish between the variable and fixed costs, which may not be available for comparable entities, and which have different effects on the decline in sales. This is one of the most significant obstacles for the adoption of this attitude. Additionally, extraordinary costs related to the COVID-19 pandemic should not be considered during the analysis. This approach requires considerable statistical and mathematical skills, detailed data and is characterized by several assumptions and proxies. In addition, if the taxpayer is unable to properly explain and defend the individual corresponding adjustments and procedures, the result will not be accepted by the tax administrator.

The basic findings are summarized in Table 4 below.

The most significant problem is, not surprisingly, absence of the data input. The taxpayers and tax authorities are facing the same in this respect. However, even under current new circumstances, the taxpayer cannot omit his by law set obligation to set the transfer price in a qualified, logically consistent and adequate manner. This is one of the conclusions (generally valid) arising from the case-law of the Supreme Administrative Court of the Czech Republic (see e.g. the judgements of the Supreme Administrative Court of the Czech Republic, 2009; 2011; 2020). This "imperative" is of course also applicable for the current and completely new situation influenced (or more precisely totally determined) by the pandemic COVID-19. At the same time, it is true that both taxpayers and tax administrators find themselves in a new situation. However, there is one issue working at taxpayers´ favour. Tax authorities are burdened with a number of obligations connected with transfer pricing tax audit – the obligation to state the correct amount of the transfer price in their opinion and to indicate how they arrived at it (see e.g. Supreme Administrative Court of the Czech Republic, 2020).

Table 4. Summary of the result reached

Method/approach/attitude	Summary
Regression analysis	• problems with input data availability • very high demands regarding the knowledge and application of sophisticated statistical methods • reached results could be in conflict with the assessment corresponding with sense of common and to particular situation of the tax-payer
Extending search analysis by loss-making companies	• problems with input data availability • delay in data availability
Extending the time period **and** **Utilization of the data from the last recessionary period**	• extending the 3-year period to 5-year period or longer up to the previous recession is recommended, but • previous crisis periods are totally different in their nature compared to COVID-19 • a need to consider specifics of the country, industry, etc. • problems with input data availability
Extending the arm´s length range	• problems with input data availability • not generally applicable (could be utilized more or less only in sectors with limited restrictions)
Adjustments to financial/profitability indicators based on tested party metrics	• problems with input data availability • a key presumption that comparable entities have been impacted in the same way as the tested party shall be met • there is a need to distinguish between variable and fixed costs (available data do not provide this type of information)

The most significant problem is, not surprisingly, absence of the data input. The tax-payers and tax authorities are facing the same in this respect. However, even under current new circumstances, the taxpayer cannot omit his by law set obligation to set the transfer price in a qualified, logically consistent and adequate manner. This is one of the conclusions (generally valid) arising from the case-law of the Supreme Administrative Court of the Czech Republic (see e.g. the judgements of the Supreme Administrative Court of the Czech Republic, 2009, 2011, 2020). This "imperative" is of course also applicable for the current and completely new situation influenced (or more precisely totally determined) by the pandemic COVID-19. At the same time, it is true that both taxpayers and tax administrators find themselves in a new situation. However, there is one issue working at taxpayers´ favour. Tax authorities are burdened with a number of obligations connected with transfer pricing tax audit - the obligation to state the correct amount of the transfer price in their opinion and to indicate how they arrived at it (see e.g. Supreme Administrative Court of the Czech Republic, 2020).

4. Discussion and Conclusions

In the article, authors investigated and evaluated six often recommended approaches used for the purposes of comparability analysis and related comparability adjustments reflecting the impact of the COVID-19 pandemic. The key problem taxpayers face is how to perform comparability analysis and look for comparable entities/transactions during the COVID-19 period if the comparable data and necessary macro- or/and micro-economic data are not available at the time of comparable adjustments or are not available in demanded quality. Based the research carried out, one can observe that indices in industrial production

can be used if the macroeconomic variables based on GDP and its derivates (GVA etc.) are not available, as it is also significant and robust in relationship with the operational profitability. However, authors are, at the same time, rather sceptical about using regression analysis as such to estimate changes in operational profitability of the comparables based on changes in financial indicators describing industry segments and indices in industrial production. Not only their practical application is limited to a certain industry segment, because a number of sub-segments of the given variables were not statistically significant, they cannot be applied for services because of the lack of relevant for this area. We assume that better results would be achieved with an ex-post approach, when the necessary data is available. However, the ex-post approach does not solve the issues of comparability adjustments being addressed during or/and at the end of 2020.

Regarding other approaches, the simplest approach can be considered to be automatically extending the acceptable arm's length range from the current transfer pricing documentation, although this approach is applicable under certain conditions. Extending search analysis by loss-making companies is more suitable for common transfer pricing analysis after the availability of 2020 data reflecting the impact of the COVID-19 pandemic. Extending the time period for the purpose of the arm's length range to cover the last recessionary period requires careful consideration of industry and other factors and conditions affecting the setting of the arm's length range as the COVID-19 pandemic and the previous economic crises have a different nature. The last examined approach "adjustments to financial indicators of comparables based on tested party metrics" requires the basic assumption that comparable entities will be impacted the same by a pandemic as the tested party. However, this assumption may not be fulfilled in practice and after all the necessary comparability adjustments the achieved result may not be accepted by the tax administrator.

Based on our findings, one can observe that taxpayers face a great challenge in how to make adequate comparability adjustments and at the same time be able to properly defend them to the tax administrator, if there is a lack of comparable data and necessary macro-or/and micro-data. Even though there is experience from the previous recession, so from the point of view of completely different nature of economic downturns due to the COVID-19 pandemic, it is not possible to use the experience without any other consideration and analysis.

Conflict of interest: none

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Research on the Impact of FDI on China's Urban-Rural Economic Integration

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Abstract: Under the background of economic globalization, FDI is becoming more and more important. It is important to explore the influence of FDI on China's urban-rural economic integration. Using the full sample province data of China from 2008 to 2019, the regression results indicate that the impact of FDI on Chinese urban-rural economic integration is significantly negative, that is, FDI significantly hinders the process of urban-rural economic integration. After grouping 30 provinces in China into northeast, East, central and West, it is found that the effect of FDI on Chinese urban-rural economic integration index in all regions is negative, but only the coefficient of FDI in western provinces on urban-rural economic integration is significant. Only by bringing FDI more to rural areas and providing services to improve rural life and production can we help contribute to the growth of the integration of urban and rural economies.

Keywords: FDI; urban and rural economic integration; inter provincial panel

JEL Classification: R0; R11; F01

1. Introduction

Economic globalization has greatly promoted China's economic growth. While China's urban-rural gap is widening, not only in the income and consumption gap between urban and rural residents, but also in the multiple gaps between urban and rural fixed investment, financial investment and urban and rural technicians. Foreign Direct Investment (FDI) plays an important role in accelerating China's capital accumulation, technological innovation and upgrading and market expansion of products and services. Urban-rural economic integration aims to narrow the gap between urban and rural areas at all levels of economy and achieve integrated development. Urban-rural economic integration is an important part of urban-rural integration and development. Most of the papers on urban-rural economic integration focus on the evaluation of its development level. Many literatures have proved that FDI has a significant impact on the income gap between urban and rural areas. However, there is a lack of literature on how FDI affects urban-rural economic integration.

The introduction of FDI may hinder the progress of urban-rural economic integration, because FDI is mainly acts on cities, few rural areas benefit. At the same time, FDI expands the economic gap between urban and rural areas through international trade (Chen, 2016). There is also evidence that FDI intensifies the income gap between urban and rural areas (Ho, 2017; Jin & Lee, 2017; Kim & Kang, 2020; Song et al., 2021). In addition, FDI inflows in the first sector have a slight negative impact on urban-rural income inequality (Wang & Luo, 2021).

Quantitative analysis of the influence of FDI on urban-rural economic integration is key to understand the role of FDI.

2. Research Design

2.1. Model Construction

Based on previous studies, the basic regression equation of the impact of FDI on urban-rural economic integration is constructed as follows:

$$lnureco_{it} = a_0 + a_1 \ln fdi_{it} + a_2 X_{it} + u_i + v_t + \varepsilon_{it} \tag{1}$$

where, $lnureco_{it}$ represents the logarithm of the urban-rural economic integration level. $\ln fdi_{it}$ represents the logarithm of FDI. X_{it} is the control variable, including per capita GDP, urbanization rate, traffic network density, the comparison of the proportion of urban and rural primary school teachers, the proportion of financial expenditure on education, the ratio of urban and rural medical insurance coverage and the ratio of urban and rural medical and health care expenditure. u_i is the fixed effect of provinces, such as geographical location, climate and other factors affecting FDI investment. v_t is the time fixed effect, which can reflect the policy effect of the government. ε_{it} is a random perturbation term.

2.2. Variable Selection

How to measure urban-rural economic integration scientifically and reasonably is one main research contents of this paper. Urban-rural economic integration means the process of realizing resource sharing and rational allocation on the basis of complementarity through the free flow of factors and production factors between urban areas and rural areas under relatively equal economic policies, so as to realize the sustainable, coordinated and common development of urban-rural economy.

To measure the level of urban and rural economic integration, firstly we need to build its evaluation index system according to its meaning, comprehensively using theoretical analysis method, frequency statistics method and expert consultation method, following the principles of comprehensiveness, scientificity, comparability, representativeness and typicality, and combing with the availability of data (Ma et al., 2020; Thi et al., 2020). The evaluation index system of urban and rural economic integration built by us is described in Table 1 (see below).

This paper uses the Time Series Global Principal Component Method to determine the weight of each index, and calculates the urban-rural economic integration index according to this method. The Time Series Global Principal Component Method can process panel data, and achieve the purpose of objective weighting and dimensionality reduction by linear transformation of the covariance matrix of the data.

We measured the level of urban-rural economic integration in 30 provinces of China (Tibet was excluded due to serious lack of data) from 2008 to 2019. Among them, the original data comes from China Statistical Yearbook, China urban and Rural Construction Statistical Yearbook, China Science and technology statistical yearbook, China Rural Statistical

Yearbook, as well as the statistical yearbooks of various provinces and CNKI China Economic and social development statistical database.

Table 1. Evaluation index system of urban and rural economic integration

Target Indicators	Dimension Indicators	Basic Indicators	Index Attribute	Index Meaning or Algorithm
Urban-Rural Economic Integration	Urban-Rural Capital Formation	Urban-Rural Per Capita Fixed Asset Investment Ratio	Backward	Urban / rural per capita fixed asset investment
		Per Capita Financial Support for Agriculture	Forward	Per capita expenditure of local agriculture, forestry and water affairs / per capita expenditure of local general public budget
	Urban-Rural Technological Progress	Proportion Ratio of Urban and Rural Technicians	Backward	Proportion of non-agricultural technicians in public economic enterprises and institutions in urban population / that in rural population
		Agricultural Mechanization Level	Forward	Total power of agricultural machinery / regional cultivated land area
	Urban-Rural Industrial Structure	The Ratio of Non-agricultural Industry to Agricultural Output Value	Forward	(output value of secondary industry + output value of tertiary industry) / output value of primary industry
		Dual Contrast Coefficient	Forward	(proportion of output value of primary industry / proportion of employees in primary industry) / (proportion of output value of non primary industry / proportion of employees in non primary industry)
		Dual Contrast Factor	Backward	ǀProportion of output value of non-agricultural industries - proportion of employees in non-agricultural industriesǀ
	Urban-Rural Employment Structure	Ratio of Non-agricultural Employees to Agricultural Employees	Forward	Non primary industry employees / primary industry employees
		Proportion of Rural Employees Engaged in Non-agricultural Industries	Forward	1 - primary industry employees / rural employees
	Urban-Rural Residents' Income and Consumption	Per Capita Income Ratio of Urban and Rural Residents	Backward	Annual disposable income per capita of urban households / annual net income per capita of rural households
		Per Capita Consumption Ratio of Urban and Rural Households	Backward	Per capita consumption of urban households / per capita consumption of rural households
		Urban-rural Engel Coefficient Ratio	Forward	Urban Engel coefficient / rural Engel coefficient

Before substituting the data into SPSS for principal component analysis, forward processing and dimensionless processing are needed. In this paper, the inverse index is taken to realize the forward of the backward index, and the dimensionless processing is realized by the mean method. The selection of principal components number follows the principle that the cumulative variance contribution rate is at least 85%. Using the above methods, we measure the level of urban-rural economic integration from 2008 to 2019 (see Table 2). This is the explanatory variable of this paper.

Table 2. Level of urban-rural economic integration in China from 2008 to 2019

Province	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Beijing	10.484	9.522	9.522	8.893	9.684	9.101	9.412	9.408	9.429	9.919	10.441	10.716
Tianjin	5.109	5.379	5.379	5.094	4.605	5.397	5.768	5.784	5.571	5.324	5.157	5.604
Hebei	1.636	1.364	1.364	1.376	1.367	1.130	1.131	1.077	1.016	0.875	0.831	0.833
Shanxi	1.758	1.792	1.792	1.385	1.472	1.327	1.340	1.258	1.126	0.988	0.956	1.011
Inner Mongolia	1.189	1.123	1.123	1.055	1.181	1.173	1.170	1.105	1.053	0.901	0.862	0.751
Liaoning	2.072	1.757	1.757	1.537	1.675	1.486	1.497	1.460	1.367	1.108	0.900	0.878
Jilin	1.389	1.187	1.187	1.076	1.200	1.039	1.048	1.017	0.970	0.851	0.789	0.734
Heilongjiang	1.475	1.219	1.219	1.072	1.297	1.052	1.011	0.906	0.935	0.739	0.766	0.752
Shanghai	12.426	12.346	12.346	11.160	14.902	13.468	12.074	11.967	13.033	13.057	13.213	12.803
Jiangsu	2.758	2.492	2.492	2.624	2.954	2.043	2.056	1.997	1.930	1.788	1.771	1.842
Zhejiang	3.589	3.370	3.370	3.452	4.053	2.843	2.833	2.743	2.598	2.408	2.284	1.934
Anhui	1.285	1.161	1.161	1.171	1.198	1.010	1.044	1.024	0.997	0.876	0.841	0.852
Fujian	1.774	1.682	1.682	1.685	1.780	1.575	1.600	1.559	1.499	1.381	1.314	1.331
Jiangxi	1.472	1.256	1.256	1.250	1.321	1.164	1.175	1.117	1.077	0.951	0.922	0.944
Shandong	2.055	1.663	1.663	1.700	1.730	1.321	1.319	1.272	1.218	1.096	1.077	1.086
Henan	1.250	1.115	1.115	1.150	1.195	0.936	0.929	0.892	0.831	0.750	0.708	0.718
Hubei	1.264	1.067	1.067	1.067	1.107	0.932	0.931	0.895	0.871	0.783	0.763	0.789
Hunan	1.310	1.154	1.154	1.130	1.111	0.964	0.939	0.890	0.844	0.720	0.671	0.684
Guangdong	2.736	2.472	2.472	2.490	1.957	1.880	1.854	1.814	1.727	1.588	1.522	1.538
Guangxi	1.016	0.853	0.853	0.831	0.870	0.726	0.700	0.650	0.625	0.532	0.508	0.489
Hainan	1.048	0.899	0.899	0.861	0.954	0.853	0.821	0.841	0.802	0.671	0.607	0.981
Chongqing	1.382	1.203	1.203	1.148	1.286	1.160	1.191	1.172	1.139	1.062	1.069	1.094
Sichuan	1.114	1.009	1.009	1.156	1.155	0.937	0.938	0.888	0.846	0.736	0.717	0.716
Guizhou	0.779	0.684	0.684	0.719	0.972	0.628	0.634	0.610	0.560	0.461	0.453	0.463
Yunnan	0.815	0.721	0.721	0.678	0.780	0.675	0.685	0.634	0.607	0.503	0.489	0.494
Shaanxi	1.262	1.158	1.158	1.070	1.164	1.078	0.923	0.888	0.857	0.748	0.736	0.745
Gansu	0.890	0.779	0.779	0.736	0.809	0.685	0.693	0.651	0.618	0.505	0.488	0.490
Qinghai	1.279	1.194	1.194	1.177	1.405	1.130	1.140	1.050	1.001	0.879	0.848	0.788
Ningxia	1.434	1.226	1.226	1.225	1.403	1.052	1.054	0.997	0.951	0.790	0.815	0.794
Xinjiang	1.151	0.983	0.983	0.898	1.031	0.854	0.812	0.771	0.741	0.625	0.591	0.617

The core explanatory variable is FDI, that is, foreign direct investment. This paper uses the inter provincial annual FDI data published in China Statistical Yearbook. The control variables include economic development level, urbanization rate, traffic situation, urban-rural education gap, education expenditure, medical insurance gap between urban and rural residents. The gap between urban and rural residents' medical expenditure. The variables used in the empirical part of this paper are defined in Table 3.

Table 3. Variable definition

Variable Name	Code	Explain
Urban-Rural Economic Integration Index	ureco	Measured by global principal component method
Logarithm of Urban-Rural Economic Integration Index	lnureco	Logarithm of Urban-Rural Economic Integration Index
Foreign Direct Investment	FDI	Foreign Direct Investment
	lnFDI	FDI logarithm
Per Capita GDP	pgdp	GDP / population of each province
	lnpgdp	logarithm of Per Capita GDP
Urbanization Rate	urb	Urbanization Rate
Traffic Network Density	tra	(highway operating mileage + railway operating mileage) / regional land area
Ratio of primary school students to teachers in urban to that in rural areas	tsr	(number of students / number of full-time teachers in urban primary schools) / (number of students / number of full-time teachers in rural primary schools)
Proportion of fiscal expenditure on Education	edu	Education expenditure / fiscal expenditure in Finance
Urban and rural medical insurance coverage ratio	insur	(number of urban residents and employees participating in basic medical insurance / urban population) / (number of participants in NCMS / rural population)
Proportion of urban and rural health care expenditure	healex	Proportion of medical and health care expenditure of urban residents in consumer expenditure / proportion of medical and health care expenditure of rural residents in consumer expenditure
Ratio of non-agricultural industry to agricultural output value	fnb	Ratio of non-agricultural industry to agricultural output value (output value of secondary industry + output value of tertiary industry) / output value of primary industry
Dual Contrast Factor	eyf	|Proportion of output value of non-agricultural industries - proportion of employees in non-agricultural industries|
Ratio of urban and rural per capita investment in fixed assets	gdzc	(urban fixed asset investment / urban population) / (rural fixed asset investment / rural population)

2.3. Variable Descriptive Statistics

Table 4. Statistical description of main variables

Variable name	Observed Value	Mean	Standard Deviation	Minimum	Maximum
ureco	360	1.995	2.670	0.453	14.902
lnureco	360	0.293	0.740	-0.792	2.702
FDI	360	113,327	183,704	2,000	1,762,227
lnFDI	360	10.728	1.406	7.601	14.382
pgdp	360	40,582	23,959	5,750	128,994
lnpgdp	360	10.443	0.593	8.657	11.768
urb	360	0.534	0.137	0.275	0.896
tra	360	0.914	0.512	0.069	2.377
tsr	360	1.283	0.274	0.674	2.100
insur	360	0.827	2.000	0.093	16.365
healex	360	0.904	0.212	0.343	1.746
edu	360	0.165	0.026	0.099	0.260

3. Empirical Test and Result Analysis

3.1. Whole Sample Analysis

Using the whole sample, we first analyze the influence of China's FDI on urban-rural economic integration. Table 5 reports the estimation results of various models. Among them, the first column shows the fixed effect model, and the second column reports the results of the random effect model as a comparison. The P value obtained by Hausmann test is 0.000, which strongly rejects the original hypothesis and believes the fixed effect model should be used. Taking the logarithm of urban-rural economic integration index as the explanatory variable and the logarithm of FDI as the core explanatory variable, and controlling the level of economic development, urbanization rate, transportation, urban-rural education gap, education expenditure, medical insurance gap between urban and rural residents and medical expenditure gap between urban and rural residents, it is found that the coefficient of lnFDI is significantly negative and -0.108 under the fixed effect model, In other words, the introduction of FDI hinders the process of urban-rural economic integration.

Table 5. Impact analysis of FDI on urban-rural economic integration (whole sample)

lnureco	Fixed Effect Model	Random Effect Model	Differential GMM	System GMM
	(1)	(2)	(3)	(4)
lnFDI	-0.108***	-0.0869***	-0.0716***	-0.184***
	(0.0230)	(0.0303)	(0.0165)	(0.0168)
lnpgdp	-0.125***	-0.358***	0.372***	-0.0237
	(0.0408)	(0.0541)	(0.0459)	(0.0258)
urb	-0.967***	1.782***	-5.549***	-0.770
	(0.267)	(0.334)	(0.589)	(0.549)
tra	0.326***	0.580***	0.0792	0.0482
	(0.102)	(0.0970)	(0.193)	(0.126)
tsr	-0.133**	-0.246***	0.159***	0.00224
	(0.0542)	(0.0768)	(0.0326)	(0.0372)
insur	-0.00459	-0.00697	-0.00342	0.00247
	(0.00424)	(0.00625)	(0.00494)	(0.00968)
healex	0.127***	0.295***	0.256***	0.187***
	(0.0487)	(0.0706)	(0.0172)	(0.0210)
edu	-0.495	-0.607	1.361***	-0.139
	(0.408)	(0.590)	(0.159)	(0.212)
Constant	3.123***	3.633***	-0.465	2.721***
	(0.314)	(0.447)	(0.406)	(0.218)
Sargan Test			0.9986	0.9993
Observations	360	360	360	360
Number of id	30	30	30	30

Using inter provincial panel data analysis will inevitably produce endogenous problems. Therefore, we use differential GMM and systematic GMM estimation, and select the distance from the region to the nearest port as the exogenous tool variable. The distance between each province and the nearest port is calculated by using Baidu map to calculate the highway mileage between the provincial capital city and the nearest port. The instrumental variable satisfies two properties of exogenous instrumental variables: one is exogenous, the second is correlation, the introduction of FDI is naturally related to the transportation cost, so it is

highly correlated with the distance from the port. It should be noted that although the tool variable meets these two conditions, it still has certain limitations because there is no time change.

The third and fourth columns in Table 5 report the regression results of differential GMM and System GMM respectively. The results show that the logarithm of FDI is still significantly negative to the logarithm of urban-rural economic integration index. However, the coefficient is -0.0716 in differential GMM Estimation and -0.184 in System GMM estimation. However, no matter which regression method is adopted, it shows that FDI has a negative impact on urban-rural economic integration, that is, the introduction of FDI will expand the urban-rural economic gap.

3.2. Subregional Analysis

According to the general practice, we divide the 30 provinces into Northeast, Eastern, Central and Western regions. The results show that the logarithm of FDI in each region is negative to the logarithm of urban-rural economic integration, but only the coefficient in the western region is significant, and the coefficient in the northeast, East and central regions is not significant.

Table 6. Impact of FDI on Urban-Rural Economic Integration Analyzed by Subregion

lnureco	Northeast	Eastern	Central	Western
	(5)	(6)	(7)	(8)
lnFDI	-0.168	-0.0302	-0.0978	-0.0905**
	(0.136)	(0.0412)	(0.0640)	(0.0373)
lnpgdp	-0.00953	-0.254***	0.0956	0.152*
	(0.0909)	(0.0945)	(0.0954)	(0.0820)
urb	1.967	-0.397	-2.307**	-4.694***
	(2.149)	(0.342)	(0.940)	(0.832)
tra	-3.558***	0.338*	0.0859	0.677***
	(0.837)	(0.193)	(0.173)	(0.175)
tsr	-0.528***	0.0653	-0.0491	-0.00859
	(0.152)	(0.110)	(0.0958)	(0.100)
insur	-0.0781	-0.0104*	-0.0314	0.0141
	(0.149)	(0.00532)	(0.0512)	(0.0316)
healex	-0.167	0.159*	0.256***	-0.0133
	(0.192)	(0.0871)	(0.0845)	(0.0714)
edu	-1.063	-1.064	-0.350	-1.044*
	(0.769)	(0.905)	(0.710)	(0.612)
Constant	4.041***	3.899***	0.994	1.101*
	(1.180)	(0.694)	(0.796)	(0.633)
Observations	36	120	72	132
Number of id	3	10	6	11
R-squared	0.880	0.551	0.875	0.787

4. Robust Test

To test the robustness of the equation and coefficient, we change the urban-rural economic integration index into the ratio of non-agricultural industry to agricultural output value, binary contrast factor and urban-rural per capita fixed asset investment ratio. To make it consistent with the change direction of urban-rural economic integration, firstly, the binary

contrast factor which is a backward index and the per capita fixed asset investment in urban and rural areas are compared as a positive treatment. In this paper, the reciprocal method is used to forward. Then, we use the fixed effect model to estimate the impact of FDI on them respectively. The results show that the results obtained by using these three replacement indicators are the same as the regression results of urban and rural economic integration index (see Table 7). The logarithm of FDI has a significant negative impact on the three, and has the greatest impact on the ratio of non-agricultural industry to agricultural output value, with a coefficient of -1.490.

Table 7. Results of Changing Explained Variables

Explained Variable	(9)	(10)	(11)
	fnb	eyf	gdzc
lnFDI	-1.490***	-0.312***	-0.0155*
	(0.338)	(0.0681)	(0.00856)
lnpgdp	-0.0371	0.435	-0.134***
	(2.244)	(0.275)	(0.0285)
urb	136.4***	11.48***	-0.0830
	(20.97)	(2.533)	(0.190)
tra	14.89***	1.590**	0.0690*
	(4.316)	(0.638)	(0.0378)
tsr	-26.95***	-0.745***	0.111***
	(1.979)	(0.255)	(0.0323)
insur	1.184***	-0.170***	-0.0280***
	(0.326)	(0.0491)	(0.00685)
healex	-0.972	-0.924***	0.0769***
	(1.120)	(0.261)	(0.0215)
edu	-122.9***	-16.14***	-1.780***
	(14.46)	(2.103)	(0.154)
Constant	5.284	1.096	1.728***
	(12.20)	(1.976)	(0.278)
Observations	360	360	360
Number of id	30	30	30

* p-value < 0.01, ** p-value < 0.05, *** p-value < 0.01

5. Research Conclusion

This paper discusses the impact of FDI on China's urban-rural economic integration. The regression results of the whole sample show that the impact is significantly negative, that is, FDI significantly hinders the process of urban-rural economic integration. After grouping 30 provinces into northeast, East, central and West, it is found that the effect of FDI on urban-rural economic integration index in all regions is negative, but only the coefficient of FDI in western provinces on urban-rural economic integration is significant. After further replacing the explained variables, the regression results are robust.

However, this paper does not explore the specific ways and mechanisms of FDI affecting China's urban-rural economic integration, which may become the main content to be studied in the next step. But only by bringing FDI more to rural areas and providing services to improve rural life and production can we help promote the integration of urban and rural economies.

Conflict of interest: none

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The Impact of the COVID-19 Pandemic on the WIG-Energy Stock Exchange Index

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Abstract: The COVID-19 pandemic, which has been ongoing since 2020, has caused very big changes in many areas of life around the world. The biggest changes were recorded in the economies of individual countries. Changes also appeared in indices on stock exchanges. The situation was similar on the Warsaw Stock Exchange, both on the main and sectoral indices. The main objective of the article was to analyze the impact of the number of COVID-19 cases on the WIG-Energy index. The Persona method was used. As a result of the research, it was found that taking into account the period from the beginning of the pandemic to the end of 2021, the number of patients does not affect the stock market index of the energy sector. However, if the analyses have been made for individual waves of the pandemic, then as the seasons of COVID-19 disease continue, the number of infections moderately affects the stock market index. The greatest impact was recorded in the first two weeks of the pandemic, in which the correlation coefficient was -0.977.

Keywords: pandemic; correlation; stock exchange; energy sector

JEL Classification: I15; O11; Q49

1. Introduction

The COVID-19 pandemic, which has been ongoing since 2020, has caused very big changes in many areas of life around the world. The biggest changes were recorded in the economies of individual countries. In Poland, based on official data from the Central Statistical Office (2021), gross domestic product in 2020 decreased in real terms by 2.8% compared to an increase of 4.5% in 2019. Similarly, domestic demand decreased in real terms by 3.7%, compared to 2019, when an increase of 3.8% was recorded. Subsequent macroeconomic indicators also show the negative impact of the pandemic on the economy Polish, such as gross accumulation, which decreased in real terms compared to the previous year by 12.2%.

This situation also significantly affects revenues from the markets operated by the stock exchange. Everything that happens in the Polish economy is reflected in the daily stock quotes. The situation was similar on the Warsaw Stock Exchange, where significant changes in individual indices were recorded. This was mainly due to restrictions on conducting business activity, announcing aid programs and granting tax reliefs. However, the biggest factor influencing the changes in the stock market was the increase in uncertainty in the financial markets, which directly affected the volatility prevailing on the capital markets, which was reflected in the value of turnover and capitalization of companies (Dietl et al., 2021).

Changes, those larger and smaller, affected virtually all stock market indices. It is no different also in the case of quotations within the WIG-Energy index, which brings together companies involved in economic sectors related to energy. This is a very significant sector that includes energy raw materials, power generation, as well as distribution. As everyone knows, the costs of energy production have a significant impact on the economy of the country and the world, mainly on its growth. In turn, transactions related to companies involved in energy sectors affect financial markets (Jennings, 2012). As Gajdka and Schabek (2013) point out, the increase in oil prices affects the deterioration of macroeconomic results on a global scale, and this is associated with a deterioration in the situation on global equity markets. On the other hand, in the case of entities related to the energy industry, any increase in oil prices causes many benefits for them and usually does not succumb to downward trends. As initially the pandemic caused a significant reduction in energy demand, and thus a decrease in the prices of energy raw materials, it was decided to analyze the impact of this situation on the activities of companies listed on WIG-Energy. Therefore, the purpose of this article was to examine the impact of the COVID-19 pandemic on the WIG-Energy index. According to previously conducted studies on the impact of the COVID-19 pandemic on the main WIG index, two hypotheses have been adopted.

H1 hypothesis – in the period from March 1, 2020 to December 31, 2021, the amount of Sars CoV-2 virus infections has a moderate impact on the WIG-Energy index.

H2 hypothesis – the greatest impact on the WIG-Energy index was observed in the first two weeks of the COVID-19 pandemic.

2. Methodology

In order to achieve the main goal and verify the hypotheses, a linear relationship between the number of infections with the Sars-Cov2 virus and the WIG-Energy index indicator was examined using the Persona correlation coefficient. Thanks to this, the strength and direction of the linear relationship between the above variables was determined. According to the interpretation, when the correlation coefficient (r) is between 0–0.3, the correlation is weak. In the case of a result of 0.3–0.5, we are dealing with a moderate correlation. A coefficient in the range of 0.5–0.7 indicates a strong correlation, and an r-factor of 0.7 to 1 shows that the correlation is very strong (Buda & Jarynowski, 2010).

Data for the period from March 1, 2020 to December 31, 2021 were used for the study. Calculations of the impact of variables on each other for the entire given period were made, and a correlation study of two variables in periods of four waves of the pandemic was also carried out. According to the number of decreases and increases in seasonal infections, it was assumed that the first wave of the pandemic in Poland lasted from March 1, 2020 to August 10, 2020. The second wave fell from August 11, 2020 to January 25, 2021. The next increase in infections began on January 26, 2021 and lasted until July 31, 2021. This was the so-called third wave. Finally, the correlation in the fourth wave falling on the period from August 1, 2021, to the end of the study period, was examined.

Before starting empirical research on the basis of the collected material, derived from official statistics of the Ministry of Health (disease rates) and quotations of WIG-Energy indexes from

the GPW Benchmark portal, a short, theoretical analysis of the topic was carried out on the basis of available source materials. The COVID-19 pandemic was mentioned, as well as information on WIG-Energy was presented. In the analysis of the obtained research results, methods of data interpretation were used, in particular the descriptive and graphic method (graphs).

3. Results and Discussion

The COVID-19 pandemic has caused many negative effects in everyday life, social life and, above all, in the global economy. However, this is an opportunity for economists to conduct numerous studies, because so far, such serious phenomena have been recorded in the existing economic crises. Changes were observed that were unusual, deviating from the pattern of seasonal and cyclical changes established for the economy. The pandemic has hit almost every sector of the economy, and the restrictions introduced by this have hit most companies. Research conducted by experts from the Warsaw School of Economics showed that only 9% of the surveyed enterprises did not feel the negative effects of restrictions in economic life introduced as a result of the COVID-19 outbreak, and every fourth considered them severe (Adamowicz, 2021). In this article, the analysis of research results and discussion was preceded by a presentation of the history of the development of the COVID-19 pandemic, with particular emphasis on its division into four stages (the so-called pandemic waves). The next subsection describes the WIG-Energia index, which brings together companies belonging to the Polish energy sector. The last subsection contains the empirical part of the article, which presents the impact of the pandemic on the WIG-Energia index.

3.1. Pandemic COVID-10

The first officially reported case of COVID-19 in the world was registered in the Chinese city of WUCHAN on December 31, 2019. Several days later, the World Health Organization (WHO) declared the COVID-19 outbreak a public health emergency of international concern. Subsequently, after the deaths from this disease began to spread around the world, the WHO declared the COVID-19 pandemic on 11 March 2020 (Singh et al., 2020).

In Poland, the first case of Sars CoV-2 infection was found on March 6, 2020 in a patient who returned to the country from Germany. From that day on, the number of new cases of the disease began to increase (Figure 1). In turn, the first fatal case was recorded on March 12, 2020. During the analysis period, from March 1, 2020 to 31.12 2021, the pandemic continues continuously around the world, taking on seasonal increases and decreases in infections. In Poland, it was assumed that by the end of 2021 there were four waves of the pandemic. The first wave, which lasted until August 10, 2020, had the mildest course, with more than 840 infections per day recorded at its peak. In the second period, the number of cases was much higher, as on November 7, 2020, 27,875 patients with Sars CoV2 arrived. In turn, the greatest number of new infections were in the third wave. Here, 35,251 people fell ill with COVID-19 on April 1, 2021. In the further period, from June 2021, the number of new infections stabilized and amounted to less than 200 people per day. However, the autumn period of 2021 brought a renewed increase in infected people, where on December 1, 2021 it exceeded 29,000 patients (Coronavirus in Poland, 2022).
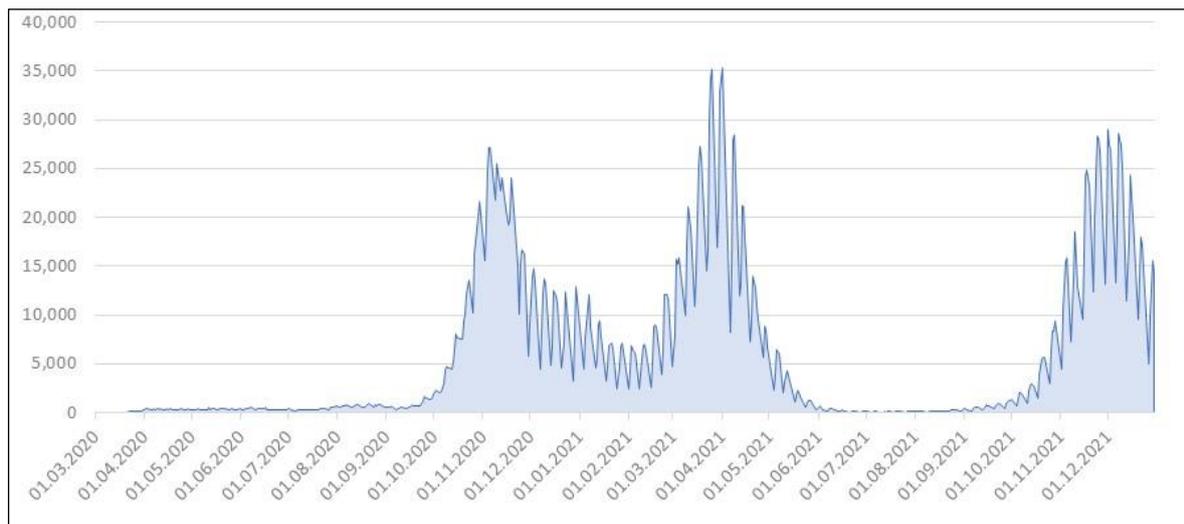
Figure 1. Daily number of new infections for SARS-CoV-2 in the period from 01.03.2020 to 31.12.2021 in Poland (www.koronawirusuna.pl)

3.2. WIG-Energy

The Warsaw Stock Exchange (WSE) is a Polish stock exchange with its registered office in Warsaw It is a public joint-stock company aimed at providing the possibility of stock exchange trading in securities (such as shares, bonds, pre-emptive rights, etc.) and non-securities financial instruments (such as options, futures contracts) admitted to stock exchange trading. It was created on April 12, 1991, and the first listing included five companies. Since 1994, the Exchange has been publishing various indices. Currently, there are 24 indices, which include companies that meet various criteria, such as the value of the portfolio or the industry to which the companies belong. Some indices are derived from others. One of such indices is WIG-Energy, often referred to as a sectoral sub-index. The calculation started on 4 January 2010 (GPW, 2013). The base value for this index is the quotations from December 31, 2009. The base value, i.e. the value from the base date, is 3,998.60 points for this index. The portfolio of this index includes companies included in the WIG index belonging to the energy sector (Gajdka & Schabek, 2013). The index initially included 4 companies, currently it includes 12 entities (GPW, 2021). The companies listed in WIG-Energy are domestic and foreign enterprises. The WIG-Energy index may include only companies that belong to the WIG index and have at least 10% of shares in free circulation, and the value of these shares is greater than EUR 1 million (Appendix to Resolution No. 866/2019).

3.3. Impact of the Covid-19 Pandemic on Stock Indices

The initial information about the emergence of a new disease and the associated deaths among civilian communities caused quite a lot of chaos on a global scale. Very high uncertainty, the announcement by various governments, nationwide collective quarantines, contributed to the economic collapse. Global GDP decreased by about 3-5% of the planned growth rate. On the world's stock exchanges, a fairly strong reaction of stock prices and stock indices was noted. Stock markets began to fall sharply. Many STUDIES on COVID-19 analyzing the reactions of stock prices have shown concern in trading in domestic and

international stock markets. For example, the National Stock Exchange (NSE) and the Bombay Stock Exchange (BSE) stopped trading with a circuit breaker on March 13 and March 23, 2020, twice in 15 days. Similarly, in March 2020, the US stock exchange used the circuit breaker four times in 10 days (Singh et al., 2020). As you can see, most stock markets have reacted negatively to the COVID-19 crisis. It was similar in Europe, where the Main Index of the British market on March 12, 2020 recorded a decrease of about 10%. On the other hand, the Tokyo Stock Exchange index fell by about 20% compared to the highest level of December 2019 (Zhang & Hamori, 2020).

In the past, there have already been periods when a pandemic was declared. Based on a literature review by Jaworski (2021), one such was the SARS epidemic, which led to the financial crisis in Asia. Interestingly, this crisis did not affect countries on other continents. In turn, the Ebola epidemic has caused negative effects only in African countries. The Zika virus, on the other hand, did not contribute to the decline in stock market indexes in South American countries.

The research conducted by the Authors showed that the main stock market index in Poland – WIG initially reacted quite significantly. However, quite quickly the situation began to return to normal. The Management Board of the Exchange quite quickly implemented a number of actions that contributed to minimizing various risks. Several strategies have been adopted to suit different situations. Among the main activities, procedures have been implemented to reduce the risk of infection and the spread of Sars-Cov-2 coronavirus infection, including remote work. Ongoing monitoring of compliance of the scope and quality of services provided by external suppliers was carried out. The most important decision was to maintain the continuity of services provided. All the above actions had a positive impact on the increase in turnover on the stock exchange markets, which resulted in an increase in revenues and generated profits (GPW, 2021).

On the Warsaw Stock Exchange, along with the announcement of the pandemic, a definite decrease in quotations in March 2020 can be seen (Figure 2). In the following months, the index increased gradually, and in November 2020, during the period when the second wave of the pandemic intensified, another collapse took place. Since December 2020, there has been a long-term upward trend, lasting until the autumn of 2021, when the fourth wave of infections began to hit.

3.4. Impact of the Covid-19 pandemic on the WIG-Energia stock market index

In the WIG-Energy index, in contrast to the WIG index, one can notice a much greater irregularity and lack of a typical trend (Figure 3). In the first weeks of the pandemic, as in the case of the main index, a fairly large decline in quotations was found. Soon after, in April and May, the WIG-Energy index stabilized at a fairly similar level, to recover decisively in the summer. In turn, autumn 2020 brings further declines, this time small. However, at the beginning of 2021, a gradual recovery on the stock exchange in the field of energy companies begins. It is only in the autumn of 2021, where the fourth wave of the pandemic appears, that declines are visible.

Figure 2. Quotations of the main WIG index in the period from 1 March 2020 to 31 December 2021 (money.pl)
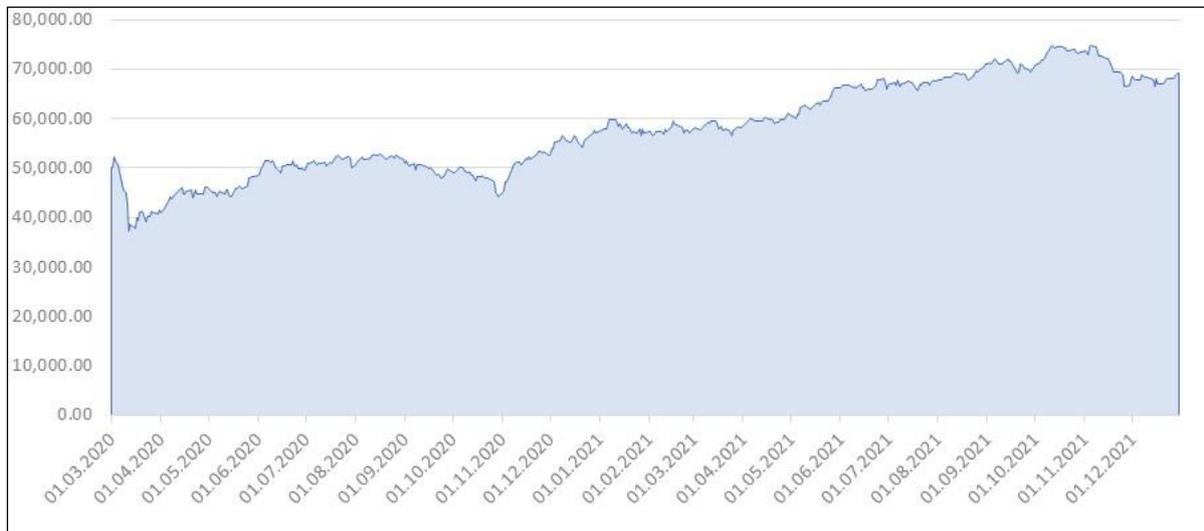
Figure 3. Quotations of the WIG-Energy index in the period from 1 March 2020 to 31 December 2021 (money.pl)

However, in order to check whether these downward and upward trends are directly due to the pandemic and the number of infections, a study of the impact of two variables was carried out using the correlation coefficient mentioned in the methodology.

The survey conducted throughout the period from March 2020 to December 2021 showed that the correlation coefficient was $r = 0.034$ (Figure 4). This result says that there is no linear relationship and practically the infection rate has no effect on the WIG-Energy index. The pandemic practically does not affect stock quotes throughout the entire research period. This result, causes that hypothesis 1, say that in the period from March 1, 2020 to December 31, 2021, the amount of Sars CoV-2 virus infections moderately affects the WIG-Energy index, in this case it is refuted.
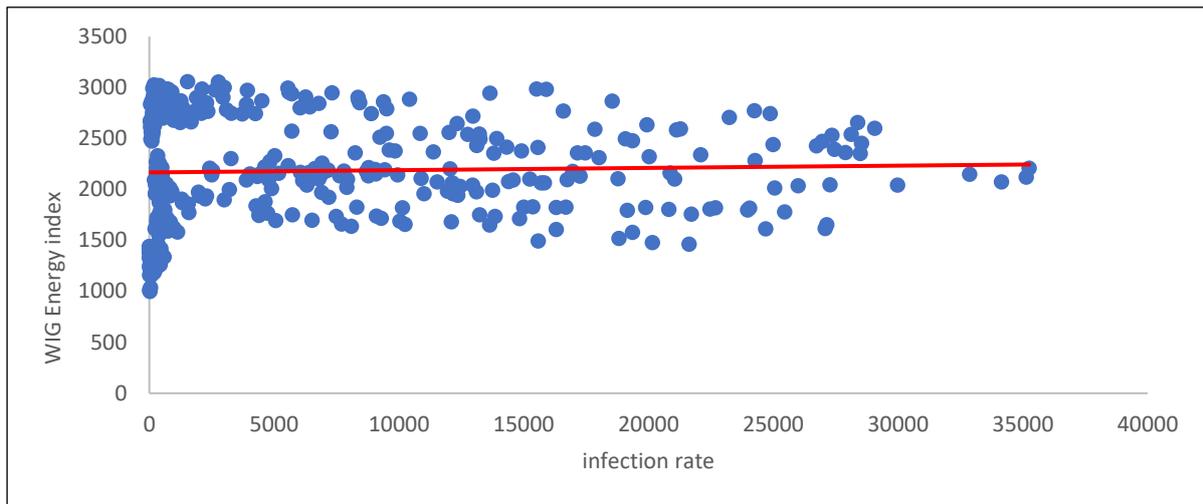
Figure 4. Dependence of the WIG-Energy index on the sars-Cov-2 infection rate in the period from March 1, 2020 to December 31, 2021 (own elaboration based on data http//:koronawirusunas.pl and money.pl)

In the analysis of the course of the pandemic, we can see a fairly high variability of infections, which shows a seasonal (wave) character. Therefore, it is widely accepted to define the next waves of the pandemic. Therefore, it was examined how individual waves affected the WIG-Energy stock market index. In the first wave, lasting from March 2020 to around August 10, 2020, the correlation coefficient for the two variables adopted was 0.423, which indicates a moderate relationship (Figure 5). However, the positive indicator shows that as the number of infections increases, the WIG-Energy index also increases. After a deeper analysis of these results, it should be concluded that in the initial period, when the stock market and the entire economy reacted quite violently to the emergence of the pandemic, there was still a small number of infections. Only from month to month of the first wave, the number of infections increased, and the stock market calmed down.
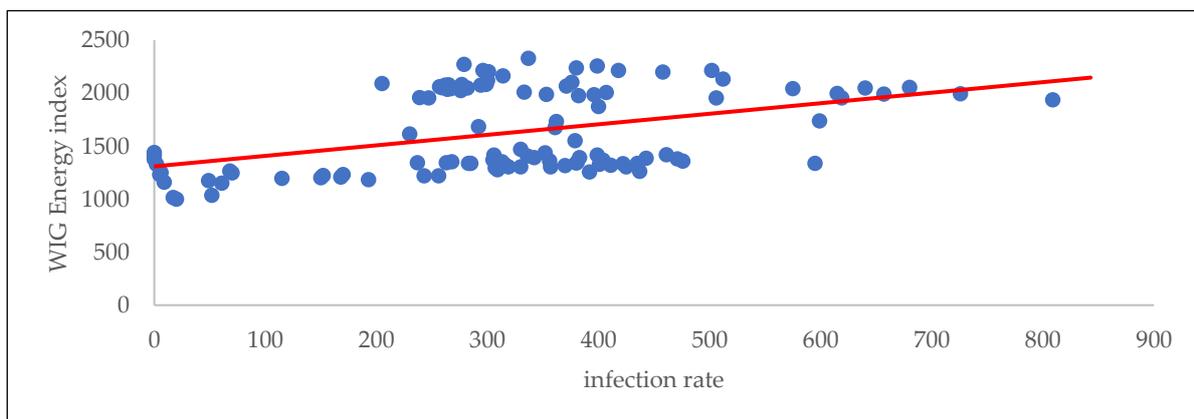
Figure 5. Dependence of the WIG-Energy index on the sars-Cov-2 infection rate in the period from March 1, 2020 to August 10, 2020. (own elaboration based on data http//:koronawirusunas.pl and money.pl)

In order to study the first reactions of the stock exchange, the time frame of this survey was shortened to the first half of March 2020 (Figurer 6). In this case, the correlation

coefficient was r = -0.977. This indicates a very strong relationship, which shows that as infections increase, the WIG-Energy stock market index drops sharply.
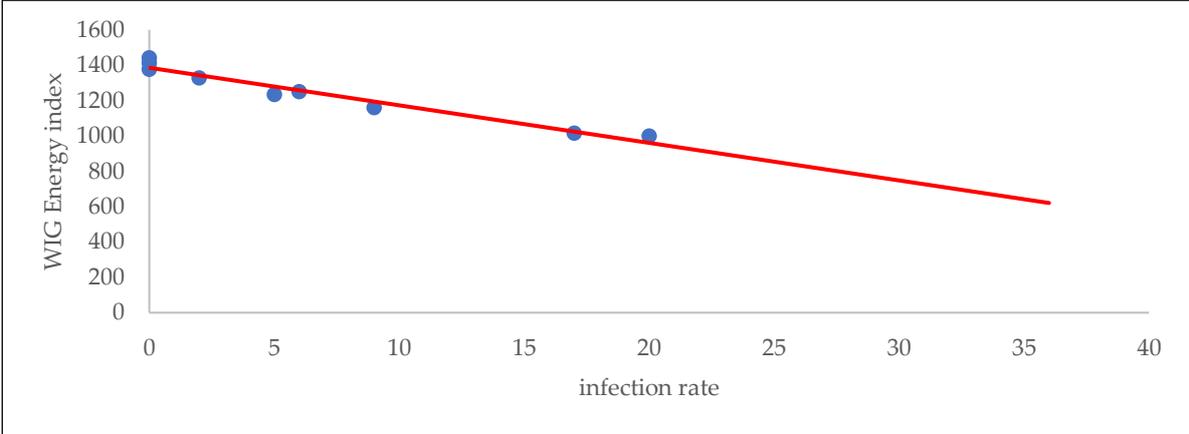
Figure 6. Dependence of the WIG-Energy index on the sars-Cov-2 infection rate in the period from March 1, 2020 to March 15, 2020 (own elaboration based on data http//:koronawirusunas.pl and money.pl)

The above result of the study of the relationship between two variables in the first two weeks of the pandemic allows to confirm the H2 hypothesis – the greatest impact on the WIG-Energy index was observed in the first two weeks of the COVID-19 pandemic.

After the summer stabilization in 2020, from mid-August another wave of the pandemic began, referred to as the second. This is the period when the global and national economies also react to the number of infections (Fig. 7). Based on the analysis, it appears that in the period from August 10, 2020 to January 25, 2021, the correlation coefficient between the number of infections on Sars-CoV2 and the WIG-Energy index is at the level of -0.276. This indicates a weak relationship between these variables, i.e. an increase in the number of infections, slightly affects the decline of the stock market index.
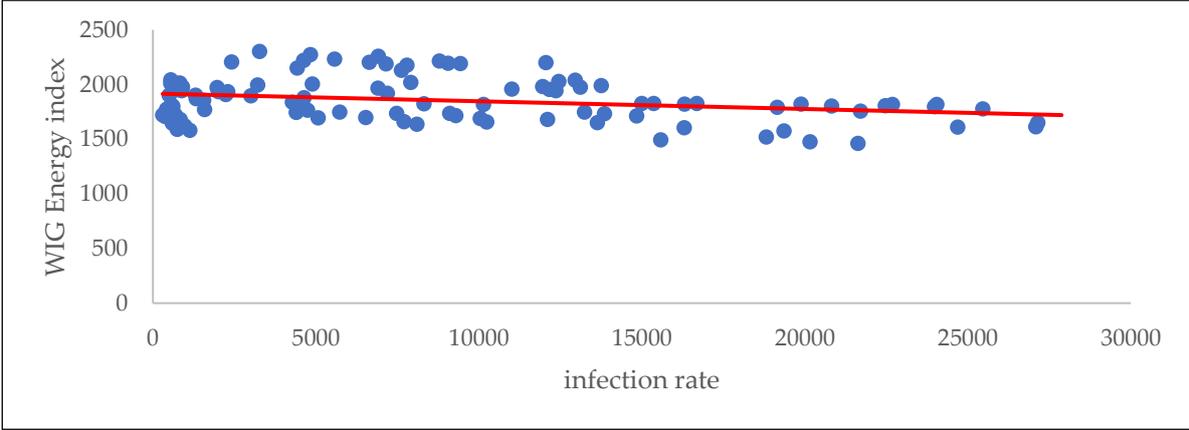
Figure 7. Dependence of the WIG-Energy index on the sars-Cov-2 infection rate in the period from 11 August 2020 to 25 January 2021 (Own elaboration based on data http//:koronawirusunas.pl and money.pl)

In the next wave of the pandemic, falling in the period from January 26, 2021 to July 31, 2021, volatility studies showed that the correlation coefficient between the data in question was r = -0.607 (Fig. 8). This indicates a moderate dependence, and as the coefficient is

negative, as the Sars-CoV2 incidence increases, the WIG-Energy stock market index decreases.
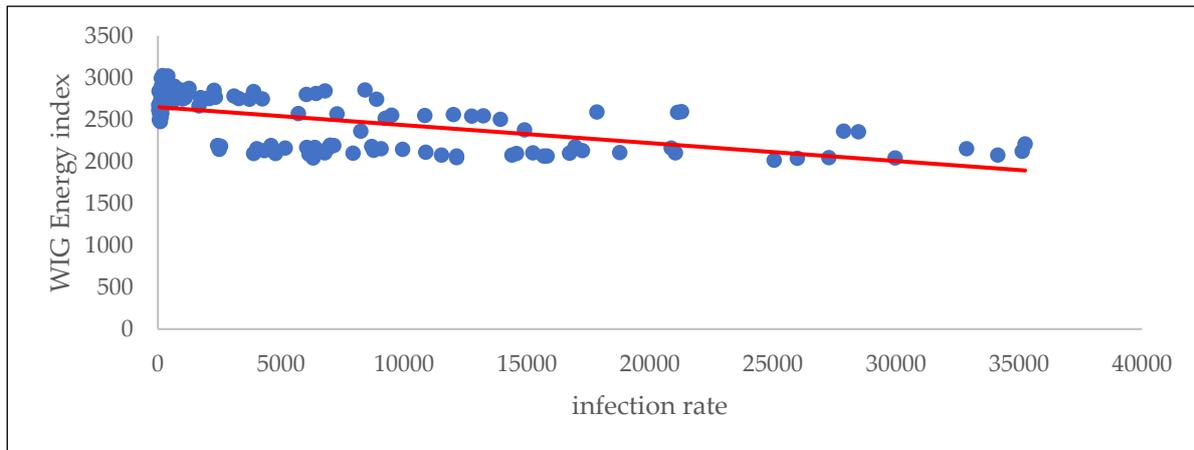
Figure 8. Dependence of the WIG-Energy index on the sars-Cov-2 infection rate in the period from 11 August 2020 to 25 January 2021 (Own elaboration based on data http//:koronawirusunas.pl and money.pl)

The fourth wave of the pandemic and the increase in cases, falling in the autumn of 2021, contributed to the maintenance of similar research results, where the linear correlation coefficient in this period was r = -0.537. As in the third wave, the dependence is moderate and the increase in the number of patients slightly causes the index to fall in the stock market.

Summing up the analyses of subsequent waves, they show that the number of infections on Sars-Cov-2 in seasonal terms has a moderate impact on the WIG-Energy stock market index. This means that hypothesis 1 – in the period from March 1, 2020 to December 31, 2021, the amount of Sars-CoV-2 virus infections has a moderate impact on the WIG-Energy index, in part it should be maintained, because in the third and fourth waves, in fact, the WIG-Energy index is moderate in terms of the number of infections.

5. Conclusions

The COVID-19 pandemic has significantly affected the global and domestic economy. It also had its negative impact on stock exchanges, as evidenced by the research conducted in this article. However, it should be taken into account that the relationship between the number of infections and the indicator of the stock index should be calculated periodically. In particular, the first period, the so-called first wave, was quite specific. Well, the greatest turmoil occurred in the first weeks, after the World Health Organization declared a pandemic. At that time, there were still relatively small rates of illness, while the indicators of the stock market index fell sharply. In this case, in addition to the spread of the disease, the stock market declines were also influenced by uncertainty, lack of medicine, fear from media reports, as well as national quarantine. However, taking into account only the impact of the number of infections on the WIG-Energy index, it was found that in each subsequent wave of the pandemic, this dependence increases.

Conflict of interest: none

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Is LinkedIn Suitable for Recruitment in Higher Education in the Czech Republic?

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Abstract: Internet marketing is used in all walks of life nowadays. It found its way also into recruitment. The article aims to investigate whether recruitment through LinkedIn and Academia is a viable option of recruitment for higher education positions in the Czech Republic. LinkedIn is a general portal for openings, and Academia is specific for higher education professionals, i.e. two different types of sites are covered. It was an associate/full professor opening. The fields were business administration and management because they are fairly broad. The location was Prague, the number of relevant academics should be the largest within the Czech Republic. The experiment yielded zero applicants enrolled because of LinkedIn or Academia. Overall, there were two applicants, they both learned about the opening from members of the department which announced the opening. It seems that for now, such portals are not suitable for attracting higher education professionals in the Czech Republic, while word-of-mouth information may be more efficient.

Keywords: internet marketing; recruitment; higher education; experiment; LinkedIn

JEL Classification: O15; O35; O33

1. Introduction

In the era of the Internet, everybody is expected to be able to provide rapid responses, the time for decision-making is getting shorter, the production time is getting shorter and the time for which employees remain in companies is shorter as well. Therefore, it is quite logical that the selection procedure must be quicker, and this is probably most evident in recruitment.

Posting an advertisement in printed media and waiting for applicants to read it is inefficient. The advertiser, i.e. the employer who is looking for new employees, loses control over the published advertisement and does not know how many people have seen it, and is unable to estimate how many people are likely to apply. There is required a more interactive tool. Some such tools are offered by social networking sites, professional ones like LinkedIn, academic like Academia and Research Gate, and more recently also Facebook.

The mentioned tools are not commonly used by universities in the Czech Republic yet. Our research aims to investigate whether placing job openings on LinkedIn and Academia is a viable option of recruitment for a higher education position in the Czech Republic. It is not possible to try all sites, all fields, all towns, so some decisions needed to be done to limit the scope. LinkedIn.com was chosen as a representative of professional networking sites meant

for hiring in general, and Academia.edu was chosen as a representative of an academic networking site. Facebook did not offer a relevant service at the time of experimenting. The field for the experiment was chosen to be business administration, and the location of the opening was chosen to be Prague. The result of the experiment can be then discounted for a less popular field and a smaller city. In this line of reasoning, if there are no applicants found this way in the capital city (which has by far the largest number of inhabitants and universities) in a very popular field, it is very unlikely that any applicants would be found in a smaller city or for a smaller field. If there are no applicants in jobs that often use the internet and on-line applications, it is very unlikely that any applicants would be found in jobs with smaller usage of internet and IT tools.

It turns out, that e-recruitment has become a common phenomenon due to the increasing use of information and communication technology by HR. Lately we can expect inclusion (although limited) of social networking sites such as LinkedIn as a part of e-recruitment.

Our article is structured traditionally: section literature review is followed by methodology, the penultimate section describes results, and the final section offers discussion with some conclusions.

1.1. Literature Review

With the advent of information technology, a possibility has originated to use servers with job offers. Sites with job offers are still considered as modern. Zajac (2012) claimed that two-thirds of European companies use recruitment portals. It is possible to place an advertisement on a site with job offers, where it is possible to modify it, use hyperlinks, and retract it if a suitable applicant has already been found and hired. However, this approach cannot also control the number of applicants, and ensuring that the selected group of potential candidates in particular response to the advertisement can only be done with difficulty. A certain possibility is to prioritize placement of the advertisement on a server on which certain groups search for job offers. However, this method is already outdated as well, and it virtually cannot be used for the selection of candidates for higher management positions in particular. According to Ramar and Sivaram (2010), only one out of every 120 applicants who get in touch themselves is suitable to be interviewed, while one out of every 20 applicants selected through active recruitment is suitable. Faliagka et al. (2012) recommend the introduction of an automated system that would exclude unsuitable candidates and it would, therefore, bring significant benefits and cost savings. The application published on Bayt.com, for example, provides 33 filters to distinguish candidates (Wolfswinke et al., 2016), and there are certainly other such systems.

Recently, e-recruiting platforms, which are used both by employers and job-seekers, are currently widespread (Sharma, 2014). Job offers are collected on the platforms and people can choose from them. If the job-seeker creates his profile on the platform, he receives primarily offers that agree with his competencies and requirements (Enăchescu, 2016). According to Doherty (2010), thanks to social media, it is possible to effectively attract the current workforce of Generation Y. This generation, called also Millennium Generation, is not unequivocally defined. There are people born between 1977-1994 (Kotler & Keller, 2006)

or 1976-2000 (Kopecký, 2013). This generation represents or will represent the majority of employees and potential employees. These people are also called digital natives (Lewis, Thomas, & James, 2015) and their retaining is very difficult. Huizing (2012, In Lewis et al., 2015) suggests that Y Generation is well educated, which stresses organizations recruiting and retaining them. When seeking a job, they go online, first recruitment sites, followed by social media. These people are self-confident, they seek interesting conditions and do not feel big loyalty to their current employer. Generation Y requires an immediate reaction, fast feedback which can be observed in the preferred work style and also in the job-seeking (Trézlová, 2015). It is suitable to aim at them with particularly active recruitment, it means recruitment focused on passive potential candidates (i.e. those who are not currently looking for a job but meet the conditions of the company recruiting).

So, HR professionals are discovering new possibilities in the use of Facebook, LinkedIn (Caers & Castelyns, 2011), or other social networks, including YouTube users or groups playing selected online games. Wright (2011) suggests that companies should follow potential employees to engage them in the recruitment. However, users are not ready for it. According to Pavlíček (2013), most job seekers tend not to pay sufficient attention to their online profile. On one hand, it is an advantage because recruiters receive unbiased information about the potential employee. On the other hand, it is also a disadvantage because it is difficult to create a complex profile and to offer appropriate job position. For effective use of social networking sites is important to create e-HR strategy (Quast, 2013). There are numerous studies covering e-recruiting area (Kashi & Zheng, 2013; Dery et al., 2006) proving that lack of user acceptance is an important barrier for companies aiming to reach benefits of e-recruiting other than time efficiency and lowered operational cost and. (Maier et al., 2013) finds that higher fluctuation and low work satisfaction can be linked to a lack of system acceptance on the part of recruiters.

In general, any social network on which individuals present information about themselves (including information on what videos they produce or view or what games they prefer) can be used for recruitment purposes. However, it greatly depends on the recruiter. According to the research of Caers and Castelyns (2011), roughly half of the HR specialists use LinkedIn to search for suitable candidates. According to the authors, as much as 82% of HR specialists do not use Facebook for active recruitment. The unwillingness or inability to use social networking sites for recruitment confirms also Kietzmann et al. (2011). On the other hand, Böhmová and Pavlíček (2015) reported that HR specialists use information from public Facebook profiles regularly, and Madera (2012) and Chauhan, Buckley, and Har et al. (2013) write about the growing trend of using social networks for active recruitment. Lewis et al. (2015) claim that LinkedIn is recruiters' most popular social media, 60% of surveyed companies claimed successful intake of the new employee through social media such as Facebook, Twitter, or LinkedIn. This is underlined by research from 2010, according to which, 83% of respondents confirmed that they have used or plan to use social networks for hiring (Lumesse, 2011). Lewis et al. (2015) found that 92% of employers use, or plan to use, social networking as a recruitment tool and that the use of these platforms will continue to be on

the rise in the immediate future. Wawer and Muryjas (2011) found that 27% of employers in the poor region of Poland used social networking sites for e-recruitment.

Recruiters who use e-recruiting websites can directly acquire a large number of job seekers (Rosoiu & Popescu, 2016) faster and cheaper (Matta & Sardana, 2012; Depardieu & Islam, 2008 (In Nasreem et al., 2016); Smith & Rupp, 2004). But it is not always an advantage because it requires only a little effort to submit a job application on these sites, so applicants are often unsuitable.

Majority of the respondent organizations in Nasreem et al. (2016) study prefer digital recruitment for the publishing of openings in marketing and IT departments. Wroblovská and Ruda (2015) recommend the use of e-recruitment also for product managers. Fisher et al. (2014) claim that the use of social networks for recruitment depends on whether the recruiter himself is active on the social network, or he is only an occasional user. Also, Caers and Castelyns (2011) suggest that job seekers who frequently use LinkedIn may get benefits for an active e-recruitment setting. Otter (2009) suggests that hiring is the perfect place to start using social networks in HR management. According to Lewis et al. (2015), HR managers consider networking with similar professionals via LinkedIn as the biggest advantage of networking implementation in a company.

The above review shows that the current articles primarily discuss the use LinkedIn for obtaining information about applicants and about the potential problems it conceals - the influence of various stereotyping views which lead to a non-objective evaluation already before the actual interview (the applicant is often not even invited to the interview). The verification of candidates according to their Facebook profiles poses similar problems. Caers and Castelyns (2011) have, for example, presented several studies confirming that by searching for information about applicants on the Internet, potential employers may already be biased prior to the selection. They are often influenced by age, race, sexual orientation, attractiveness, maturity, obesity, tattoos, and more. Organizations thus rightfully face a risk of discrimination (Lewis et al., 2015). Also, Zide et al. (2014) have focused on determining which elements recruiters look for on the LinkedIn profile when recruiting.

It is possible to decrease some disadvantages. The literature also deals with the use of LinkedIn profiles to automatically evaluate the suitability of the enrolled applicants. To assess the applicants' personalities, the employers require a link to their blogs, on which they then use a linguistic analysis (Gill et al. 2009; Oberlander & Nowson, 2006; Caers & Castelyns, 2011). In particular, the degree of extroversion, education, practical experience, and loyalty are assessed. But online recruitment strategies may feel too detached. And it is important to think that further research expects the increasing use of mobile devices (tablets, smartphones) in e-recruiting transformation. It will be possible to reach applicants everywhere. But more information is required on applicants' daily behavioral patterns and locations (Eckhardt et al., 2014).

These articles show that recruitment is done on LinkedIn by searching for suitable potential candidates, to whom an offer for a position is then sent. Either individuals (more commonly in the case of active recruitment by a personnel agency) or groups of people are sought, depending on what groups they follow, who they have in the net-work, or what education they declare. It looks like headhunting to some extent – they reach out to a specific

person, regardless of whether he/she currently has a job and wants to change it. However, compared to headhunting, they reach out to much larger number of potential workers at the same time. Caers and Castelyns (2011) have reported that neither LinkedIn nor Facebook is suitable for internal recruitment with a small number of potential candidates. However, we did not find any sources that explain how e-recruitment works. The exception is the model offered by McCabe (2016).

Hosain et al. (2020) in his meta-analysis E-recruitment: A Social Media Perspective analyzed in detail the role of social media on e-recruitment process based on existing extensive literature. He concluded, that majority of the studies indicate that social media is not being used as the main source of e-recruitment, but rather just as one of the additional sources. It is in accordance with our findings. Furthermore, Hosain revealed that such use of social networking sites as complementary source gets quite popular due to the wide and cheap availability of data and information. His paper, similar to this one, may be beneficial for the scholars as a literature reference as well as for HR professionals for some practical guidelines (based on recommendations provided) regarding the use of social networking sites for e-recruitment. (Hosain et al., 2020)

Recruitment agencies have both the resources and staff to ensure the creation of the best personalized headhunting after selecting the suitable candidates, the majority of whom are people who are employed and are not actively searching for a new job. Candidates tend to not respond to emailed or posted offers that are not specifically targeted to them. We nevertheless decided to verify whether the candidates selected through software express an interest. We created an advertisement, which was placed on LinkedIn.com and Academia.edu, and sponsored these ads. This means that we have entered the requirement that the advertisement is sent to the selected groups of candidates.

Passive candidates who are not seeking a position themselves, but would consider the change if the offer seemed interesting to them are thus used. It is, of course, possible that other suitable candidates will come across the advertisement accidentally. However, this is unlikely if they themselves are not actively seeking a new job. We therefore mainly relied on software that should be able to find a suitable group for recruitment. There are all kinds of automated systems from simple ones that make a rough selection based on, for example, the email address of the candidate, to sophisticated systems that monitor the level of representation of keywords and their synonyms in the CV (Faliagka et al., 2012). Such programs could also be used for analyzing profiles on LinkedIn, but we have not used them in our research. The strengths and weaknesses of multiple professional social networks are discussed by Olexova (2010). In general, it seems that the analysis of the social media use is quite straightforward and there is no need for some advanced statistics (Malec, 2022).

2. Methodology

The research was based on an experiment. Identical job advertisements were posted at LinkedIn.com and Academia.edu. LinkedIn.com was selected because it is a professional networking site meant for hiring in general. Academia.edu was chosen because it is a

networking site meant for academics. The aim was to compare the two sites in how many applicants they can attract.

The field chosen for the experiment was business administration because of its popularity among students. It can be argued that students, in general, prefer social sciences and humanities (compared to science and technology programs). So one could ask why not to choose e.g. social work; it grew rapidly in the last decade. Although it is correct, due to a high number of graduates and their limited applicability, and due to decreasing prestige of social work degrees among the general public, it is possible to expect the number of social work students to plummet in the near future and to stay low afterward. On the other hand, business administration graduates can find a position in a wide range of organizations (private, public, industrial, agricultural, social, etc.), and also start their own business.

Business administration or economic programs can be studied at multiple faculties of public and private universities. Many of those faculties are located in Prague. So conducting an experiment in Prague may be considered the most representative in the sense that if recruitment using LikedIn.com and Academia.edu does not work there, it is even less likely to work in smaller cities.

For the experiment to be as inclusive as possible, two positions were announced in business administration and management. Such courses belong to the core of any curriculum. Moreover, even teachers researching other topics could easily teach these courses.

Although e.g. Horváthová et al. (2011) point out that "[m]odern education depends on how to utilize various possibilities of modern technology to improve learning and teaching", there was no requirement of skills related to software nor hardware.

On the other hand, it was an associate/full professor opening. There are two reasons for that:

1. Assistant professors are easy to find, both assistant professors with several years of practice and people who just defended their Ph.D. thesis.

2. It is full professors (and associate professors to some extent) who are needed for accreditation of study programs and for guaranteeing courses.

Information about the job opening was posted in Czech because this was the language in which the candidates would need to teach. This would be the case for most such openings in the Czech Republic.

The experiment was conducted in the first quarter of 2015, the campaign was active for 3 months, it was not specially promoted /only standard rules applied/, campaign was not targeted to any specific competing university. With regards to costs, about 160 USD was used for LinkedIn.com plus extra about 20 USD for sponsored ads; 300 USD was used for Academia.edu.

3. Results

The job advertisements posted at LinkdIn.com and Academia.edu did not attract any candidates. Overall, two candidates applied for the position, they did not notice the postings on LinkdIn.com nor on Academia.edu, though they knew about the opening and, therefore, would notice it in social networking sites more likely than other potential candidates.

In spite of this short main finding, there are several observations worth mentioning. With regards to LinkedIn.com, 70 unique users clicked on the job posting. Only 26% of them had a Ph.D. degree, 27% had a master's degree, 3% had a bachelor's degree, and 44% had other degree. Possibly not even all 26% with Ph.D. degree would qualify for the position.

With regards to Academia.edu, there were 1,199,993 mini-ad views, attributed to 496,536 unique users. Of these, 213,113 were registered Academia.edu users and 283,423 were not. These 1,199,993 mini-ad views led to 1,887 full-page ad views, to 719 unique users. Of these, 148 were registered Academia.edu users and 571 were not. It is unclear how Academia.edu investigates the uniqueness of non-registered users, so it is possible that the latter number was somewhat smaller.

But the really interesting observation is the geographical distribution of 1,887 full page ad views – top 5: 423 Hong Kong, 415 United States, 97 France, 84 India, 84 Morocco.

To sum up, it is almost impossible to estimate the success of a job ad based on the number of views – a vast majority of ad views, which were observed in this research, were irrelevant.

The results are limited to associate/full professor openings in business/economics in Prague these days. Since the two fields advertised (business administration and management) are general, the results would be at least as bad for a more specialized opening.

The results would likely be the same (no applicants) in other Czech cities at the same time because other cities are smaller than Prague and the relevant labor market is also smaller.

It is necessary to stress the time perspective as well. Since the experiment was conducted, there is a new university law in the Czech Republic and there was established a new accreditation committee. As of the time of writing the paper, the committee has not made any decisions, so it is not clear what expectations it will have. It is possible that the new accreditation committee will be less strict, fewer full and associate professors will be needed for each program, so there may be more of them available on the market. Or it can be that the new accreditation committee will be as strict or even stricter than the previous one and all programs will need the same or even higher number of associate and full professors. In a long run, it could also mean that some programs lose accreditation due to an inadequate number of associate and full professors and, therefore, there may be more of them available on the market.

Job ad views on LinkedIn.com were not surprising only because only 26% of users claimed to have a Ph.D., which was necessary but not sufficient for the job, but also because of their current employers. Some worked for AT&T, T-Systems, BBC, Orange, Victoria's Secret. Of course, it could be those with bachelor's, master or "other" degrees. The geographical distribution seems logical – 16% from Prague, 6% from Brno, 3% from Šumperk that is the approximately same distance from Prague as Brno is from Prague. Most of the identifiable views were from the Czech Republic and Slovakia.

The high number of mini-ad views at Academia.edu could be explained by a really low number of postings at Academia.edu in total. But the geographical distribution of full-page ad views is puzzling. It is possible (but not very likely) that there could have been 415 non-unique (let's say 158 unique) users from the United States (Czechs, Slovaks, and a small portion of Poles). But it is unlikely that there would 423 non-unique (let's say 161 unique) users from China (accessing the social network through a proxy server in Hong Kong). There is no history of people

from former Czechoslovakia fleeing to China, unlike to the United States. Moreover, there were only 84 views from India, which has a similarly large population as China. It is hard to judge 97 views from France; they are approximately in the same relation to the population of France and 415 views to the population of the United States. Morocco with 84 views is certainly suspicious. This is final version of the top 5 list. During the life of the job posting, even Indonesia and Turkey appeared on the top 5 list. They were pushed away by France and Morocco.

India, Egypt, Indonesia, Malaysia, and the Philippines are known for fake likes on Facebook. Although it is unclear what economic advantage they would get from clicking on job ads on Academia.edu, it would still explain only India in the final top 5 list and Indonesia appearing there temporarily.

Comparing LinkedIn.com and Academia.edu, there were fewer views on LinkedIn.com but they were geographically more relevant (although probably only less than a quarter of users, who viewed the ad, would qualify).

4. Discussion

Internet has become the main source of information, also for job searches. The research aimed to investigate if placing job openings portals such on LinkedIn and Academia is a viable option of recruitment for higher education positions in the Czech Republic. Typically, there are enough applicants for Ph.D. positions. Often, there are not as many assistant professor openings as there are finishing doctoral students at a particular workplace. It is the recruitment of associate and full professor positions that require extra effort.

Currently, it seems that e-recruitment in higher education in the Czech Republic is not the best option. Since information about staff (including their titles and often also their list of publications) is public, it may be better to identify potential candidates by looking at the list of employees of relevant departments. The value of LinkedIn.com is in seeing common connections, so a recruiter can contact a potential candidate through a common connection rather than making a cold call. Traditional methods of word-of-mouth recruiting, and advertisement of open positions on university / departmental website seems to work better than e-recruitment.

We assume that when there were no applicants in a very popular field and a job with very frequent usage of the Internet in the capital, it is very unlikely that this way would help to recruit academics in other – narrower – fields who additionally spend a considerable amount of time outdoors or in the laboratory, such as forestry or food biology. Although we must admit, that the research was conducted some time ago, current situation with academic hiring over LinkedIn has not evolved much in the Czech market. Our finding, unfortunately, are still quite valid in regards of LinkedIn – it is still not a good tool in the Czech academic environment. However, recently a new trend has emerged – a dedicated website focusing exclusively on local research job opportunities has been launched (www.researchjobs.cz). It seems to be working well, contains job postings from various institutions across the Czech Republic and Bratislava. It could be the subject of further research, since its success can be a major game changer in the area of academic recruitment.

Conflict of interest: none

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Spatial Differentiation of the Situation on Local Labor Markets in the Areas of Impact of Airports in Poland

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Abstract: Spatial autocorrelation makes it possible to learn about the spatial structure of the dependence of the objects of the set and the interaction between the values of the studied variable in different locations. In the own research, it was used to assess the specificity of spatial differentiation of districts located in the areas of influence of Polish airports. In the course of their conduct few publications related to common areas of impact of airports were noticed. It was an inspiration to undertake research on such issues. The article has been divided into two parts. In the first part, districts located in the areas of influence of two or more Polish airports were identified; in the part, the spatial differentiation of regional labor markets in the studied area was assessed. The study was carried out in a dynamic approach, and then a comparative analysis of changes was made. As a result, it was found, inter alia that there is a phenomenon of non-random distribution of the tested objects. The selected results presented in the text are a continuation of the author's own research and fit in with the problem of verification of development differences.

1. Introduction

Air transport is an active element of the world economy and the modern transport system. From a historical point of view, it is the most recent branch of transport and its powerful development can be observed so far. The growing economic importance of airports contributed to the increased interest in the areas in their vicinity. They attract economic entities, the location of which often requires large-area facilities, or more generally, is land-consuming. In addition, transfer hotels, office and conference centers are being built in the vicinity of airports. In this situation, the proper location of airports in relation to built-up areas has become a determinant of the possibility of effective use of development stimuli brought by their vicinity (Trzepacz et al., 2012). On the other hand, air transport is becoming more and more popular, which constantly increases the importance of its infrastructure in the socio-economic space. Growing air mobility is accompanied by growing expectations regarding the scope and quality of services provided not only by air carriers, but also by individual airports. This affects the architecture of check-in terminals, as well as the policy regarding the surroundings of these facilities, and thus their location (Trzepacz et al., 2012). Moreover, as some authors note, the development of air transport and its branch infrastructure is conducive to systematic transformations in spatial development. Airports

dynamize urbanization processes, including agglomeration, and the surrounding areas change their public and economic utility (Ruciński & Rucińska, 2017). Indeed, any investment which does not offer satisfactory medium-term prospects for use or which causes a deterioration in the use of existing infrastructure in the areas of impact of air transport cannot be regarded as contributing to the achievement of the objective of common interest. It is worth emphasizing that the issue of spatial development is an interdisciplinary issue and is at the center of interest of town planners, architects, geographers, economists, sociologists and representatives of some technical sciences, and the publication achievements in this area are impressive (Ruciński & Rucińska, 2017).

The increase in air traffic is related, inter alia, to the need to increase investments in infrastructure. At the same time this increase means inter alia the possibility of increasing employment at the airport and its surroundings as well as increasing tax revenues. This in turn has an impact on the economic development of the region. There must be a balance between the airport's response to the projected growth and the elimination of its negative impact on the environment (Syta, 2019; Kalinowski, 2016). The aim of the article is a quantitative analysis of the structure of districts located in common areas of impact of air transport at least two airports in Poland, as well as an assessment of the degree of diversification of the situation on the local labor markets of these units.

2. Areas of Impact of Airports in the Light of Economic Literature

As some authors note, the basic unit determining the spatial range of origin of passengers choosing a given airport is the areas of impact air transport. In the literature, they are differently defined and named. It is caused by the variety of purposes for which the areas of impact of airports is studied, the multiplicity of entities analyzing such a catchment area, and the multiplicity of methods of determining this zone for a specific airport (Huderek-Glapska et al., 2016). Lieshout (2012) gives the most simplified definition of it. He calls the area of impact air transport its surroundings that attract passengers (Lieshout, 2012). According to Augustyniak (2012), the term impact zone has not yet been strictly defined by science. As a general rule, he proposes to assume that this is the geographical area around the airport from which most of the passenger and freight traffic handled is originated. Sometimes this definition is also extended to the area to which most of the said traffic is heading. One interpretation of the above definitions is the assumption that there is a circle-shaped zone around the airport with a radius of 100 km, from which most passengers and goods come (Augustyniak, 2012). The latter criterion was taken into account in the authors' own research, the partial results of which are presented in the next part of the study. The most basic and often used by airports method of determining the area with the same access time is to draw concentric circles with the airport being the focal point. Still other authors precisely specify the size of this area. The radii of the circles correspond to the time or distance needed to reach the airport. Areas of influence of the airport with a radius of 60/90/120 km, respectively, are an accurate illustration of areas delineated by curves connecting points, with the same travel time to the destination point – the nearest communication airport (Paner-Cybulska, 2014).

There are also positions that the determination of the catchment area of an airport should be made by:

a) adopting the airport accessibility criterion as a criterion of the geographically relevant market, where this criterion is expressed not in units of distance (kilometers), but in time units of airport availability;

b) analysis of other criteria:

- competitive constraints from other airports, both neighboring and more distant (e.g. passengers may be more interested in direct connections from a further airport than connecting connections from a closer airport);
- the fact that an airline based in one hub airport is in competition with an airline based in another hub;
- the fact that the carrier actually threatens to transfer the connections to
- another airport, even if that airport is not an alternative from the point
- view of passengers (Czernicki & Skoczny, 2011).

According to Trzepacz et al. (2012) it is a space within which there are entities that use a given airport for the purpose of air travel. In the analysis of passenger air transport, it is therefore residents or persons visiting a given area in relation to a specific airport. There are also positions that the load zone is:

- the geographical area of origin of departing passengers,
- the geographic area targeted by arriving passengers,
- estimated passenger distribution for both of the above-mentioned categories (Kujawiak, 2016).

The catchment area, or the area of influence of a given airport, is also understood as the ability to attract visitors and customers. It depends on the number of people living in the vicinity and the possibility of surface transport. The designation of such an area makes it possible to show the geographical dimension of the functioning of a given airport on the market of air transport services. The studies on the example of Polish airports have shown that the catchment areas depend on transport accessibility (Trzepacz et al., 2012). Passengers are often faced with the choice of one of several airports that operate in the conditions of strong competition of overlapping areas of gravity. In this situation, the choice of a given airport will often be determined by factors such as the network of connections, the transport availability of the airport or the price of the air ticket. In the course of the research, it was observed that the choice of the port to travel depends mainly on the availability of the connection network. Reaching your destination often requires a transfer at a larger port. In such a situation, a greater offer of connections with a large transfer port, giving the possibility of a flexible choice of travel dates, may be a more advantageous solution than a schedule with individual flights a week to various destinations. The quality of passenger service is also important for the selection of airports (Trzepacz et al., 2012).

The range of the ports' influence is determined by economic, social, functional and spatial relations with the airport. As aviation activity increases, the branch infrastructure and superstructure develop, and in the immediate vicinity of airports, unique functional structures

are formed, activating the development potential of these areas (Ruciński & Ruciańska, 2017). Ports and airport-proximate zones strengthen the competitive and marketing potential of cities and regions, stimulate their development and effective use of shared resources. Following the example of world experience, there is also a tendency to create airport-proximate areas around airports in Poland. This, in turn, is the result of a wide spectrum of natural and socio-economic conditions. And indicating the distance from the airport as a factor determining the "catchment area" is necessarily arbitrary and cannot be treated as a decisive criterion for determining the relevant market (Czernicki & Skoczny, 2011).

The area of the airport's impact on the activity of entities in its vicinity is called the airport's catchment area. The analysis of this area allows, inter alia, to assess the volume of demand for air transport. The acquired data is an important element in the management and development process of an airport, including the expansion of the existing and construction of new airport infrastructure (Kujawiak, 2016; Rutkowski, 2018). In this context, it is worth noting that, in fact, the interests of influence in the areas of impact of air transport overlap.

3. Methods of Measuring Spatial Autocorrelation

Global statistics are used to study the occurrence of spatial autocorrelation in the scope of the entire spatial system. They are complemented by local measures, determined individually for each of the regions included in a given system. One of the most frequently used measures to assess the strength and direction of spatial autocorrelation is the global Moran I statistics (Kołodziejczyk & Kossowski, 2016). It is determined by a formula:

$$I = \frac{n}{S_0} \times \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} a_{ij} (y_i - \bar{y})(y_j - \bar{y})}{\sum_{i=1}^{n} (y_i - \bar{y})^2} \tag{1}$$

where:

n – number of units in space,

a_{ij} – individual elements of the neighborhood matrix A,

S_0 – sum of all elements of matrix A,

y_i – value of the phenomenon for the i-th unit,

$\bar{y}$ – generalized arithmetic mean from all areas.

Usually, this statistic is interpreted as a correlation coefficient, although its value is not limited to the interval (-1,1). Positive autocorrelation means that neighboring objects are similar and that there are clusters of similar values. Negative autocorrelation resulting from the differentiation of neighboring objects corresponds to islands that are definitely different from the surrounding values. Several orders of neighborhood are distinguished in spatial analysis. First-order neighborhood refers to the direct neighbors of the tested object. The neighborhood of the second and further rows concerns the next neighbors of these neighbors. Most often in practice, the neighborhood of the first row is used.

4. The Problem of Overlapping Areas of Pressure in the Context of Conducting Research on the Impact of Air Transport on Regional Labor Markets

It should be noted that the areas of influence of most airports extend beyond the area of the voivodeship where they are located, which results in the existence of a common catchment area. On the other hand, as a result of a review of the literature to date, we notice that the problematic of overlapping areas rarely becomes a source of interest in scientific research (Tłoczyński, 2017; Bul, 2018). With the above in mind, one of the research objectives was to identify statistical units located in overlapping areas of influence of Polish airports. For this purpose, with the help of the Geostatistics Portal, the names of districts in the studied areas were determined. The results obtained in this way are summarized in Table 1. A detailed description of this procedure can be found in the literature (Surówka, 2019).
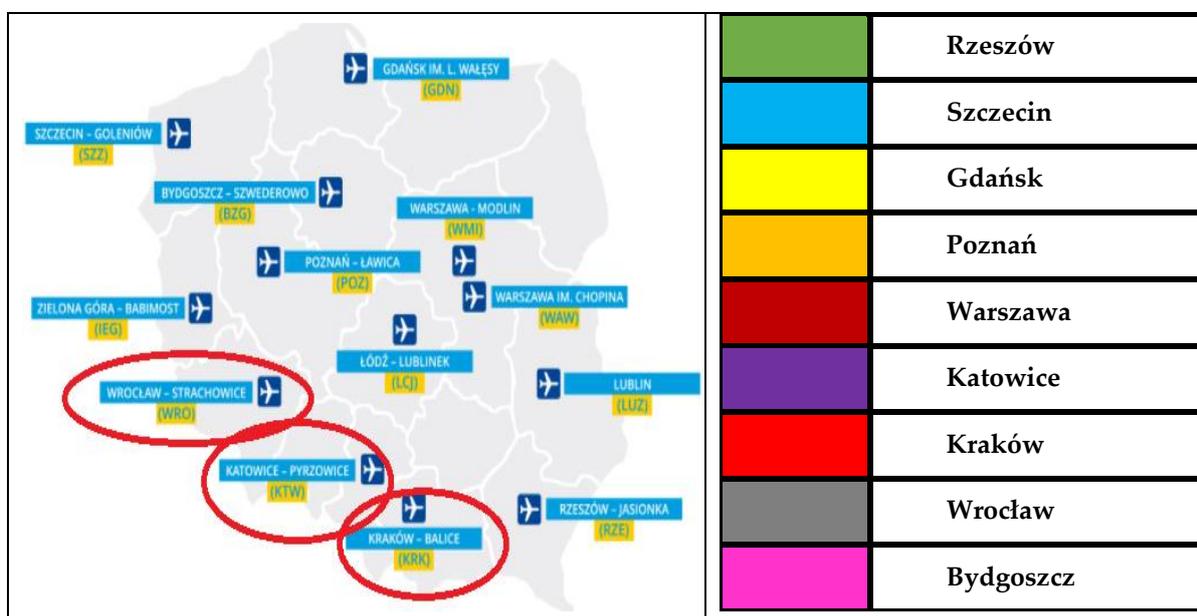
Figure 1. Illustrative map of designating districts located in the areas of influence of overlapping airports

The names of the districts are marked with colors according to the legend in Figure 1. Each airport is marked with a different color. Additionally, the names of the cities in which the port is located are given in brackets.

In the next step of the study, the results from Table 1 are presented in a graphical manner in the figures below in Figure 2. The color of the dot refers to the area of influence of the port to which a given unit belongs (see Figure 1).

Analyzing the information contained in Table 1 regarding the area of influence of the Solidarity Szczecin- Goleniów Airport, we note that out of the twenty-three sites only the czarnkowsko-trzcianecki and choszczeński districts are also within the influence of Poznań Airport. It is the smallest number of them. In the area of influence of Bydgoszcz Airport we note that four statistical units (Grudziądz, mogeliński, nakielski and żniński districts) are also in the area of influence of other airports. These are units characterized by a bad situation on local labor markets. In Grudządz a large imbalance in the labor market is observed, and the

Table 1. Cities and cities with districts rights belonging to the protection of 100 km of airports in Poland – Part 1

Rzeszów International Airport	Areas: biłgorajski, janowski, krasnostawski, kraśnicki, lubelski, **tomaszowski (Warszawa),** zamojski, **bocheński (Katowice, Kraków**), **brzeski (Katowice, Kraków, Wrocław),** dąbrowski, gorlicki, **nowosądecki (Katowice, Kraków**), **proszowicki (Kraków) tarnowski (Kraków), Tarnów (Kraków**), lipski, bieszczadzki, brzozowski, dębicki, jarosławski, jasielski, kolbuszowski, krośnieński, leżajski, lubaczowski, łańcucki, mielecki, niżański, przemyski, przeworski, ropczycko-sędziszowski, rzeszowski, sanocki, stalowowolski, strzyżowski, tarnobrzeski, leski, Krosno, Przemyśl, Rzeszów, miasto Tarnobrzeg, **buski (Kraków**), **kazimierski (Kraków, Katowice), kielecki (Katowice**), opatowski, ostrowiecki, **pińczowski (Kraków, Katowice),** sandomierski, staszowski
Solidarity Szczecin - Goleniów Airport	Areas: gorzowski, strzelecko-drezdenecki, Gorzów Wielkopolski **czarnkowsko-trzcianecki (Poznań),** białogardzki, kołobrzeski, koszaliński, **choszczeński (Poznań),** drawski, myśliborski, pyrzycki, szczecinecki, świdwiński, wałecki, łobeski, Szczecin, goleniowski, gryficki, gryfiński, kamieński, policki, stargardzki, Świnoujście
Gdansk Lech Walesa Airport	Areas: **Grudziądz (Bydgoszcz),** bytowski, chojnicki, gdański, kartuski, kościerski, kwidzyński, lęborski, malborski, **nowodworski (Warszawa),** pucki, starogardzki, tczewski, wejherowski, sztumski, Gdańsk, Gdynia, Sopot, braniewski, elbląski, Elbląg
Poznań Ławica Airport	Areas: **górowski (Wrocław), mogileński (Bydgoszcz), nakielski (Bydgoszcz) , żniński (Bydgoszcz)**, międzyrzecki, sulęciński, **wschowski (Wrocław)**, Zielona Góra, **chodzieski, czarnkowsko-trzcianecki (Szczecin)**, gnieźnieński, **gostyński (Wrocław), grodziski (Warszawa), jarociński (Wrocław), koniński, kościański (Wrocław), krotoszyński (Wrocław), leszczyński (Wrocław)**, międzychodzki, nowotomyski, obornicki, pilski, **pleszewski (Wrocław)**, **poznański, rawicki (Wrocław)**, słupecki, szamotulski, **średzki (Wrocław), śremski (Wrocław)**, wągrowiecki, wolsztyński, wrzesiński, Konin, **Leszno (Wrocław), Poznań, choszczeński (Szczecin)**
Warsaw Chopin Airport	Areas: Warszawa, pruszkowski, piaseczyński, warszawski zachodni, **grodziski (Poznań**), legionowski, **nowodworski (Gdańsk**), otwocki, żyrardowski, wołomiński, miński, sochaczewski, grójecki, pułtuski, skierniewicki, Skierniewice, rawski, wyszkowski, płoński, garwoliński, białobrzeski, węgrowski, kozienicki, łowicki, ciechanowski, makowski, płocki, przysuski, **tomaszowski (Rzeszów),** brzeziński, Radom, Siedlce, rycki, łukowski, Płock
Katowice Airport im. Wojciecha Korfantego	Areas: **bieruńsko-lędziński (Kraków**), chrzanowski, **myślenicki (Kraków), oświęcimski (Kraków), bocheński (Rzeszów, Kraków), kluczborski (Wrocław), Jastrzębie-Zdrój (Kraków**), wodzisławski, wielicki, krapkowicki, **Sosnowiec (Kraków**), gliwicki, pajęczański, będziński, Gliwice, **Jaworzno (Kraków**), Częstochowa, cieszyński, **rybnicki (Kraków), nyski (Wrocław), suski (Kraków), Bytom (Kraków), Rybnik (Kraków), wadowicki (Kraków), mikołowski (Kraków), wieluński, opolski (Wrocław),** Siemianowice śląskie, **Świętochłowice (Kraków), Mysłowice (Kraków**), Ruda Śląska, kłobucki, **Piekary Śląskie (Kraków), Żory (Kraków**), Zabrze, **pszczyński (Kraków**), kędzierzyńsko - kozielski, **Opole (Wrocław),** strzelecki, głubczycki, Katowice, radomszczański, zawierciański, krakowski, myszkowski, **namysłowski (Wrocław),** włoszczowski, miechowski, raciborski, **pińczowski (Rzeszów), żywiecki (Kraków), tarnogórski (Kraków), lubliniecki (Kraków),** piotrkowski, bełchatowski, **Dąbrowa Górnicza (Kraków),** łaski, **proszowicki (Rzeszów, Kraków**), **olkuski (Kraków), Bielsko-Biała (Kraków), Tychy (Kraków), prudnicki (Wrocław),** oleski, częstochowski, **jędrzejowski (Kraków),** konecki, **brzeski (Wrocław, Rzeszów, Kraków**), **Chorzów (Kraków), kielecki (Rzeszów), kazimierski (Rzeszów, Kraków), wieruszowski (Wrocław), bielski, (Kraków)**

phenomenon of unemployment has become severe and is one of the main problems in the development of the local community. In the opinion of the local government, it causes constant impoverishment of the inhabitants. In the area of influence of the Krakow Airport im. Jana Pawła II, the most numerous group is the districts located also in the catchment area

Kraków Airport im. Jana Pawła II	Areas: **bocheński (Rzeszów, Katowice), brzeski (Rzeszów, Katowice, Wrocław**), chrzanowski, dąbrowski, krakowski, limanowski, miechowski, **myślenicki (Katowice), nowosądecki (Katowice, Rzeszów)**, nowotarski, **olkuski (Katowice)**, oświęcimski **(Katowice), proszowicki (Rzeszów, Katowice), suski (Katowice), tarnowski (Rzeszów)**, tatrzański, **wadowicki (Katowice**), wielicki, Kraków, Nowy Sącz, **Tarnów (Rzeszów**), będziński, bielski, cieszyński, częstochowski, gliwicki, **lubliniecki (Katowice), mikołowski (Katowice)**, myszkowski, **pszczyński (Katowice), rybnicki (Katowice), tarnogórski (Katowice), bieruńsko-lędziński (Katowice**), wodzisławski, zawierciański, **żywiecki (Katowice), Bielsko-Biała (Katowice), Bytom (Katowice), Chorzów (Katowice**), Częstochowa, **Dąbrowa Górnicza (Katowice)**, Gliwice, **Jastrzębie-Zdrój (Katowice), Jaworzno (Katowice)**, Katowice, **Mysłowice (Katowice), Piekary Śląskie (Katowice**), Ruda Śląska, **Rybnik (Katowice**), Siemianowice Śląskie, **Sosnowiec (Katowice), Świętochłowice (Katowice), Tychy (Katowice)**, Zabrze, **Żory (Katowice), buski (Rzeszów), jędrzejowski (Katowice), kazimierski (Katowice, Rzeszów), pińczowski (Rzeszów, Katowice)**, włoszczowski
Wroclaw Airport	Areas: wrocławski, Wrocław, **Opole (Katowice), Leszno (Poznań**), lubiński, **leszczyński (Poznań)**, Legnica, jeleniogórski, **śremski (Poznań), średzki (Poznań**), oławski, ostrowski, trzebnicki, **kościański (Poznań**), ostrzeszowski, Jelenia Góra, świdnicki, kępiński, bolesławiecki, **gostyński (Poznań), pleszewski (Poznań**), oleśnicki, **brzeski (Kraków, Rzeszów, Katowice)** głogowski, milicki, polkowicki, **namysłowski (Katowice)**, złotoryjski, **wschowski (Poznań), jarociński (Poznań**), ząbkowicki, legnicki, **opolski (Rzeszów, Katowice), kluczborski (Katowice), rawicki (Poznań), krotoszyński (Poznań)**, krapkowicki, wołowski, dzierżoniowski, **nyski (Katowice), wieruszowski (Katowice**), strzeliński, jaworski, wałbrzyski, kłodzki, lwówecki, kamiennogórski, **prudnicki (Katowice), górowski (Poznań)**
Bydgoszcz Airport	Areas: bydgoski, toruński, Bydgoszcz, Toruń, brodnicki, chełmiński, golubsko-dobrzyński, grudziądzki, rypiński, wąbrzeski, **Grudziądz (Gdańsk)**, aleksandrowski, lipnowski, radziejowski, włocławski, Włocławek, inowrocławski, **mogileński (Poznań), nakielski (Poznań), żniński (Poznań)**, sępoleński, świecki, tucholski

of the Katowice-Pyrzowice Airport. On the right-hand side of this impact area, the green dot (see Table 1) marks the districts also located within the area of influence of the Rzeszów International Airport. In the area of impact of the Warsaw Chopin Airport, there are three districts (Grodziski, Nowodworsk and tomaszowski districts), located also in the area of influence of the second airport. Grodziski district is also located in the area of the isochrone of Poznań Airport. It is characterized by a decline in the unemployment rate. Nowodworski district in the catechment area of Gdańsk Lech Walesa Airport and tomaszowski district in the area of impact of Rzeszów International Airport. They are distinguished by high rotation in the labor market. The analysis of information on Poznań Airport shows that its area of influence is also in the zones of influence of four other ports. Among them, the following districts: mogileński, nakielski and żniński are also located in the catchment area of the Bydgoszcz Airport. When analyzing the data relating to the Rzeszów International Airport, we notice that on the left side of the studied area there are objects located in the areas of influence of overlapping isochrones of airports. Among them, the brzeski district is also located to the area of influence of the airports in Katowice, Kraków and Wrocław. The vast majority of objects are located in the isochrones of the neighboring ports in Kraków and Katowice. Four districts (Bochnia, nowosądecki, kazimierski and Pińczów) are located in the zone of influence of two additional ports. Due to the fact that in the area of impact of Katowice

Figure 2. Graphical presentation of districts located in the areas of overlapping isochrones
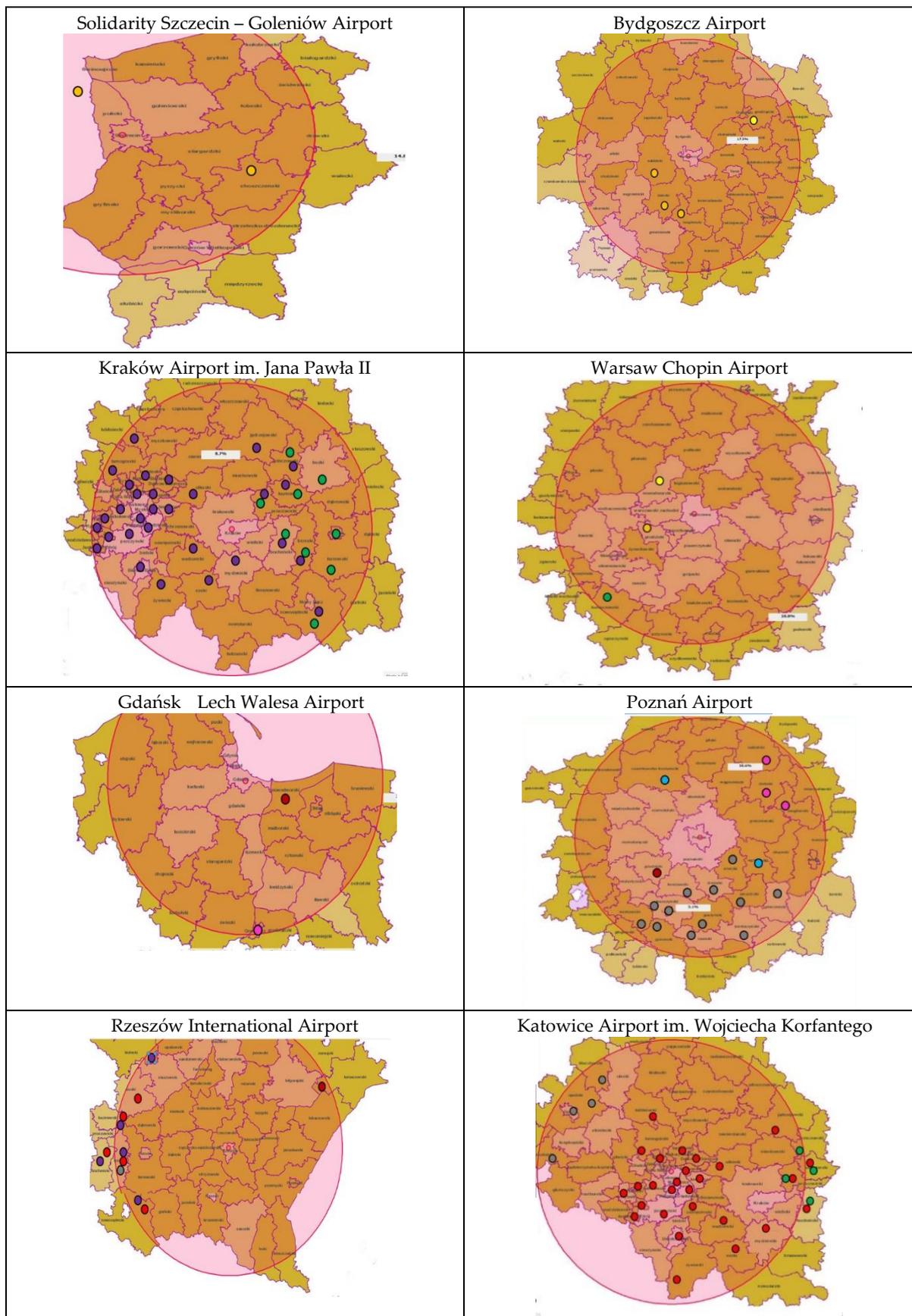
Airport im. Wojciecha Korfantego there are most districts located also in the catchment areas of Kraków Airport im. Jana Pawła II and Wrocław airport, these objects became a source of interest in the next part of the study (see Figure 1).

4. Discussion and Conclusion

The catchment area analysis is used by some airports, for example in the process of planning future investments. Unfortunately, in Polish and European literature we can find only a few results of research related to a comprehensive analysis relating to districts located in the areas of overlapping isochrones. Considering the above, the analyzes carried out by the author may be a source of inspiration for further research. In the course of the own research, a number of conclusions were drawn. Due to the limited scope of the publications, only selected ones are included in it. It was observed in the research procedure that the fewest objects belonging to more than one load area are located in the area of isochrones of airports in Gdańsk, Warsaw, Bydgoszcz and Szczecin. The most numerous group of facilities located in the area of at least two airports can be found in the zones of influence of airports located in the southern part of Poland (in Kraków, Wrocław and Katowice). The conducted research also assessed the degree of differentiation of the examined counties in terms of the situation on local labor markets (Surówka, 2020). The subject of interest in the text are only objects located in the area of the Katowice Airport im. Wojciecha Korfantego. The adopted list of characteristics determining the labor market can be found in the author's earlier publications (Surówka, 2019). The obtained results of spatial differentiation of regional labor markets in the areas of pressure of the analyzed ports, together with the list of indicator names, are also presented in Figure 3. The following designations have been adopted in the figure: the green dot marks the districts also located within the impact zone of Wrocław Airport, and the yellow dot Kraków Balice. Results refer to the year 2017.

In order to detect the nature and strength of the observed spatial relations in a given area, the Moran I spatial autocorrelation coefficient is used (Pośpiech, Mastalerz-Kodzis, 2016). Its significance is verified by the test of autocorrelation coefficients. As a result of the analysis of the determined values of these measures (Moran's I coefficients and p-value), it was noticed that almost all features are statistically significant throughout the entire period under investigation. Thus, it allows to consider the positive spatial autocorrelation as significant for most of the variables. The obtained results are presented graphically in the figures in Figure 3.

As a result of its analysis, the question arises whether the objects located within the range of more than one airport are characterized by different specificity. The conducted research allowed to answer this question and draw detailed conclusions. Among other things, by analyzing the ratio of units newly registered in the REGON register per 10 thousand. population, we observe a high level of concentration within a given location of areas with similar values of the analyzed variable. These areas form a group of poviats located in the eastern part of the studied region. It contains only objects located in the area of influence of the port under study. Most of the structures located in the areas of impact of air transport neighboring ports form the second cluster, located in the north-western part of the studied region. When analyzing the indicators selected for the study, in most of them, we do not

observe a tendency to cluster areas within a given location (districts located in the catchment area of at least one airport) with similar values of the analyzed variables. The exception is the entities per 1,000 inhabitants of working age index, for which the districts located also in the

Figure 3. Differentiation of the situation on local labor markets in districts located in the area of the Katowice Airport im. Wojciecha Korfantego
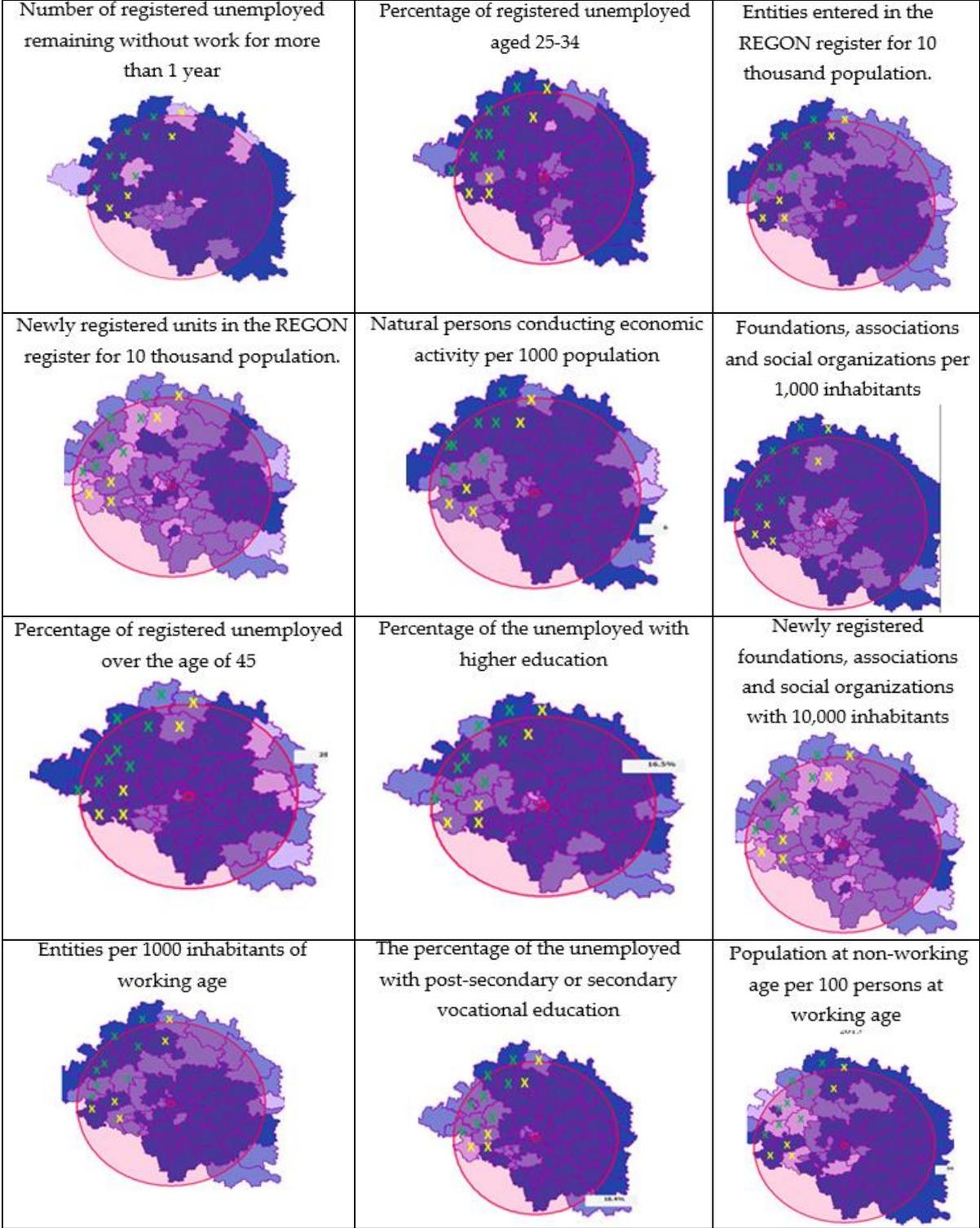
area of influence of the Rzeszów International Airport and Kraków Airport im. Jana Pawła II create areas with similar values of the analyzed variable. In the course of the research, it was

also observed that the ratio of the share of the total unemployed with higher education in relation to the number of working age population is characterized by a tendency to cluster objects that became the source of interest in the text. Such an indicator of natural persons conducting economic activity per 1,000 population was also analyzed. Positive values of the obtained Moran's I coefficients (2011-2017) indices indicate the presence of a positive spatial autocorrelation of this feature. The spatial autocorrelation coefficients of this feature were statistically significant (at the level of 0.05) and had a similar value. A similar trend in 2017 was observed for the feature of foundations, associations and social organizations per 1,000 inhabitants. Graphical analysis of this feature allows us to distinguish three clusters. One of them included almost all the districts located in the north-western part of the analyzed area. It is distinguished by the largest number of foundations, associations and social organizations per 1,000 inhabitants, which is the largest in this group. On the other hand, the analysis of the Moran I coefficients shows a very weak correlation between newly registered foundations, associations and social organizations per 10 thousand. residents. This means a very low increase in these forms of activity. The detailed results of the study are presented graphically in Figure 3. They give the opportunity to make your own interpretation.

Conflict of interest: none

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Corporate Social Responsibility in the Czech Banking Sector

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Abstract: The aim of the paper is to map and analyze CSR reporting in the 10 largest commercial banks in the Czech Republic. The focus will be to forms of reporting and areas of reporting. The three basic reporting options for publishing are the annual report, the individual CSR report and the www pages. Additional criteria will be analysed in all three reporting options. The analysis showed that only the three largest banks use all three media for reporting. The next section analyzes the reporting areas of CSR, where economic, social, environmental, philanthropic and ethical areas are monitored and evaluated. All banks report at least one of the routes or selected areas, except for Fio bank and Air bank, which do not have this obligation due the act on Accounting that sets the rules to report the non-financial information.

Keywords: bank; corporate social responsibility; reporting

JEL Classification: M14; M21; M41

1. Introduction

The influence of business entities on society and the role they play in it are important issues that need to be addressed in our own interest. At the same time, it is also necessary for business entities themselves to be aware of their role and all the attributes that companies bring, while the attributes that allow them to exist and ensure their successful development cannot be neglected. Corporate Social Responsibility (CSR) is an unintended obligation of an organization to take into account in its business the needs of its employees, suppliers, customers, government agencies and any other entities that are directly or indirectly affected by the organization's activities. Due to this broad concept, corporate social responsibility must be seen as a comprehensive issue that affects the wider environment. This environment can generally be divided into economic, social and environmental areas.

The concept of corporate social responsibility has become more and more popular in recent years and is very topical, especially in the phase when the company is "maturing". With the arrival of large national and multinational organizations on the market, the individual strategies of the principle of corporate social responsibility are expanding and gradually implemented in practice.

The modern era of CSR, or social responsibility as it was often called, is most appropriately marked by the publication by Howard R. Bowen of his landmark book Social

Responsibilities of the Businessman in 1953. Bowen's work (Bowen, 1953) proceeded from the belief that the several hundred largest businesses in the United States were vital centers of power and decision making and that the actions of these firms touched the lives of citizens in many ways. The key question that Bowen asked that continues to be asked today was "what responsibilities to society may businessmen reasonably be expected to assume?" Bowen for the first time tried to define the term CSR as to act as desired in the light of the goals and values of our society.

The year 1979 can be considered a turning point, as Archie B. Carroll defined four basic areas of CSR, which until then had been considered contradictory. It is about:

- economic responsibilities,
- legal liabilities,
- ethical responsibilities,
- discretionary responsibilities (Carroll, 1979).

Since then, the theory and practice of CSR have expanded exponentially, but it has still not been possible to come up with a definition that fully expresses the broad scope of CSR and becomes universally acceptable. For better poses, some definitions are given below.

The World Business Council for Sustainable Development (1999) defines Corporate Social Responsibility as the "continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large".

The European Commission defines CSR as "the responsibility of enterprises for their impact on society and, therefore, it should be company led. Companies can become socially responsible by integrating social, environmental, ethical, consumer, and human rights concerns into their business strategy and operations and following the law. Public authorities play a supporting role through voluntary policy measures and, where necessary, complementary regulation." (European Commission, n.d.)

"This is a concept where the company voluntarily assumes co-responsibility for well-being and sustainable development of modern society, while expecting competitiveness and profitability, which are not two conflicting objectives ". (Kunz, 2012)

According to Petříková et al. (2008), CSR "includes all activities that are far beyond the maximum legitimate requirements, as well as activities through which the organization seeks to understand and meet the expectations of all stakeholders in society".

Corporate social responsibility (CSR) is "a self-regulating business model that helps a company be socially accountable to itself, its stakeholders, and the public. By practicing corporate social responsibility, also called corporate citizenship, companies can be conscious of the kind of impact they are having on all aspects of society, including economic, social, and environmental." (Fernando, 2022)

KPMG, one of the biggest auditing company in the Czech Republic, defined Corporate social responsibility as "it forms an important part of our corporate culture, our values, and our business strategy". (KPMG, 2020)

CSR is currently still evolving and experiencing a steady increase in interest (Kunz, 2012). According to Zadražilová (2010), the growth of interest is caused, among other things, by a greater focus of public attention on the negative effects of the world economy.

The current lack of a uniform definition of CSR is due to the voluntariness on which the concept of CSR is based (Kunz, 2012; Petříková et al., 2008).

Dahlsrud (2008) contributed to the definition of CSR by analyzing the available definitions and identifying the five areas of CSR that are most common in the definitions:

- environmental,
- social,
- economic area,
- stakeholders,
- voluntariness.

In this analysis, Dahlsrud (2008) found that all five areas appear in 80% of the definition of CSR, three of these areas even appear in 97% of cases.

Moravcikova et al. (2015) presented that CSR is a trend that appeals to change of business orientation from short-term to long-term goals and from maximum to optimum profit. CSR reports, respectively triple-bottom-line reports have become tool of communication for Corporate Social Responsibility.

Accounting researchers have become increasingly interested in CSR, which has received notable attention in accounting and finance. Traditionally, CSR integrates social activities and business activities. Moser and Martin (2012) point out that the firms engage in socially responsible activities when they conduct business activities.

Despite the large number of definitions and their differences in interpretation, the authors agree that a company is part of society and cannot operate in complete isolation from the outside world. Definitions are usually interpreted in general terms, so any company can follow them, regardless of its size, legal form and subject of business.

1.1. Method of Reporting

Companies to which Act No. 563/1991 Coll., on Accounting imposes the obligation to provide non-financial information, must publish this information together with the (consolidated) annual report or in a separate CSR report. At the same time, they are obliged by this law to state the given content in their reports. All institutions are free to choose how they publish information on the CSR activities of stakeholders, whether companies do so voluntarily or required by law. These non-financial instruments are an annual report, a separate report on CSR or a website.

1.2. Reporting in the Banking Industry

All of the world's largest banks, and over four fifths of smaller N100 banks, report on corporate responsibility (CR). This suggests that CR reporting is well established as a standard business practice in the Banking sector. Banks are more likely to present CR information in their annual financial report than companies in any other sector. Almost all

(93 percent) of the largest banks do so, which is almost 30 percentage points above the global average (65 percent). (KPMG, 2015)

Pérez and Rodríguez del Bosque (2014) identify significantly consistent patterns in the CSR expectations of savings banks and commercial banks customers. The customers of both types of banking companies have similar high expectations concerning the CSR oriented to customers, shareholders and supervising boards, employees, the community and legal and ethical CSR. Also customers of both types of banking companies can be consistently classified as customer oriented, legally (customer)-oriented and CSR-oriented customers depending on their CSR expectations.

2. Methodology

Information on commercial banks operating in the Czech Republic was used in the analysis. The list of all financial institutions operating in the Czech Republic was taken from the official website of the Czech National Bank. In the spring of 2022, there were more than 50 banking institutions in the Czech Republic. The 10 largest commercial banks were selected for closer analysis. The criterion for the selection and ranking of banks became the amount of the balance sheet total, which was the insurance company from the annual reports of individual institutions from 2020.

According to the balance sheet total, these are the largest banks that can to some extent affect the economy or the social and environmental environment in our territory, so it is interesting to monitor their Corporate Social Activity.

The article will deal with individual areas of CSR and their activities, which are carried out by selected banks and which are published to the general public. Information on the bank's CSR activities was obtained from three basic sources. Annual reports, separate CSR reports or from the official website were used. The data for 2020 became the subject of research, because the annual reports and separate reports on social responsibility for 2021 were not published by all banking institutions at the time of writing.

3. Results

The following tables summarize the results of the reporting methods on non-financial information and on the examined CSR areas.

3.1. Reporting Methods

Table 1 provides the results of an analysis that focuses on how individual banks report. Annual reports were monitored for all banks, whether they prepare a separate CSR report or provide information on their websites.

Only 3 out of 10 banks provide CSR information in all ways. It is also the 3 largest banking institution on the Czech financial market.

- 7 out of 10 banks publish information on CSR activities in the annual report.
- 3 out of 10 banks prepare a separate CSR report.
- 7 out of 10 banks address the topic of CSR or sustainability on their websites.

Table 1. Analysis of the method of reporting on CSR activities

Name of the commercial bank	Annual report	The CSR report	www pages
Československá obchodní banka, a. s.	YES	YES	YES
Česká spořitelna, a. s.	YES	YES	YES
Komerční banka, a. s.	YES	YES	YES
UniCredit Bank Czech Republic and Slovakia, a. s.	YES	NO	YES
Raiffeisenbank, a. s.	YES	NO	YES
MONETA Money Bank, a. s.	YES	NO	NO
Fio banka, a. s.	NO	NO	NO
PPF banka, a. s.	YES	NO	YES
ING Bank, N. V.	NO	NO	YES
Air Bank, a. s.	NO	NO	NO

Annual report

Companies are required to prepare an annual report if their financial statements are subject to audit. The information that the annual report must contain is given in Section 21 of Act No. 563/1991 Coll., on Accounting. It follows from the law on all surveyed banking institutions to compile and publish an annual report with mandatory content.

Table 2 lists the banking institutions that publish CSR information in the annual report. The table also provides data on the number of pages, graphic processing, the scope of the CSR part and the regularity of the published CSR information in the annual report. The annual reports are each year prepared in the more precise and detailed way. It is possible to see it in the range of the annual report and also in the graphic design.

Table 2. Analysis of annual reports

Name of the commercial bank	Range	Range in 2017	Graphic design	Scope of the section on CSR	Regularity of publishing CSR activities
Československá obchodní banka, a. s.	349 p.	323 p.	YES	11 p.	annually since 2005
Česká spořitelna, a. s.	355 p.	267 p.	YES	2 p.	annually since 2007
Komerční banka, a. s.	330 p.	286 p.	YES	1 p.	annually since 2004
UniCredit Bank Czech Republic and Slovakia, a. s.	254 p.	204 p.	YES	1 p.	annually since 2013
Raiffeisenbank, a. s.	372 p.	268 p.	YES	3 p.	annually since 2013
MONETA Money Bank, a. s.	394 p.	308 p.	YES	20 p.	annually since 2016
PPF banka, a. s.	234 p.	193 p.	NO	0 p.	annually since 2013

- The range of annual reports ranges from 194 to 394 pages.
- All annual reports are excellently graphically processed and visually appealing.
- The number of pages of the CSR part ranges from 0 to 20 pages.

All commercial banks mentioning CSR in the annual report do so annually, even before the turning point of 2017.

CSR report

The analysis showed that only 3 banks prepare a separate report on CSR. At the same time, these are the three main players in the Czech banking market. The content of these reports is an introductory word, basic information about the bank, CSR strategies and an analysis of individual areas. Table 3 provides information on the number of pages, graphics

and clarity of the report. Last but not least, it deals with the publication interval, including the implementation of the first report. As with the annual reports, CSR reports evolve over time and the reports contain more information and are more graphically processed.

Table 3. Analysis of individual CSR reports

Name of the commercial bank	Range	Range in 2017	Graphic design	Regularity of publishing CSR activities
Československá obchodní banka, a. s.	109 p.	63 p.	YES	annually since 2006
Česká spořitelna, a. s.	31 p.	26 p.	YES	for the first time in 2007, with annual regularity since 2017
Komerční banka, a. s.	81 p.	25 p.	YES	annually since 2017

- The range of reports ranges from 31 to 109 pages.
- All reports are graphically modified and clear.
- Out of 3 reports has been issued regularly since 2006, the others since 2017.

www pages

The Internet has been used by a large number and a wide range of users in the last few years. He has become a carrier of information that is quickly and easily accessible from different parts of the world. All analyzed banks have their own websites, but only seven of them deal with the CSR topic on their websites. Table 4 contains the amount of information on the CSR topic on banks' websites and the difficulty of finding this information.

Table 4. Analysis of www pages

Name of the commercial bank	Difficulty in finding CSR information	Content
Československá obchodní banka, a. s.	NO	sufficient
Česká spořitelna, a. s.	NO	sufficient
Komerční banka, a. s.	NO	sufficient
UniCredit Bank Czech Republic and Slovakia, a. s.	NO	sufficient
Raiffeisenbank, a. s.	YES	sufficient
PPF banka, a. s.	YES	insufficient
ING Bank, N. V.	NO	sufficient

The concept of sufficient information is a detailed description of CSR areas supplemented by monetary amounts, photos, graphs and other graphic elements. The concept of insufficient information expresses a very strict description of areas, which does not have all three basic pillars of CSR.

Table 4 shows that:

- The term had to be searched for 2 out of 7 banks.
- 6 out of 7 banks have a large amount of information on the CSR topic on their websites.

The following table 5 shows the results of the performed analysis dealing with the areas of CSR. The table lists the areas that banking institutions mention in the analyzed sources. The analysis did not focus only on the basic areas of CSR, but was extended to the philanthropic and ethical areas, which are also often mentioned in the sources as is stated in the introduction.

Table 5. Reporting areas of CSR

Name of the commercial bank	Economic	Social	Environmental	Philanthropic	Ethics
Československá obchodní banka, a. s.	YES	YES	YES	YES	YES
Česká spořitelna, a. s.	YES	YES	YES	YES	YES
Komerční banka, a. s.	YES	YES	YES	YES	YES
UniCredit Bank Czech Republic and Slovakia, a. s.	YES	YES	YES	YES	YES
Raiffeisenbank, a. s.	YES	YES	YES	YES	YES
MONETA Money Bank, a. s.	YES	YES	YES	YES	YES
Fio banka, a. s.	NO	NO	NO	NO	NO
PPF banka, a. s.	YES	YES	NO	YES	NO
ING Bank, N. V.	YES	YES	YES	YES	YES
Air Bank, a. s.	NO	NO	NO	NO	NO

- 2 out of 10 banks do not mention economic and social activities.
- 3 out of 10 banks do not report activities falling into the environmental area.
- According to the analyzed sources, 2 out of 10 banks do not participate in the support of other people.
- 7 out of 10 banks respect the ethical and moral approach.

Tables show that Fio bank and Air Bank do not disclose any CSR information. At Fio bank, this is due to the fact that it is a company that does not have a non-financial reporting obligation imposed by Act No. 563/1991 Coll. At the same time, it does not meet all the conditions required by this law and has not decided to provide non-financial information voluntarily based on its decision. Air Bank is also not obliged to prepare and publish non-financial information under the Accounting Act, as this is done for the entire group by the parent investment company PPF. Last but not least, PPF bank does not publish CSR information in full and deals only with selected areas, as, like Air Bank, it falls under the PPF investment group.

4. Discussion

Banks tend to include CSR disclosures in the management commentary. They present CSR information in a diverse manner, focusing mainly on community involvement. The quality of CSR disclosures in 2011 was higher as compared with 2005. None of the banks in the sample produced integrated reports. (Krasodomska, 2015)

The analysis focusing on the development in publishing of CSR reports was also done in the 4 Asian countries. Over the seven years, bank CSR disclosure improved in all four analysed countries. Australian banks were found to have the best scores and Indian banks demonstrated maximum improvement. The next ones were from China and Japan. Despite

the absence of legislative requirements or standards for CSR, this paper finds that CSR reporting continued to improve in quality and quantity in the region on a purely voluntary basis. (Jain et al., 2015). If we compare not only the number of pages, but also the processing and content of reports in the Czech Republic, there is a significant shift in the more detailed and precise processing of CSR information and activities.

Similar results were also gained in the presenting of information on the websites. (Hladíková, 2022) Three-quarters of the banks communicate on CSR issues on their corporate website – either located in the section "About Us" or under a separate "CSR" heading which is directly accessible on the front homepage. Company reports published on the website are the most important vehicle for CSR communication. Their publication increased from six for the publication year 2000 to a peak of 63 reports for the year 2011. The reports' titles are most commonly linked to the concepts of "responsibility" or "sustainability" and refer to ten main stakeholders and topics. In a comparison between continents there is a difference in the use of titles: European banks prefer the title "Sustainability Report", while Asian and American banks in particular prefer the title "CSR Report". (Hetze & Winistörfer, 2016)

Matuszak and Różańska (2020) presented that the results indicate that accessibility to CSR information is relatively good. The placement of CSR information on websites varies among banks. Moreover, community involvement was the most disclosed dimension on the banks' websites. There was a lack of disclosure on items regarding the environment. Furthermore, the findings of this paper showed that significant determinants for explaining online CSR disclosure level were size and being listed.

MacGregor Pelikánová (2019) focused on CSR information in annual reports in the EU. She focused on the Czech case study. The 10 largest Czech companies are subjects of the legal duty to prepare and e-file with the Commercial Register their annual reports with CSR information, but this legal duty is set up in a rather general and vague manner. In our research in the banking industry it wasn´t the same.

A similar analysis was performed in the Czech automotive sector, that has lower level of reporting in the selected areas. (Svobodová & Bednarska-Olejniczak, 2021)

Evaluation of cluster initiatives that can be used also in CSR is presented in Bureš et al. (2012) CSR activities may be one of the reasons why individuals choose the bank institution. Selection of bank account is also solved in Hedvičáková (2017).

5. Conclusions

The concept of corporate social responsibility has become more and more popular in recent years and is very topical, especially in the phase when the company is "maturing". With the arrival of large national and multinational organizations on the market, the individual strategies of the principle of corporate social responsibility are expanding and gradually implemented in practice.

All steps of CSR implementation in the company are intertwined with proper communication of CSR activities back to stakeholders. The analysis of the social responsibility of selected banking institutions showed that they report on their CSR activities mainly on their websites, in their annual reports, and only 3 commercial banks from 10 largest

in the Czech Republic have their own CSR report. The main principles, attitude and values of social responsibility are published on the website, and the available CSR reports provide information in greater detail. Commercial banks, which are required to report non-financial information, do so in their reports.

Conflict of interest: none

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EMS Application in Businesses – Systematic Review

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Abstract: This systematic review answers the question what aspects of Environmental Management System (EMS) implementation in small and medium sized enterprises (SMEs) are dealt in contemporaneous literature. For this purpose, by applying keyword search queries and the follow-up screening, 26 publications were filtered out of Web of Science database, which were then analyzed in a quantitative method using bibliometric procedures, followed by a systematic qualitative review. It was based on a conceptual analysis, identifying the basic EMS implementation aspects comprised. Through synthesis of the ascertainments obtained, we conclude that the main aspects of EMS implementations in SMEs are the implementation procedure hindrances, be that internal barriers, prohibitive costs and need for their justification.

Keywords: EMS; business; environmental practices; systematic review

JEL Classification: Q18; F52

1. Introduction

Small and medium businesses (SMEs) in general are often unconscious of their environmental impact (Ormazabal et al., 2018; Teriö & Kähkönen, 2011) and lack the knowledge and experience required to build and administer environmental management systems (EMS). These corporations however have had a substantial impact on the environment (Ammenberg & Hjelm, 2003), either alone or in combination with other industries. As a result of the challenge of optimizing their production processes to account environmental factors, SMEs have increased their focus on EMS (Yen Nee & Abdul Wahid, 2010).

1.1. Environmental Management System

To really be a successful aspect of corporate management, EMS must be an indispensable part of an integrated management solution (Teriö & Kähkönen, 2011). In this regard, EMS should be a constituent of a larger plan that incorporates workplace safety measures, quality management and healthcare (Frehe & Teuteberg, 2017). Thus, an EMS becomes an efficient tool to assist a corporation in realization of its periodic audits of its components (Ptáčková Mísařová, 2012) and developing appropriate process for setting environmental objectives, duties and internal regulations.

There is a stress for the need of an environmental management system which considers a company's structure via a complete evaluation of processes (Johnstone, 2020b) which analyzes how a company's activities effect ecological problems, reinforcing these notions, and which analyzes how a company's activities effect ecological problems, reinforcing these

notions (Granly & Welo, 2014). It should be pointed out that EMSs are applied as part of a set of administrative instruments to manage effects in order to encourage enterprises to upgrade their environmental and in general "green" practices. Besides the EMS application with small and medium size enterprises may aid them in the implementation of environmental standards and, under most circumstances, adhere to the standards of ISO 14001 (Pangboonyanon & Kalasin, 2018).

1.2. Application of EMS in Case of SME

In general terms, the majority stream of researches (Culley, 2019; Johnstone, 2020a; Naidoo, 2010) argue for incorporating an EMS into the core conception of a small and medium enterprise. They stress that it is absolute necessary to create efficient environmental management, health care system and quality management system.

The Standard ISO 14001 (Johnstone, 2020a) has made it possible to use EMS as a quality certification system. This guideline views environmental management system as a component of a wider system that comprises a business's whole strategic planning (Chan, 2011), institutional framework, duties (Hai, 2008), processes, operations, methods (Taylor & Murphy, 2004) and assets (Zobel, 2007) for integrating, developing implementing, improving and monitoring its green management.

Green developments in the case of small and medium size enterprises could be vital steps with the following benefits:

- contribution to improvement of environmental consequences and/or particular ecological renewable energy targets (Hillary, 2004);
- generation of new attitude, ideas, technologies and methods, or services (Rasit et al., 2019).

Combining these 2 beneficial aspects, the business can remain or become successful even in intense competition as a direct result of analyzing a corporate environment and identifying appropriate environmental improvements (Yen Nee & Abdul Wahid, 2010).

In Europe, a business is regarded as a small and medium enterprise (SME) (Musso & Francioni, 2014) if: a) its headcount is below 250 employees; and b) has either an annual turnover of less than EUR 30 million or a yearly balance equal or less than EUR 25 million. Also, in order to be taken as an SME, the business must allow a public body to control 25% of its capital and/or its voting rights.

Whilst big businesses have major environmental consequences (Santos et al., 2011), SMEs possess unique characteristics (Zorpas, 2010) which must be considered when applying EMS. Deficiency of experience and expertise (Ibrahim et al., 2018), a shortage of specific policies (Tüzün Rad & Gülmez, 2017), scarcity of funds (Campos, 2012) and high deployment expenses (Adel et al., 2020) with this sort of business, have all hampered SMEs' implementation of EMSs. The need of creating specific ways for adopting EMSs in SMEs has been underscored under these circumstances (Granly & Welo, 2014; Hillary, 2004; Zobel, 2007).

In past years, numerous studies on the application of environmental management in SMEs have been conducted all over the planet (Burke & Gaughran, 2006; Johnstone, 2020a;

Rasit et al., 2019; Zheng & Zhang, 2010). Several SMEs analyses have targeted on hazards, impediments to innovation, budget, technological and scientific improvements, and environmental indicators (Adel et al., 2020; Granly & Welo, 2014; Michlowicz, 2021). The significance of EMS as a prospective instrument for adopting environmental control in these businesses has also been stressed (Zorpas, 2010).

However, it must be admitted that only very few of the studies were systematically targeted at mapping individual EMS aspects applied in SMEs, which is regarded as a research gap by the authors of this study.

In light of this, the research question that inspired this study originated as follows: what are the main aspects of EMS implementation in SMEs that the contemporaneous research literature deal with? In order to answer this question, the systematic review presented aims to provide a survey of the state-of-the-art in the subject area.

2. Methods

This type of systematic literature review is characterized as mixed approach (Zhang et al., 2020) since it combines quantitative (i.e. bibliometric analysis) (Donthu et al., 2021) and qualitative (systematic analysis of papers, including their content analysis) techniques (Page et al., 2021a).

The study was carried out in the below consequent steps.

1. Determination of the database selection criteria and dataset fields

The database used in this research was Web of Knowledge (WoS) because of its a long and steady standing as a trans-disciplinary index of the most referenced periodicals in their related disciplines (Singh et al., 2021).

2. Formulation of inclusion and exclusion criteria for publications analyzed
3. Keyword database searching

The title, abstract, and keywords referencing to concepts related to EMS and SMEs were filtered out using an internal search WoS interface based on the selected keywords with application of the pre-defined search settings (Table 1) and search queries (Table 2) in conformity with the inclusion/exclusion criteria above.

Table 1. Search settings

Item	Settings	Rationale
Indexing service	Web of Science	Quality of materials published
Database	Web of Science Core Collection (1945-present)	Leading publications, full indexation and searchability
Edition	SCI-EXPANDED SSCI ESCI	Elimination of documents pertaining to irrelevant research areas
Exact search	disabled	Abridgement and simplicity of search queries, however without reduction of the scope of documents retrieved

Table 2. Search queries

Item	Query segment	Number	Rationale
Publication Years	PY=(1992-2021)	#1	Broad research period, enabling determination of time trends
Language	LA=("ENGLISH")	#2	Practical reasons: language gap
WOS Index	EDN=("WOS.SCI" OR "WOS.SSCI" OR "WOS.ESCI")	#3	Elimination of irrelevant research areas
WOS Categories	TASCA=("ENVIRONMENTAL SCIENCES" OR "GREEN SUSTAINABLE SCIENCE TECHNOLOGY" OR "ENVIRONMENTAL STUDIES" OR "MANAGEMENT" OR "ENGINEERING ENVIRONMENTAL" OR "BUSINESS" OR "PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH" OR "OPERATIONS RESEARCH MANAGEMENT SCIENCE" OR "ECOLOGY" OR "ECONOMICS" OR "BUSINESS FINANCE" OR "TRANSPORTATION SCIENCE TECHNOLOGY" OR "TRANSPORTATION" OR "PUBLIC ADMINISTRATION" OR "LAW" OR "POLITICAL SCIENCE")	#4	Elimination of irrelevant research areas
Research Areas	SJ=("ENVIRONMENTAL SCIENCES ECOLOGY" OR "BUSINESS ECONOMICS" OR "TRANSPORTATION" OR "OPERATIONS RESEARCH MANAGEMENT SCIENCE" OR "PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH" OR "PUBLIC ADMINISTRATION" OR "GOVERNMENT LAW")	#5	Elimination of irrelevant research areas
Keywords	TS="environmental management system*" OR TS=("EMS" AND "environment*")	#6	Focus on environmental certification
	TS=("emergency" OR "medical")	#7	Elimination of items related to "Emergency Medical Service"
	TS=("small and medium enterpris*" OR "small and medium business*")	#8	Focal on small and medium sized enterprises

Note: The resulting search query was formulated by concatenating the above query segments in the WoS Advance Search Interface with the following syntax: #1 AND #2 AND #3 AND #4 AND #5 AND #6 NOT #7 AND #8

4. Screening of keyword database searching results

The goal was to check whether the publications obtained by the preceding stage through keywords database searching of their titles, abstracts, and keywords and full-texts are factually related to the subject examined in this study. Unlike the preceding keyword database searching, this one was performed by human screening exclusively. To visualize the results obtained we used an adapted extended version of the standard PRISMA flowchart (Moher et al., 2016)

5. Bibliometric (quantitative) and systematic (qualitative) analysis

The bibliometric analysis was performed through human screening by the authors, with the support of the online WoS analytics interface. Systematic analysis was carried out through human screening performed by the authors (no automatic searching tools) in 2 steps as recommended by Page et al. (2021b): a) First, the papers were searched for presence of conceptual definitions of EMS, and then b) Aspects of EMS implementation in SMEs were identified and classified and the outcome then synthesized in accordance with the main subject of this study. As regards software applications used, The gathered references were stored and processed using Mendeley online (Takatori, 2016). This application is a reference manager that may be coupled with the databases used in this review.

3. Results and Discussion

3.1. Keyword Database Searching

The keyword database searching was executed on January 31, 2022 by applying the search settings and queries as specified in the methods section. The database searching (publications) respectively identification of publications via other methods yielded 29 results, respectively 25 results, as rendered in the upper left (resp. right) bold-framed nod of the PRISMA Flowchart (Annex).

3.2. Screening of Keyword Database Searching Results

The total of 54 results obtained as specified above were screened for compliance with the inclusion/exclusion criteria as specified above. The screening lead to a resulting portfolio of 26 publications as rendered in the lower bold-framed nod of the PRISMA Flowchart (Annex), which were then entered into the quantitative bibliometric analysis and the following qualitative systematic analysis.

3.3. Bibliometric Analysis

In the resulting portfolio we identified 3 reviews, 15 case studies and 8 surveys (Figure 1 A). This shows that – in the subject of environmental aspects of small and medium enterprises – case studies are clearly predominant, which is confirmed also by Balanovska et al. (2019).

The portfolio comprises 11 theoretical studies and 15 empirical studies (Figure 1 B), which indicates that empirical approach is most applied on this subject. Like Hai (2008), the authors believe that this may have its rise in the purely practical and complex character of the subject explored, i.e. EMS implementation in business sphere, which makes its – due to its complexity – its rendering by means of constructs in the theoretical plane is rather difficult and impracticable.

The most frequented keywords identified in the resulting portolio were EMS (15 occurrences), Environmental Management System (11), small and medium business (4), small and medium enterprise (7), environmental protection (3) (Figure 1 C). This makes us conclude that the environmental certification aspect is the most accentuated, followed by the

aspect of the enterprise size. This outcome is quite understandable and could undoubtedly be expected.

We identified 21 qualitative oriented articles in the portfolio, versus only 5 quantitative oriented ones (Figure 1 D). This leads us to assume that qualitative aspect is absolutely predominant within the scope of problems related to environmental aspect of activities of small and medium enterprises. This observation is in a perfect correspondence with Pangboonyanon and Kalasin (2018), who – however – do not try to explain the reason. The authors of the study presented believe that the predominance of qualitative-oriented research has its rise in the fact that environmental aspects of business operations are difficult to be rendered in quantitative manner, which requires clear identification and unambiguous definition of constructs, followed by an exact numerical analysis, as also has been mentioned in the section related to the study approach (theoretical vs. empirical).
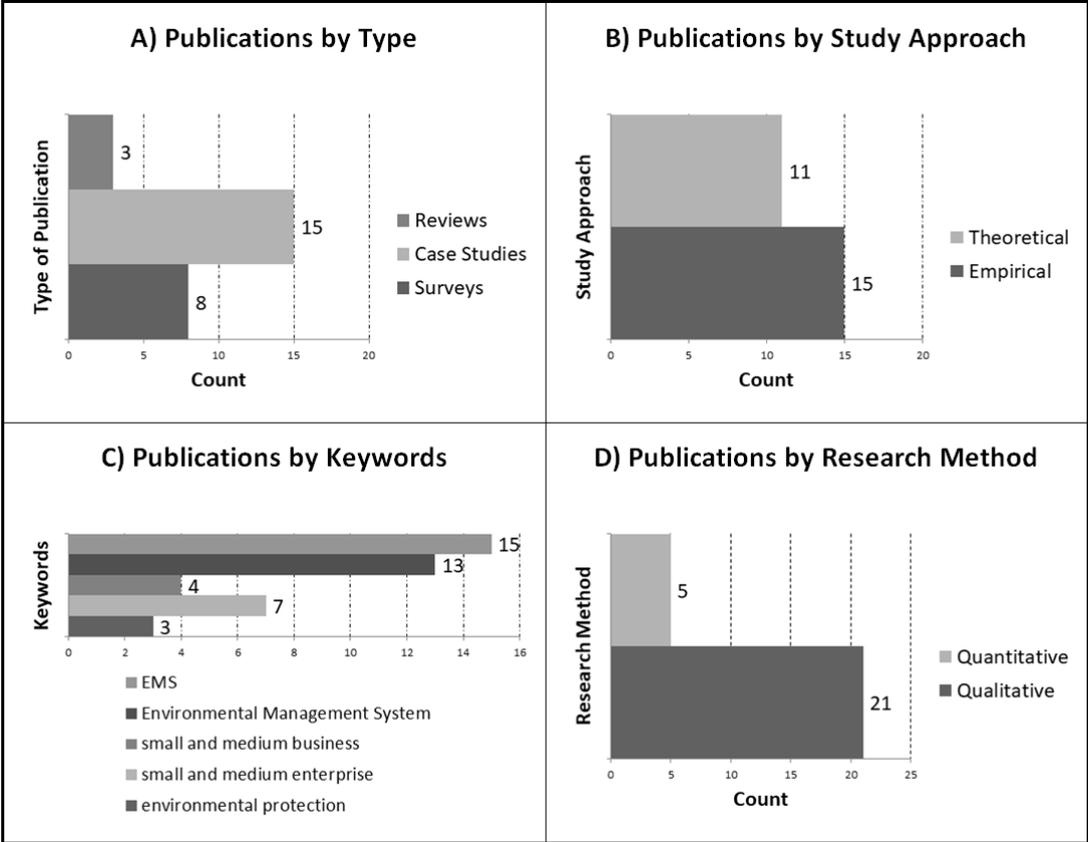
Figure 1. Bibliometric analysis of the resulting portfolio

3.4. Systematic Analysis

Following the quantitative bibliometric analysis, the portfolio publications entered into qualitative analysis stage for systematic review as defined by Johnstone (2020a), which was the main goal of this study (no quantitative analysis was performed within the framework of the systematic review) It consisted in examining the state of literature dealing with EMS implementation in SMEs. Table 3 provides a list of the dominant aspects of the EMS implementation as treated in each of the resulting portfolio publications.

Table 3. Publications by EMS implementation aspect in SMEs

Publication	Aspect
Musa and Chinniah (2016)	Presents analysis of failures, corrections of the procedure course and improvements to environmental policy.
Teriö and Kähkönen (2011)	Recommends application of other tools for data collection of EMS aspects, such as webpage research, report analysis.
Adel et al. (2020)	Proposes to apply cross-evaluation in decision-making on EMS implementation
Zobel (2007)	Proposes behavioral methods in researching SME activities
Sampaio et al. (2012)	Stresses the role of efficient systems for evaluation of EMS efficiency in decision-making about EMS implementation and maintenance
Campos (2012)	Points out the importance of in-depths analysis of both internal and external environment of SMEs in decision-making about eventual EMS implementation.
McKeiver and Gadenne (2005)	Considers how operation of SMEs influences living environment; examines environmental aspects SMEs activities
Seiffert (2008)	Points out the risk of endeavors to reach maximum integration of environmental and other systems across a group of SMEs comprising heterogeneous business as regards their economic power.
Zorpas (2010)	Elaborates planning, documentation, measurement, monitoring, and evaluation of environmental responsibility implementation goals
Ramos et al. (2013)	Emphasizes that in research aspects of EMS implementation in SMEs it is important to obtain a sufficient sample of examined businesses.
Yen Nee and Abdul Wahid (2010)	Emphasizes the importance of engaging SMEs employees; underlines the need to assign powers to them; the business should give incentives to the employees to actively support environmental endeavors of the business
Cordano et al. (2010)	Deals with special methods applied in research of environmental aspects of activities pursued by SMEs
Chan (2011)	Focuses on resource availability
Santos et al. (2011)	Deals with the scope of problems concerning implementing EMS in groups of SMEs.
Ammenberg and Hjelm (2003)	Suggests that also third parties should be involved in decision making process about implementation and maintenance of EMS in SMEs.
Chavan (2005)	Considers a wide range of factors active in decision of SMEs about implementing EMS
Hillary (2004)	Considers mutual differences between the SMEs based on internal division of SMEs according to their size and field of their entrepreneurial activity (business sector)
Hai (2008)	Underlines environmental management training
Rasit et al. (2019)	Stresses the importance of certification and compliance with ISO standards
Granly and Welo (2014)	Emphasizes that there should be made a distinction between the individual SMEs in the group depending on their economic situation (prosperous versus poor). EMS implementation should consider differences between individual SMEs in the group and the implementation policy should be differentiated and formulated accordingly.
Burke and Gaughran (2006)	Stresses the role of specialists and external consultants in implementing EMS within the SME organization structure
Wong et al. (2020)	Considers the quality of the relation between the SME managers and their owners; points out the fact that their environmental interests (and thereby also approach) may differ or be even contradictory
Jaroenroy and Chompunth (2019)	Details aspects of EMS maintenance in SMEs
Prajapati et al. (2021)	Deals with engagement of the supporters, public and media in decision –making procedure about EMS implementation.
Ardente et al. (2006)	Emphasizes the importance of innovations leading to new environmental solutions which combine efficient "green" benefits and low costs
Johnstone (2020b)	Defines recommended corporate environmental policy and planning sets

Bases on the ascertainment as stated above, we can gather that the papers analyzed pointed out the following problems associated with EMS implementation in SMEs: cost savings in long-term sustainable practices (Balanovska et al., 2019), necessity of gaining a competitive edge as a result of EMS implementation (Campos, 2012), insufficient knowledge concerning environmental consequences (Johnstone, 2020a), need for formal environmental regulation (Chan, 2011), strengthening business reputation of the enterprise owing to environmental compliance (Teriö & Kähkönen, 2011), unclear ethical benefits ensuing from environmental compliance and need for clear definition of "green" responsibility (Zorpas, 2010), difficult EMS administration (Balanovska et al., 2019), need for schooling on environmental issues (Ammenberg & Hjelm, 2003), gaining new clients based on improved environmental image (Taylor & Murphy, 2004), inter-business cooperation in environmental problems (Hai, 2008), high expenses associated with EMS implementation (Wieczorek-Kosmala et al., 2020).

However, a great many of the studies reviewed (Adel et al., 2020; Ammenberg & Hjelm, 2003; Balanovska et al., 2019; Ramos et al., 2013; Yen Nee & Abdul Wahid, 2010; Zorpas, 2010) also state that – once and if SMEs managed to overcome early financial obstacles and a lack of prior expertise about deploying EMSs, the EMS implementation did yield favorable benefits and had a positive impact on the operational efficiency of the enterprise. Consequently, as a result of successful EMS implementation, a majority of small and medium sized enterprises were able to implement and successfully run environmental management of their organizations as confirmed by Adel et al.(2020).

4. Conclusions

Based on conceptual analysis of literature sources, using the PRISMA standard and OSF-open-ended – registered protocol the systematic literature review identifies what aspects of EMS implementation in SMEs are treated in the contemporaneous research papers.

Having synthetized the results, we can conclude that the most frequented focus is directed to the scope of problems related to difficulties with EMS implementations, hindrances, be that internal barriers, prohibitive cost and need for their rational justification. Thereby the study presented offers a deeper insight into green aspects of SME operation, which are to be considered even in the for-profit sector.

Conflict of interest: none

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Annex. PRISMA flowchart (adapted from Tricco et al. (2018)).

	Identification of studies via databases and registers		Identification of studies via other methods	
Identification	**Records identified from database through keyword searching:** • WoS (29) **Total n = 29**	**Records removed before screening:** • No duplicate records removed (because only one database was used and so no additional records identified through other databases) (0) • No records marked as ineligible by automation tools (because no automation tools were used) (0) • Records removed for other reasons (0) **Total n = 0**	**Records identified from:** • Websites (22) • Organizations (0) • Citations searching (2) **Total n = 25**	**Records removed before screening:** • No duplicate records removed (because only one database was used and so no additional records identified through other databases) (0) • No records marked as ineligible by automation tools (because no automation tools were used) (0) • Records removed for other reasons (0) **Total n = 0**
Screening	Records screened for eligibility (inclusion and exclusion criteria) based on title and abstract (21)	**Records excluded based on title and abstract:** PRACTICAL SCREENING: • Title and/or summary not consistent with the study objectives (5) • Paper not dealing with environ. impact of implementation EMS, conditions and/or problems of implementation, conditions for for success etc. (3) METHODOLOGICAL SCREENING: • Paper not published in a peer-review journal (0) • Editorials (0) **Total n = 8**	Records screened for eligibility (inclusion and exclusion criteria) based on title and abstract (25)	**Records excluded based on title and abstract:** PRACTICAL SCREENING: • Title and/or summary not consistent with the study objectives (1) • Paper not dealing with environ. impact of implementation EMS, conditions and/or problems of implementation, conditions for for success etc. (2) METHODOLOGICAL SCREENING: • Paper not published in a peer-review journal (0) • Editorials (0) **Total n = 3**
	Documents sought for (full text) retrieval (n = 19)	**Documents not retrieved (full text unavailable)** (n = 2)	Documents sought for (full text) retrieval (n = 22)	**Documents not retrieved (full text unavailable)** (n = 3)
	Documents screened for eligibility based on full text (n = 24)	**Documents excluded based on full text:** PRACTICAL SCREENING: • Irrelevant – different research area (4) • Irrelevant – different study focus (2) METHODOLOGICAL SCREENING: • Not appropriate study design (1) • Additional studies based on those already existing (0) • Insufficiently described methods applied (n = 0) • Sample selection not properly justified (0) • Data collection method unclear (unexplained) (3) • Insufficient data analysis and/or uncleared results (0) **Total n = 10**	Documents screened for eligibility based on full text (n = 19)	**Documents excluded based on full text:** PRACTICAL SCREENING: • Irrelevant – different research area (2) • Irrelevant – different study focus (1) METHODOLOGICAL SCREENING: • Not appropriate study design (0) • Additional studies based on those already existing (0) • Insufficiently described methods applied (n = 0) • Sample selection not properly justified (0) • Data collection method unclear (unexplained) (2) • Insufficient data analysis and/or uncleared results (2) **Total n = 7**
Included	Documents included (n = 14)		Documents included (n = 12)	
	Total documents included in systematic review presented (qualitative analysis and synthesis) (n = 26)			

Note: No quantitative analysis we performed within the systematic analytical stage

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Knowledge Management and Knowledge Transfer in a Tourism Destination

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Abstract: The paper compares the work of the UNWTO Knowledge Network with Czech tourism practice. It shows that our tourism practice is behind in the implementation of knowledge management. The paper describes the environment as a source of data and information in respect to knowledge. One of the important sources of knowledge is academic research. The paper describes the current approach of academic research to the needs of tourism practice, including the knowledge creation in a tourism business and in the academic sphere. A prerequisite for the successful implementation of knowledge management in the practice of tourism is, on the one hand, a change in the method of academic research (finding problems with subsequent problem solving) and the application of a suitable knowledge transfer model on the other. The basis for such a model is a network concept of the destination, and accepting risks in the field of knowledge management.

Keywords: knowledge management; knowledge sharing; knowledge transfer; tourism

JEL Classification: Z3; M2; J5

1. Introduction

In order to successfully face global challenges, the World Tourism Organization (UNWTO) at its Algarve forum held on 1-3 June 2011 in Vilamoura, Portugal, stressed the significance of taking advantage of innovation and providing for the full use of networks and information-communication technologies into practice. The issue is apparent in regional development, climate change, tourism impact on the environment, product innovation, or competitiveness. All that, however, requires competent decision making based on relevant knowledge. The forum gathered an UNWTO network of people, so called UNWTO Knowledge Network, or UNWTO.Know, which agreed on forming a community supporting technology, innovation and knowledge management in tourism. Discussion and negotiations were transferred into guidelines and policy programs known as the UNWTO Algarve Consensus. Resulting concept Tourism and Science: Bridging Theory and Practice now has eight papers (UNWTO, 2011).

Knowledge management is a hot issue in general and tourism is no different. Already in 2015, there was a conference on knowledge management in tourism and hospitality held in Prague. That is going to be followed in 2022. The primary goal of the conference is sharing knowledge and practical experience in gastro services, including new trends and innovations, but also risks (ICKMTH, 2022). The conference is going to gather academic scientists and researchers to exchange and share experience and research results on all aspects of knowledge management in tourism and hospitality.

The UNWTO.Know platform as well as the above-mentioned conference inspired the author in this paper goal setting. Literature analysis combined with orientation survey revealed that there is a gap between the academic research and practice needs. Based on this, the paper tries to describe what needs to be included in the discussion with companies, should the academic sphere be involved in the implementation of knowledge management in tourism companies. For this purpose, at first knowledge, knowledge management system and knowledge transfer are characterized. Furthermore, the need to create an effective system of knowledge sharing and transfer in tourism is justified.

1.1. Knowledge, Knowledge Management

The word "knowledge" does not have universal definition. The difference comes from different multidisciplinary perspectives, where knowledge is discussed. We may use the commonly accepted definition of knowledge as provided by Davenport and Prusak (1998, p. 5): *"Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight………embedded not only in documents or repositories, but also in organizational routines, processes, practices, and norms"*. The definition simply shows its academic origin. Yet, there is also a concept of usable knowledge, which is important for the needs of practice. It is based on the fact that *"a person is sufficiently sure of the correctness of the knowledge or belief so that it will be used to make decisions, to solve problems…"* (Hunt, 2003, p. 107).

Probably the most used classification of knowledge was brought by Polányi (1967), who distinguishes knowledge: implicit (tacit, or also personalized knowledge, i.e. knowledge coming from personal experience), and explicit (that is knowledge that can be specifically expressed in numbers, words or rules). On the other hand, Narvaez et al. (2017) classifies knowledge by characteristics such as what, why, how and who: declarative knowledge (know-what), is fact-based knowledge; causal knowledge (know-why), knowledge that is more specialized; procedural knowledge (know-how), is knowledge related to our abilities to do something; knowledge of resources (know-who) is probably the most important as it shows who can handle the task and how. In addition to the type of knowledge, their content categorization is also important, for example based on the work of Nonaka et al. (2000) or tourism-specific according to Bouncken and Pyo (2003).

Naturally, knowledge must be appropriately managed, or handled, to provide for the best results. That is called knowledge management, or KM. Knowledge management is a subject of many publications, where it is mostly defined as a set of processes consisting of the generation, identification, collection, processing and sharing of individual and collective knowledge using information technology (e.g. Ciampi, 2008). Dalkir (2005) defines KM as a planned and systematic coordination of sources (people and technology), processes and organizational structures in order to create value. Knowledge transfer (KT), on the other hand, involves variety of interactions between individuals or groups of people, between teams or organizations (e.g. Joshi et al., 2004).

From the practical point of view, it is desirable to design a pragmatic model of KM. A decision making model, for example, may be used. Choo (2001) came up with the "Known organization" concept, which provides a picture on the organization from information

perspective, i.e. how an organization utilize information to overcome external changes and to boost internal growth. Another model which can be used in practice is the one proposed by Zack (1999), which applies knowledge gap (what a corporation should know) and a strategic gap (what a corporation should do, or can do). In addition to the above-mentioned models, there are other KM models, e.g. Dalkir (2005), Evans et al. (2014) etc.

1.2. Tourism Industry, Tourism Enterprise and Tourism Business Environment

Tourism industry, or travel industry, are human activities related to travelling to other locations. That can be domestically or internationally, for leisure, business or social purposes. It closely relates to accommodation (hoteling), hospitality and the transport industry. For many countries it is the main source of economic income, or GDP (UNWTO).

The primary element of tourism is a destination, i.e. target place of our journey, regardless of its purpose, such as culture, sport, or leisure. Štumpf (2015) states that destination management is formed by a variety of businesses, which all mutually provide services to tourists. These businesses may be, according to Roth (2003 in Štumpf, 2015, p. 57): „*information services: information centres; gastro services: restaurants, hotels, bars; accommodation services: hotels, hostels, camps, etc.; transport services: regional buses, lifts, boats, etc.; entertainment services: sport centres, cinemas, theatres, etc.*"

Naturally, there are also trends visible in tourism that form its development, such as environment protection and security. These have impact on tourists, ecosystems as well as tourism-related activities. Additionally, there is a virtual world, such as the Internet and social media, where tourists search for opportunities to spend their time and money, but also provide retrospective thoughts or reviews of their experience. In order to gain competitive advantage, service providers must differentiate among tourists to provide specific and one-to-one targeted marketing, but also communicate with them. These trends require analytical skills to identify and recognize client´s demand for information.

According to Damonte et al. (1991), there are two interactive and mutually interrelated segments in an organization's external business environment. One is the operating environment (Porter's 5 Forces), and the other is the remote environment (it depends on conditions such as general political, economic, social and technological).

All this shows that doing business in tourism is heavily influenced by the environment. Therefore, any business to be competitive must monitor its environment in order to be able to quickly react to business opportunities, or threats. In addition, current business environment is very unstable, or even turbulent (e.g. Volberda and van Bruggen, 1997). Yet, besides the turbulent concept, there is also VUCA concept. VUCA has become the standard description of contemporary environment. It also has huge impact on KM. VUCA factors are described by many authors, such as e.g. Ambler (2012), Kambil (2008), Mack et al. (2016), Sullivan (2012) etc. deal with VUCA concept from the management perspectives.

1.3. Environment as a Source of Data and Information

Each environment can be understood as a source of data and information that is scattered in it. Internal environment of a business is represented by data and information processes on

personal, financial, or marketing issues. These processes are under the control of management. But even in this environment there is some degree of uncertainty, resulting from individual decisions, human errors, and communication, or ambiguity. For internal environment, the most important is knowledge on marketing and financial issues, but also risk management, and crisis management.

Tuomi (1999) issued a paper, in which talks on data, information and knowledge hierarchy. Tuomi claims that data come up after we have information, and information come up after knowledge is gained. It is in opposite to general understanding that data are represented by simple facts, while the data become information after their analysis and handling. Tuomi claims that already in the identification and collection processes of even primary data there is always some knowledge already present.

The relationships between knowledge, information and data is given, for example, by Becerra-Fernandez and Sabherwal (2015).

1.4. Knowledge Management in Tourism

Despite the fact that the role of knowledge in business management is generally recognized, in tourism the situation is quite different (Vikrant, 2018). Author also says that tourism had been very careful in its acceptation and implementation of KM, and that because of these reasons:

- There is ineffective relation between tourism and academic research. Businesses do not cooperate with researchers. In fact, there is even a question whether researchers are really interested in knowledge transfer.
- Tourism may be reluctant towards KM for its excessive time requirements and extensive financial costs.
- The KM concept has been proposed primarily for manufacturing industries and large companies. It does not respect specifics of accommodation and gastro services.
- As Grizelj (2003 in Vikrant, 2018) claims, the KM concept ignores networking, which is so characteristics for tourism destinations.

Also, according to Vikrant (2018), academics and businesses look at KM differently. The main difference is in the understanding of knowledge and its dissemination. Businesses accept mainly explicit knowledge, represented by numbers and figures, which may be easily handled. In other words, businesses look whether knowledge is static (allowing for routine work), or dynamic (when these change according to situations).

Tourism is also very specific for its balance between clients´ expectations and reality, we may also say a "supply-demand" balance. It is necessary to create a well-organized system of knowledge and its management in a destination, so that subjects in the destination can: create knowledge on the destination (for its economic, cultural, historical and environmental values), gather and analyse existing knowledge (especially knowledge on good-practice), provide access to knowledge to all stakeholders and general public, etc.

Tourism is often represented by small and medium enterprises (or SMEs). These generally have simple internal procedures. That also means that SMEs may be more flexible

and more acceptable towards internal changes. That, however, does not necessarily mean that implementation of knowledge management is easy. That is supported by McAdam and Reid (2001), or Wong and Aspinwall (2004).

As McAdam and Reid (2001) showed, there is somehow rigid understanding of KM at SMEs. There is a lack of systematic approach to knowledge sharing, and benefits of KM are seen rather externally (market environment) than inside an organization. Also, important findings from KM and tourism can be found in a paper published by Wong and Aspinwall (2004), who state that: SMEs often do not understand KM concept, and SMEs are too slow in the application of KM, i.e. KM agenda is often not prioritized. According to authors, SMEs are more suitable for KM implementation. It is often for their simple organizational structure, direct communication, and smaller number of employees. Their disadvantage, however, prevail, because managers often do not have competences and skills to promote implementation of KT.

Based on a recherche of available literature related to KM and KT in tourism, the following can be stated:

- Less attention is paid to KT in tourism than in other sectors (e.g. Xiao and Smith, 2007).
- KT in tourism refers to the transfer of knowledge between different regional actors (e.g. Czernek, 2017; Lopes and Farinha, 2020; Raisi et al., 2020; Ruhanen et al., 2021).
- SMEs in tourism have certain limitations related to the absorption of knowledge and innovations created at academic sphere (Carlisle et al., 2013; Pikkemaat and Zehrer, 2008).
- Research in tourism encounters obstacles arising from the characteristics of tourism, esp. seasonality, fragmentation, diverse workforce, low acceptance of research results, low attention to innovation etc. (e.g. Hjalager, 2002; Shaw and Williams, 2009).

1.5. Networking and Analysis of Tourism Destination

Tourism is often described as a network of interconnected organizations, which mutually cooperate to produce goods or provide services. The network shows relations as bonds between certain entities. These bonds represent also flows of data, information and knowledge. Bonds may be described or analysed qualitatively, or quantitatively.

Qualitative approach is used by e.g. Žemla (2016), Sørensen (2007). According to Žemla (2016), a destination is a primary element of tourism, it is a place of interactions between businesses and institutions. Naturally, destinations may also be seen as a network. That is also claimed by Halme (2001), who adds that a business alone cannot apply effective competitive strategy and sustainable development.

Mathematical (quantitative) approach to networking is applied by e.g. Baggio (2008), D´Agata et al. (2012). Bąkowska-Morawska (2014), or Del Chiappa and Baggio (2015) point out that networks are a suitable model for the process of KT and knowledge sharing both in the destination and in tourism company.

2. Methodology

The research methodology is based on procedures set by Peffers et al. (2007), which consists of the following six steps: 1) Problem identification; 2) Goal definition for theoretical solution; 3) Design and development; 4) Demonstration; 5) Evaluation; 6) Communication. Due to the complexity of creating an effective KT model that would have practical use in tourism, the author of this paper applies only the first two steps.

Ad1) Problem identification

The author from the recherche available literature learned that tourism is behind in the application of KM and KT. This has been supported by a simple survey of seven entrepreneurs active in accommodation and gastro services (these were small entrepreneurs located in the Hradec Kralove region). The research was carried out at the end of 2021. The survey was performed in the form of mutual discussions to find out the opinion on the issue. There was no statistical analysis made at this point. Besides KM, the orientation survey also mapped the level of managerial competencies and marketing skills. This type of survey was chosen as the most common type of qualitative research. It did not aim to describe the data set or verify hypotheses, but only to verify certain values – esp. whether or not managers have awareness of KM and whether they have appropriate competences in these areas.

The orientation survey was built on the question: "Have you ever thought about the use of knowledge management in your business practice?" The positive answer would be followed by other questions such as: "Would you be interested in further research on the use of KM in your business?" (see steps 2–6 of the methodology). Since there were mostly negative answers, the author concluded that entrepreneurs have very low awareness of working with knowledge and have no understanding on knowledge management. The survey also showed that tourism practice is primarily interested in knowledge coming from the academic sphere, which could help in solving common business problems.

Ad2) Goals definition for theoretical solution

The primary goal of the paper is to assess the knowledge transfer from academic institutions as the primary source of knowledge to tourism practice and suggest ways to improve the system of sharing and transfer of knowledge to tourism companies. Additionally, the design of a knowledge transfer model for tourism destinations will be outlined. The paper should also stimulate a discussion on the transfer of knowledge at the professional public.

Ad3) Design and development

Before the actual design of the KT model for tourism destinations, it will be desirable to evaluate the existing theoretical KT models and provoke a professional discussion. Only then the design a suitable model for practical use in tourism should be proposed (for a certain type of tourism business/destination). In the phases of KT model design and development, there should be a comparison with other models (to assess similarities, or differences) incl. identification of positives and negatives of the proposed KT model.

Ad 4–6) Practical use of the proposed model, its evaluation and communication

These steps will be related to the selection of a specific company/destination for the subsequent research. The proposed model will respect many factors that play role in knowledge transfer. For example, Hamid and Salim (2011) list some 28 factors related to the knowledge source and its recipient, management, communication and relationship. However, Frank et al. (2015) present 39 such factors.

3. Results

In the knowledge transfer, depending on the situation and requirements, the source and receiver of knowledge can exchange roles. Therefore, it is appropriate to take a quick view of the creation of knowledge in tourism enterprises and in academic institutions.

3.1. Knowledge Creation in Tourism Enterprises

Even before KM era tourism businesses used knowledge, but only the KM concept brought up the required systematic procedures. Gathering knowledge in a business is usually performed individually by personnel itself. Knowledge is used for business results, such as make products or provide services. In tourism business, knowledge is applied to problem solution and decision making. This explicit knowledge is set into internal documentation, such as procedures and manuals. However, new knowledge may be created by interpretation of generally available knowledge, or by innovation (e.g. Pitra & Mohelská, 2015).

This indicates that KM requires skilled workforce. However, one may ask: *Is also a small enterprise, which is active in the tourism sector, able to effectively gather or generate knowledge?* The answer may be found in a study published by Grimsdottir and Edvardsson (2018), who wrote: 1) Lack of or limited access of SMEs to primary sources of information may result in that they use second-hand sources, such as literature, conferences, research. 2) Only few SME employees are able to gather and analyse knowledge within their daily duties. Managers might do that, but they have other responsibilities as well. 3) Due to limited internal sources in SMEs we may expect that external sources play vital role in knowledge creation.

3.2. Knowledge Creation at Academic Institutions

The concept of KM was introduced at the academic ground. Then, KT to commercial subjects also comes to mind. Academic institutions study tourism environment primarily for educational purposes; research results are published and thus given to the public. Research is made in combination with other disciplines, such as marketing, management, economy, sociology, psychology, which is called multidisciplinary approach. At the same time, tourism enterprises are also studied from many perspectives, including environmental impact, or client satisfaction, and that by applying various methods and techniques, such as interviews, questionnaires and surveys, or observations. As a result, academic work comes up with new theories, models, or tools. That may be "Business process" (Raghu & Vinze, 2007), "Knowledge based- firm" (Gudas, 2012) or "Knowledge intensive firm" (Kemp, 2006).

New knowledge is made upon research performed by applying new hypotheses and their verifications. Explicit knowledge of academic staff can be found in textbooks or papers. Tacit knowledge, on the other hand, is expressed as author´s experience and attitude and is

often presented in academics´ articles. New knowledge does not necessarily come up as a new method, or procedure, but may also be unique know-how, formerly not considered in practice. Business knowledge is always put to the test as it succeeds in solving business problems or in formulating strategies (successful or less successful). The academic environment, on the other hand, is often cut out from these events. Therefore, academic-based knowledge should be first examined in business environment, and only then made available to the commercial world.

3.3. Knowledge Transfer from Academic Institutions to Tourism Business

Recherche of available literature showed, that today, we may see that focus is laid on technical and technological KT than to that in tourism. Liubchenko et al. (2019) come up with a proposal of university v. business relations. It might be used in tourism as well.

Schofield (2013) describes KT between university and commercial sector. She says that in order to reach effective KT common features of both sides are necessary. On the university side, these are the level of general as well as very specific knowledge, supported by motivation to perform primary research. The industry, on the other hand, has resources, such as financial ones, susceptibility to absorb new knowledge and promote changes.

Practical discussions of the author with experts revealed that tourism businesses do not seek for KM issues. They primarily deal with economic issues and core business existence (that was true especially at the time of coronavirus pandemic era). Therefore, implementation of KM from academic ground to tourism practice is subject of a change in the attitude of academic research. This is possible under certain conditions: Instead of the currently applied so-called top-bottom attitude, the focus should be made on the opposite, i.e. bottom-up. New hypothesis or idea, made up in a research room, or laboratory, may be well prepared, but may also still be misinterpreted, and also there are often biases in human thinking, as suggested by Kahneman et al. (1982). This approach is fine for primary research and its publication, but the use of the results in practice is highly questionable.

More suitable is therefore bottom-up approach. Researchers should first gather problems dealt with in tourism business practice and these bring up to the academic ground for further analysis and research. Results of the research should be transferred to daily life. The problem may be already at the very start as both, the researcher and the businessman, may not have the same understanding or opinion. This indicates that even academics should use some KM model, while it is very difficult to implement a KM model if the academics do not already have one inherited or implemented.

3.4. Prerequisite for the Design of a Knowledge Transfer Model for Tourism Destination

When making a KT model, one should always identify and evaluate knowledge flows in a business. According to Snider and Nissen (2003, cited in Koskinen & Ajmal, 2008), the knowledge flow is critical for the business success. The Snider and Nissen framework describe three kinds of knowledge flows: Knowledge as solution – it flows across organizational and geographical space. In this view, knowledge is created and used by other stakeholders or processes. Knowledge as experience – it flows across time. In this view,

knowledge is first created and stored and only later it is used. Knowledge as socially created – it is created through social interactions, i.e. between people.

According to Joshi et al. (2004), KT occurs when knowledge spreads from one entity to another or when one entity is affected by the experience of another entity. The authors confirmed the idea that KT takes place through the processes of education and learning. They also emphasize the core purpose of KT.

Research concerning with the application of KM in tourism practice and the subsequent design of the KT model should be carried out in the following steps:

1. Find the degree of KM awareness in various tourism companies/destinations at the management levels.
2. Define and understand the knowledge requirements in tourism companies/destinations.
3. Examine the level of procedures for the exchange of knowledge among employees in tourism companies/destinations (advantages, disadvantages).
4. Find out whether knowledge exchange is encouraged at the level of enterprises and destinations, in order to provide better tourism services.
5. Examine the level of customer satisfaction with tourism services in a destination.
6. Propose appropriate measures and proposal to improve KM practices in tourism destination.

4. Discussion

KT models were developed by researchers with the aim of providing truly effective knowledge flows. There are many models currently known, such as Hansen (1999), Kwan and Cheung (2006), Liyanage et al. (2009), Narteh (2008), Szulanski (1996) etc. Even though none of these models is related to tourism, the author of the paper has chosen two of them that could serve as a topic for creating a KT model for tourism destinations: Szulanski (1996) and Liyanage et al. (2009).

According to Szulanski (1996), there are four stages in the transfer process: initiation, implementation, ramp-up and integration. The initiation stage is represented by the needs to take action in order to gather knowledge. In the implementation stage knowledge is transferred in from its origin, or source. Such transferred knowledge is then used in practice, allowing for process fine tuning. That is the ramp-up stage. Then the integration stage starts, and the knowledge is routinely applied into practice. Szulanski also claims that there are four attributes that may impact KT: Characteristics of the transferred knowledge: knowledge specifics, or uniqueness. Characteristics of the source of knowledge: motivation and credibility. Characteristics of the recipient knowledge: cumulation and retention capacity of knowledge. Characteristics of the transfer itself: organization, interactions and inter relations. The reason for choosing the Szulanski model for creating a KT model for tourism destinations is its connection with the factors influencing the KT process, as stated in the methodology.

The KT model of Liyanage et al. (2009) is a process model built on holistic approach (it reflects the fact that knowledge transfer may be influenced by many factors, both positive,

but also negative). KT is then realized in these steps: Knowledge identification (identification of suitable knowledge and its value). Knowledge acquisition (relates to the ability of gathering external knowledge). Knowledge transformation (knowledge conversion so that it is useful for the recipient, and potentially initiate further knowledge gain or improvement). Knowledge association (connection with internal organizational requirements). Knowledge application (acquired knowledge is applied in practice). The primary idea of the model is that should KT have any value, then it must be successfully transferred to recipients, and it is also applied in practice. That may be reached by effective communication and cooperation. Additionally, important is timely and effective feedback, in which knowledge value may be enhanced not only for its recipient but also knowledge source. The reason for choosing the Liyanage model is, in addition to the stated above, that it includes three important elements: networking (effective KT is subject of close interactions between participating entities, i.e. individuals, organizations); influencing factors (that can positively or negatively influence the process of KT), and performance measurement, which assesses the accuracy and quality of acquired knowledge to identify the efficiency of the KT process.

Risks associated with knowledge should not be neglected when evaluating any KM and KT model, as risks can be somewhat detrimental to the whole knowledge process. Ferraris (2019) highlights four key risks in KM: risk of knowledge obsolescence, risk of knowledge loss, risk of knowledge scarcity and risk of knowledge leakage.

5. Conclusion

The paper is focused on the KT between the academic institutions as the primary source of knowledge and tourism practice. The author suggests ways to improve the system of sharing and transfer of knowledge to the tourism companies through a suitable KT model. The paper points that tourism companies are lagging in systematic work with knowledge, and thus also in the application of knowledge management. Therefore, it would be appropriate to implement the concept of the knowledge transfer in tourism practice.

The academic sphere should play the key role in the process of implementing KM/KT into practice, providing that it remakes its current research approach. The so-called "bottom-up" approach is recommended. Its essence is first to identify specific problems that tourism subjects are facing, and then to look for suitable solutions that can be applied in practice. Before the actual application of KM in practice, it is necessary to verify KT model at a selected tourism company. Then, a methodology that would allow the extension of KM and KT processes according to the business characteristics and its requirements, should be created.

This is going to be the topic of author's further research. The author will design a theoretical KT model for the tourism destination and subsequently test it on a selected tourism company/destination. Based on the results suitable KT methodology will be defined. The basis of the KT practical model in tourism will be a network concept, based on a network of relationships between sources and recipients of knowledge, network of tasks and network of data, information and knowledge flows. The model will also include a Knowledge Risk Management approach accepting risks in the field of knowledge management – the risk of

obsolescence, loss, scarcity and leakage of knowledge according to Ferraris (2019). Further interviews will be made, which should include, for example, these questions: *How informed is the company´s management about KM and KT? What kind of training and education is done internally? Which business functions and activities are related to KT?* etc.

Conflict of interest: none

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The Efficiency of Premier League Clubs According to the Country of Origin of the Majority Owner

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Abstract: Owning a successful football club is a matter of good management, financial stability but also prestige. Owning a club participating in the English Premier League, the most prestigious and richest football competition in the world, has so far attracted investors from the Middle and Far East, the United States and other parts of the world. The aim of the presented paper was to use data envelopment analysis to calculate efficiency and then evaluate and compare the efficiency of selected clubs of the English Premier League owned by British investors and by foreign ones. The researched period are the seasons 2019/2020 and 2020/2021. The data used were obtained from the official databases of both examined sports competitions and subsequently supplemented with private databases of companies operating in the football environment. In terms of results, some implications for the management of football clubs are discussed and suggestions for increasing efficiency in inefficient clubs are made. Clubs owned by British investors are not generally less efficient than clubs owned by foreign investors and vice versa.

Keywords: sport management; football; data envelopment analysis; efficiency; performance factors

JEL Classification: C10; L83; C67; C44

1. Introduction

Currently, football is one of the most important sports, and at the same time a business of high economic importance. In the last few years, there have been active negotiations concerning the ownership of the clubs of the most prestigious football competition in the world, the English Premier League. Every year, the largest amount of funds flow into the English top football competition compared to other European top football competitions. The prestige and attention of the media and spectators has already attracted investors from the Middle and Far East, the United States and other parts of the world.

Every sport organization strives to evaluate its performance: its weaknesses and strengths. Nowadays, success in the professional football league is related to successful coaching and leading the entire team. But the efficiency goes beyond that kind of perspective onto the company level. There, the board and crucially the owner is willing to see club's increasing performance charts and curves. In the world of business, the comparison with the competition is important to important for objective evaluation of the company's direction. One of the most favored methods for this kind of analysis is the data envelopment analysis (DEA).

The aim of the presented paper is to contribute to previous research and to use data envelopment analysis to calculate efficiency and use it to compare the efficiency of selected clubs of the English Premier League that are owned by British investors and by foreign ones.

The hypothesis is based on an assumption that a foreign investor should have lower emotional ties to the club than the British owner. He should therefore place higher demands on club performance, both on and off the pitch. Because the financial reality of every football club is closely linked to the team's performance on the pitch, sports and economic metrics are used in the work. The presented research evaluates the performance of English professional football clubs that participated in two consecutive seasons (2019/2020 and 2020/2021) in the top-level English football competition.

2. Performance Management of Sports Companies

The English professional football clubs which were playing in the Premier League, the top-tier English football competition, in the seasons 2019/2020 and 2020/2021 were selected to evaluate performance. The specificity of European football competitions is the closedness of individual performance levels (competitions). Sports companies (football clubs) do not have the opportunity to move freely between levels, but, for example, unlike professional sports competitions in the United States, there are clear rules under which they can do so – at the end of the season by relegation or promotion. Newly established companies cannot immediately participate in the highest competitions, they have to go through a long way from the lowest competitions to professional leagues. That is why it is often more advantageous for investors to buy an already "well-established" club with a history, fan base and sports and personnel facilities than to establish a club on a green field. At the same time, one investment entity may not own more than one football club that participates in European Cups. This is a safeguard for the oligopolization of professional European football (UEFA Article 5, 2021).

A wide range of authors deals with the performance of sports companies. The majority of the researchers use only sports statistics in order to evaluate the club's efficiency, the rest combines the sport and economic metrics to achieve more accurate efficiency results.

In their research, Espitia-Escuer and Garcia-Cebrian (2016) apply the DEA method and the Malmquist Indices to the ranking of football teams that have participated in the UEFA Champions League. Barros and Douvis (2009) estimate productivity changes using DEA analysis applied to a representative sample of football clubs operating in two European countries: Portugal and Greece. They rank football clubs according to their productivity changes between the 1999/2000 and 2002/2003 seasons, concluding that some clubs saw productivity growth while others saw productivity decline (Barros & Douvis, 2009).

Halkos and Tzeremes (2013) use the DEA to compare the actual level of market value of football clubs and their performance. The research shows that the level of market value of football clubs has a negative effect on their performance. The high value of football clubs does not guarantee the higher performance.

Petrović Djordjević (2015) used the nonparametric variable output-oriented DEA model and analyses technical efficiency of the national football teams in the qualifications for 2010

FIFA World Cup. DEA model has a two-stage structure, the first stage uses inputs to generate outputs that then became the inputs to the second stage.

Arabzad et al. (2013) utilized a DEA model to identify the best English Premier League football players. Another type of DEA model has been used to rank the selected players. The proposed approach has been examined in the English Premier League 2010/2011. Findings imply that Rooney, Drogba and Tevez are ranked as first, second and third players.

3. Statistical and Quantitative Methods Used

The methods in the work can be divided into statistical and exact. In addition to descriptive statistics, the statistical methods used include, in particular, dependency analysis especially, correlation analysis. Correlation analysis examines the relationships of variables using dependency measures (correlation coefficients). Correlation indicates the degree of association of two variables. It is important to distinguish between correlation and causality, i.e. the direct relationship between cause and effect. Hendl (2012) explains that correlation, however strong, does not by itself mean evidence of a causal relationship, i.e. that changes in the variable X actually affect the changes in the variable Y.

In the main part of the paper the method of data envelopment analysis (DEA) is used, a quantitative method based on the theory of business economics. DEA models are divided into input-oriented and output-oriented models. Using input-oriented models, it is possible to estimate the degree of technical efficiency, which determines the reduction of input indicators, so that the unit becomes technically efficient with unchanged output. Effective units get a score of 1, inefficient ones get a lower score in the interval between 0 and 1 (Cooper, 2011).

The research of sports performance of companies is also connected with their economic performance, when the club receives a financial reward from the league competition authority for placing in the table according to the points obtained at the end of the season. The better the position the club achieves, the higher the financial reward. In addition, clubs compete with each other for funding for television rights. It is true that the more often the league matches of a given club are broadcast on television screens, the greater the reward the club will receive when redistributing these funds. The financial reward for placing in the table does not cover all the costs of the clubs, so sponsorship and partnership agreements come into play and, of course, the involvement of the owners and their financial help is also taken into account.

The BCC model (Banker, Charnes and Cooper) is an input-oriented model, considering variable economies of scale and estimating Pure Technical Efficiency (PTE) (Sengupta, 1995). The CCR model (Charnes, Cooper and Rhodes) considers constant economies of scale and estimates Overall Technical Efficiency (OTE), which consists of two parts, Pure Technical Efficiency (PTE) and Scale Efficiency (SE). Scope efficiency is then determined by the relationship between OTE and PTE and indicates the extent to which the unit can improve its efficiency by changing its size (Cooper, 2011). The BCC and CCR models form two basic (mathematically simplest) DEA models.

4. Methodology and Data

Creating a database is preceded by data collection from several sources. In addition to publicly available information published by the football competitions themselves, the data sources used in the paper also include private databases of a company dealing with sports data analysis, the InStat. The economic data were obtained from the specialized server Transfermarkt. The complexity of the database used in the work lies in the combination of the mentioned sources and their supplementation with data from the register of companies doing business in the United Kingdom of Great Britain and Northern Ireland (UK Business Register, 2021). The research process can be divided into the following phases:

1. **Creating a list of evaluated companies** – in the first step, a database of surveyed clubs that participated in the period under review, i.e. the 2019/2020 and 2020/2021 seasons, was created. To better work with the data, the names of the surveyed clubs were shortened to three-letter abbreviations. The majority owner and his country of origin were traced to these clubs. The majority owners and their country of origin is listed in Table 1.

Table 1. Majority owners of selected sports companies

Club	Parent company or fund	Majority owner name	Country
BOU	Opalus Trust	Maxim Demin	RUS
ARS	Kroenke Sports & Entertainment	Stan Kroenke	USA
AVL	NSWE Group	Nassef Sawiris	EGY
BRI	B&H Albion Holdings Ltd	Anthony Grant Bloom	GBR
BUR	ALK Capital	Alan Pace	USA
CHE	Fordstam Ltd	Roman Abramovich	RUS
CRY	Palace Holdco LP	Steve Parish (Harris, Blitzer)	GBR
EVE	OOO USM Holding Co	Ferhad Moshiri	GBR
FUL	Shahid Rafiq Khan Family Trust A	Shahid Khan	PAK
LEE	Aser Group Holding	Andrea Radrizzani	ITA
LEI	King Power	Aiyawatt Srivaddhanaprabha	THA
LIV	Fenway Sports Group	John Henry	USA
MCI	City Football Group	Sheikh Mansour	SAE
MUN	Red Football Ltd	Glazer (rodina)	USA
NEW	St James Holdings	Michael Ashley	GBR
NOR	Norwich City Plc	M. Wynn-Jones, D. Smith	GBR
SHU	Blades Leisure Ltd	Abdullah bin Mosa'ad	SAU
SOU	Lander Sports Development Co Ltd	Gao Jisheng	CHN
TOT	ENIC Group	Joe Lewis	GBR
WAT	Hornets Investment Ltd	Gino Pozzo	ITA
WBA	Yunyi Guokai Sports Development	Lai Guochuan	CHN
WHU	WH Holding Ltd	David Sullivan	GBR
WOL	Fosun International	Guo Guangchang	CHN

In the second column of the Table 1 are listed parent companies for the clubs playing the English Premier League in the observed period. For the Norwich City FC (NOR) there is no evidence of parent company, instead the major owners – Mr. Michael Wynn-Jones Mrs. Delia Smith – are the major owners of Norwich City FC Plc. The rest of the clubs has a major owner either in the form of a parent company or an investment fund.

2. **Collecting of sport and economic metrics** – data concerning the sports performance of clubs in the mentioned seasons was added to the list.

   a) The sport data can be divided by several perspectives. First, we can determine whether the statistics are offensive or defensive. Or you can determine whether the statistic is positive or negative (a typical negative statistic can be the number of fouls in the season). And last but not least it is possible to determine whether the statistic is in absolute or relative units. All the sport data with no exceptions were provided by statistical company InStat and its server instatscout.com (InStat Football Data, 2021).

   b) Then, the information about the average attendance and a maximum stadium capacity from the official English Premier League database was added (Premier League, 2021).

   c) The economic data consisted of a sum of market values of players who have played at least one match of the season, obtained from the open Transfermarkt database. These data do not include actual transfer amounts but estimated current market values of the players (Transfermarkt, 2021).

3. **Determination of inputs and outputs of DEA model** – one of the most important steps of creating and calculating the DEA model is determination of relevant inputs and outputs. In the paper research, three inputs and one output have been chosen. All factors are chosen so that the inputs correlate between themselves weakly or not at all, in relation to the output is required the highest possible degree of correlation. Bowlin (1998) established the rule that the number of DMUs should be at least three times the number of inputs and outputs. The chosen inputs and outputs are listed in the Table 2.

Table 2. Inputs and outputs of the DEA model

Factor	Resource	Input/Output
Squad size	InStatScout DB	Input
Total Market Value	Transfermarkt DB	Input
Average Stadium Occupancy	EPL DB	Input
Total points	EPL DB	Output

   a) The inputs include the squad size of the club in the season. The squad is defined as the number of players who have started at least in one match of the season. The second input is the total market value of the squad in the season. Average stadium occupancy was calculated as the share of the average stadium attendance in the season and the maximum possible capacity of the stadium.

   b) The only output of the model is the total points achieved by club in the end of the season.

4. **Determination of technical efficiency values** – to measure the performance of football clubs, an input-oriented CCR model was used. The CCR model measures overall technical efficiency (OTE$_{CCR}$). The model aggregates pure technical efficiency (PTE) and scale efficiency (SE) into a single value. The OSDEA-GUI (Open-source DEA) software was used for all the calculations related to DEA. The data were entered into the software separately after each season in the form of csv files with inputs and outputs in separate

columns. The efficiency limit defines the maximum output combinations that can be selected for a given set of inputs. Assuming a set of n DMUs, each DMU_j ($j = 1, \ldots, n$) uses m inputs x_{ij} ($i = 1, 2, \ldots, m$) to create with outputs y_{rj} ($r = 1, 2, \ldots, s$). Input-oriented models with constant returns to scale can be formulated according to equation (1) to minimize inputs while keeping outputs at their current level.

$$
min\ \theta - \varepsilon \left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+ \right)
$$

$$
s.t. \sum_{j=1}^{in} \lambda_j x_{ij} + s_i^- = \theta x_{ip} \qquad i = 1, 2, \ldots, m
$$

$$
\sum_{j=1}^{n} \lambda_j y_{rj} + s_r^+ = y_{rp} \qquad r = 1, 2, \ldots, s
$$

$$
\lambda_j, s_i^-, s_r^+ \geq 0, j = 1, 2, \ldots, n.
$$

(1)

The overall technical efficiency of the DMU is measured in relation to the other units analyzed using the efficiency score. The overall level of technical efficiency (CCR-I OTE) is taking on values in the range $\langle 0, 1 \rangle$. Technically efficient DMUs achieve efficiency rates of 1, inefficient units the efficiency rates are less than 1 (Cooper, 2011).

5. **Comparison of the performance of football clubs owned by the British owners and the foreign ones** – a non-parametric test was chosen because using the Shapiro-Wilk test, it was proved that the values of the individual variables do not have a normal distribution. A Kolmogorov-Smirnov test was used to compare the performance of selected club groups divided according to the origin of the majority owner. The Statgraphics Centurion XVIII software was used for statistical testing at a significance level of 5%.

5. Research Results

Applying an input-oriented CCR efficiency model, the performance levels achieved by English football teams for seasons 2019/2020 and 2020/21 are reported in Table 3. The analysis shows how clubs are able to convert the inputs into points gained within competition tables. The values refer to the current members of the season.

The CCR-I model described 3 clubs as efficient in the first season and 5 clubs in the second season. The efficient clubs have chosen the appropriate sports tactics and at the same time are able to efficiently transform the inputs into outputs and have the optimal size. The most efficient club in the researched period of two seasons in the English highest competition is Burnley FC. As the only one, the club has managed to be efficient in both observed seasons. Liverpool FC and Sheffield United FC achieved an efficient OTE_CCR score in the 2019/2020 season. In the second season, beside Burnley FC, were determined as efficient Leeds United FC, Manchester City FC, Manchester United FC and West Ham United FC.

DMU			Season					Avg.
			2019/2020		2020/2021		↑↓	
Abbr.	Full name	Owner origin	Pos.	OTE$_{CCR}$	Pos.	OTE$_{CCR}$		
BOU	AFC Bournemouth FC	RUS	18	0.5925	-	-	-	-
ARS	Arsenal FC	USA	8	0.6914	8	0.7815	↑	0.7365
AVL	Aston Villa FC	EGY	17	0.6493	11	0.8148	↑	0.7321
BRI	Brighton & Hove Albion FC	GBR	15	0.7543	16	0.6062	↓	0.6803
BUR	Burnley FC	USA	10	1.0000	17	1.0000	→	1.0000
CHE	Chelsea FC	RUS	4	0.7889	4	0.7637	↓	0.7763
CRY	Crystal Palace FC	GBR	14	0.7383	14	0.8695	↑	0.8039
EVE	Everton FC	GBR	12	0.7275	10	0.8365	↑	0.7820
FUL	Fulham FC	PAK	-	-	18	0.4753	-	-
LEE	Leeds United FC	ITA	-	-	9	1.0000	-	-
LEI	Leicester City FC	THA	5	0.8871	5	0.8540	↓	0.8706
LIV	Liverpool FC	USA	1	1.0000	3	0.7516	↓	0.8758
MCI	Manchester City FC	SAE	2	0.9415	1	1.0000	↑	0.9707
MUN	Manchester United FC	USA	3	0.7931	2	1.0000	↑	0.8966
NEW	Newcastle United FC	GBR	13	0.7894	12	0.7633	↓	0.7764
NOR	Norwich City FC	GBR	20	0.3888	-	-	-	-
SHU	Sheffield United FC	SAU	9	1.0000	20	0.5260	↓	0.7630
SOU	Southampton FC	CHN	11	0.9254	15	0.6553	↓	0.7904
TOT	Tottenham Hotspur FC	GBR	6	0.6846	7	0.8285	↑	0.7565
WAT	Watford FC	ITA	19	0.6164	-	-	-	-
WBA	West Bromwich Albion FC	CHN	-	-	19	0.6026	-	-
WHU	West Ham United FC	GBR	16	0.6292	6	1.0000	↑	0.8146
WOL	Wolverhampton Wanderers FC	CHN	7	0.9846	13	0.8010	↓	0.8928
		Avg.	-	0.7791	-	0.7965	-	-

On the other side of the efficiency spectrum, Norwich City FC and Fulham FC were the least efficient clubs in the observed seasons. After achieving this unflattering score, both clubs have been relegated. The clubs that have been relegated in the end of the seasons (the last three clubs in the table) have never have OTE$_{CCR}$ score higher than 0.6200.

The average OTE$_{CCR}$ score in the first season was 0.7791, in the following season the score has slightly increased to 0.7965. As was already mentioned, the number of efficient DMUs has raised as well from 3 to 5 between seasons.

Among the clubs that have participate both of the observed seasons, Burnley FC (1.0000), Manchester City FC (0.9707), Manchester United FC (0.8966), Wolverhampton Wanderers FC (0.8928) and Liverpool FC (0.8758) were the top 5 clubs by OTE$_{CCR}$ average score. Above the seasonal average were 10 clubs in the first season and 11 in the second season. The arrows in the last but one column shows trend of the OTE$_{CCR}$ score among seasons. For example, Chelsea FC's down arrow shows that the OTE$_{CCR}$ score dropped from 0.7889 in the first season to 0.7637 in the second season. Beside the OTE$_{CCR}$ scores Table 3 shows the position of the clubs in observed seasons.

The first of the graphs (Figure 1) shows OTE$_{CCR}$ score and the rankings of clubs with the majority owned by British investors. Among these clubs, only Newcastle United FC was above the OTE$_{CCR}$ score average in the first observed season. In the second season, four clubs with a majority of British owners reached OTE$_{CCR}$ above average. The value of OTE is shown on the main vertical axis, and the rankings of the clubs in the table on the secondary vertical

axis. The horizontal axis contains clubs in the English Premier League, where the majority share is controlled by British owners. The first season is shown in blue (horizontal stripes & rhombus), the second one in red (vertical stripes & triangle).
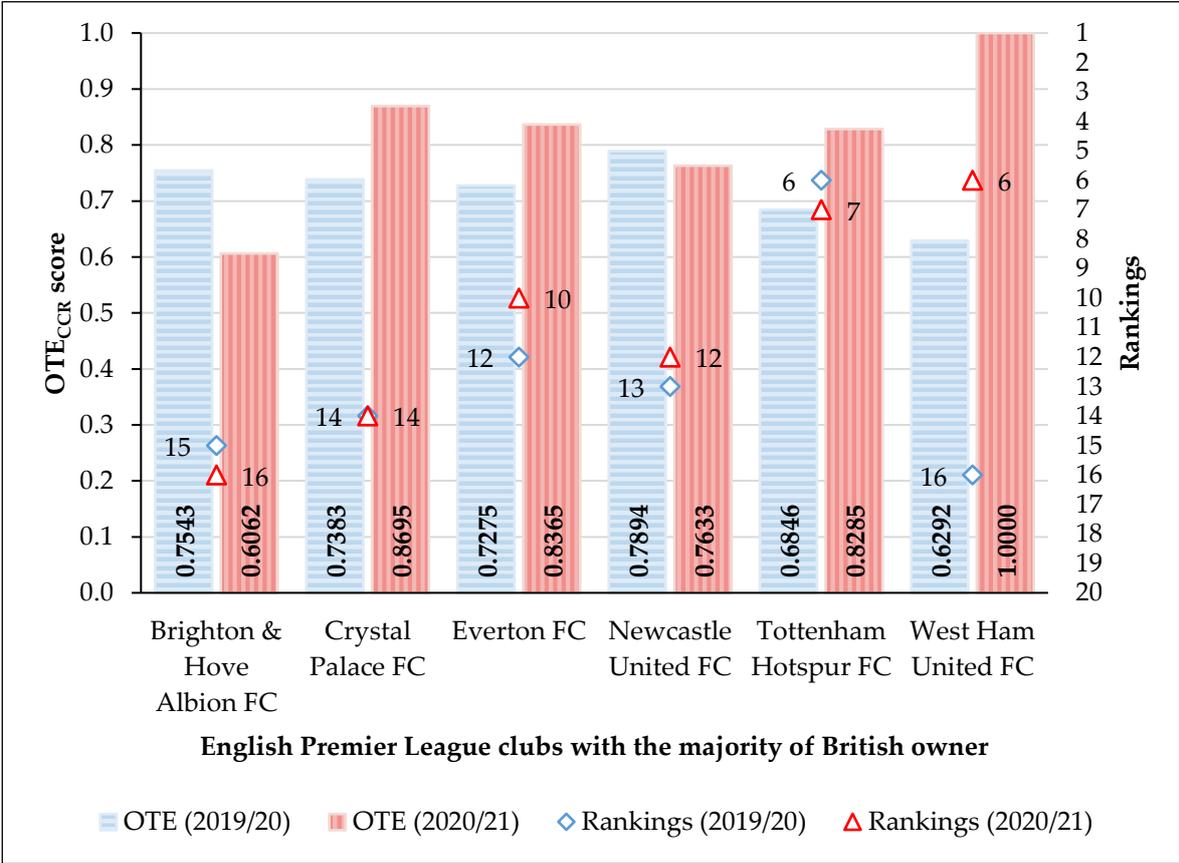
Figure 1. OTE$_{CCR}$ score and rankings of English Premier League clubs with the majority of British owner

The largest cross-season positive difference in both the value of OTE$_{CCR}$ and the ranking in the table was achieved West Ham United FC. In the 2019/2020 season, the club was on the verge of relegation to the second highest English football competition (16th place), in the following season 2020/2021 it placed sixth, thus guaranteeing the company participation in European cups. Interestingly, West Ham United FC achieved an OTE$_{CCR}$ score of 0.6292 in the first observed season – which was the worst score of any Premier League club that season. In the following season, the club reached the effective value of the OTE$_{CCR}$ score. This is the most significant cross-season improvement in the value of OTE among all the clubs surveyed.

The ranking in the table for other British-owned clubs differed by a maximum of two places seasonally, which means a relatively constant sports performance of the clubs. The value of OTE$_{CCR}$ of other clubs in the 2019/2020 season ranged from 0.6846 to 0.7894, in the 2020/2021 season from 0.6062 to 0.8695.

The OTE$_{CCR}$ score of Premier League clubs owned by foreign investors showed a higher range of variation compared to companies owned by British investors. Due to the high number of DMUs, club names are shown as three-letter abbreviations in the following graph (Figure 2).
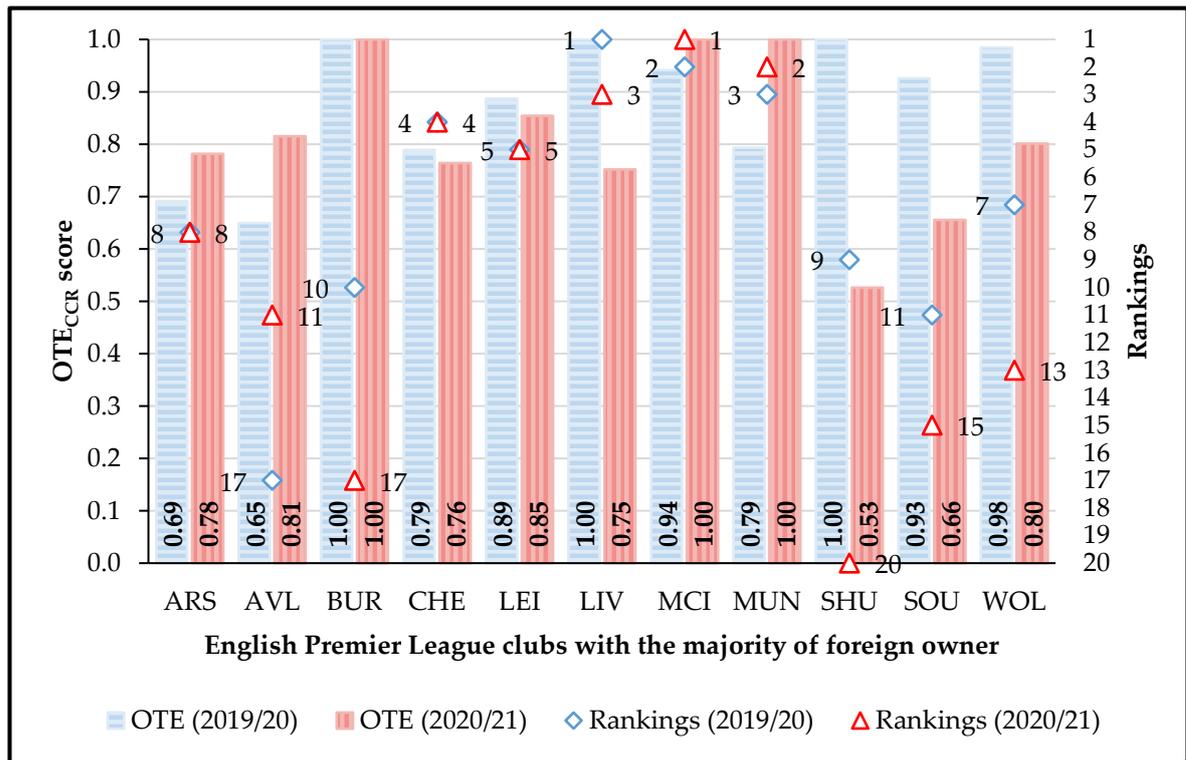
Figure 2. OTE$_{CCR}$ score and rankings of English Premier League clubs with the majority of foreign owner

A phenomenon typical for football clubs, called the second season syndrome has taken place in the case of Sheffield United FC (SHU) in the 2020/2021 season. This phenomenon is connected with the fact that a club that promote to the top-tier football competition in its country can compete with the best clubs in the first season, but in the second season it does not build on successes and relegates from the top-tier competition.

The average OTE$_{CCR}$ score for clubs with domestic owners increased from 0.7206 to 0.8173 seasonally. West Ham United FC had the greatest impact on improving the average. On the other hand, the average seasonal score of OTE$_{CCR}$ fell from 0.8042 to 0.7876 for clubs with a foreign majority. Sheffield United FC had the biggest impact on the deteriorating average.

In the first observed season, clubs owned by foreign investors were in average more efficient than clubs owned by British investors. In the second season, clubs owned by British investors were in average more efficient.

6. Discussion and Conclusion

In this paper, the effectiveness of professional football clubs playing the English Premier League was measured. For this purpose, the time span of two seasons from 2019/20 to 2020/21 was taken. The efficiency of football clubs was measured using the non-parametric DEA method. Number of players, total market value of the team and average stadium occupancy were chosen as club inputs. The average stadium occupancy was added to the standard models used by other several authors. Output was measured by the total number of points in the season. This particular specification proved to be suitable for this application, but can also be used to analyze the effectiveness of other team sports.

Nowadays, there is an increasing need to know how efficiently a club uses its resources due to the current economic and financial situation. Based on the analyzed seasons, there are several conclusions of the research: in both of the observed seasons, the winner of English Premier League was always marked as efficient. The club with the lowest efficiency was relegated in both cases. Also, it can be stated that there are no significant differences between clubs owned by British and foreign investors. It is also possible to discuss the sources of clubs' inefficiency. The first source of clubs' inefficiency is related to the waste of resources. Clubs should only need a lower value of inputs (either a lower number of players, a lower total squad market value or a lower average stadium occupancy) to achieve the same output.

As the hypothesis of the paper was stated, clubs owned by foreign investors should be in average more efficient than clubs owned by British investors. But in the second season, the clubs owned by British investors achieved higher average OTE_{CCR} score. The hypothesis cannot be confirmed nor rejected – the following research could be done on longer time period. Also, the BCC model can be compiled for scale efficiency and pure technical efficiency calculation. By calculating the scale efficiency, the second source of inefficiency could be determined. The BCC model should be applied in further research to assess a detailed view on the sources of inefficiency. The smaller football clubs have always an opportunity to get inspired by the big clubs, e.g. Manchester City FC or Chelsea FC. They should transfer practices that can be useful for them and gradually improve – at the level of sports management, medium and long-term vision or financial management.

Conflict of interest: none

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Protecting the Economy of Slovakia and the Czech Republic during the Covid-19 Pandemic with the Help of the European Union

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Abstract: The world market is now to be imagined as a person who has broken his leg and at the end of his convalescence, when the plaster is removed, he jumps to his feet and starts to run happily, but after a few steps he collapses due to atrophied muscles. In this publication, we have looked at how the EU is responding to the challenges posed by the pandemic and how this will affect Slovakia and the Czech Republic. The aim of the thesis is to present the European Union Next Generation package and to analyse its Slovak and Czech parts. In this publication, we calculated aid to Slovakia and the Czech Republic in proportion to their populations. It is important to note that this is an extremely topical issue that is currently shaping everyday life in the European Union. It is possible that some of the figures will be changed or added at the time of publication. In our calculation, Slovakia is better off than the Czech Republic, but this is a subjective assessment. A vast number of factors must be considered while calculating this matter, thus only time will tell which country can use the given resources more efficiently and benefit more from the aid.

Keywords: Slovakia; Czech Republic; next Generation EU; recovery and resilience facility

JEL Classification: O11; E52

1. Introduction

The impact of COVID-19 on the global economy is yet to be fully revealed, but the forward-looking nature of the financial market shows the market's anticipation of future economic growth (Nozawa & Qiu, 2021). Based on literature review (Sun et al., 2021; Apergis, 2021; Vo et al., 2021; Ma, 2020), it has been discovered that many scholars, experts, researchers and scientists have been analysing the development of the pandemic and its impacts on the economies using different data sets, information, and indicators.

Anyone who has been following the economic news for the past year or two may feel rather fooled these days. At the beginning of 2021, there was talk that this would be a year of economic recovery, with vaccination programmes kicking in, restrictions lifted and growth firing again after the start button, leaving the discomforts of the crisis behind us, at least in economic terms. In comparison, we are now seeing that, while the growth figures are indeed good, there are a number of things overshadowing the sense of recovery and there are insane price rises in many sectors. In the second half of 2021, hardly a week went by without a new global shortage in the press. This year, wood, steel, magnesium, aluminium, microchips,

roofing foil, paper, PlayStation, bicycles, new and used cars, cotton, AdBlue, wheat and even cargo containers on ocean liners have become shortages. If there is not enough of something, that something becomes more valuable, more expensive. At first, shortage is recognized only in the given industry, which leads to the overall growth of production costs and then, a few months later, as a result this pushes up consumer, shop prices. This is how we get from supply and demand mismatches through production-delivery disruptions to inflation. In Slovakia, CPI (Consumer Price Index) inflation reached 5.1% in October. The acceleration this time was mainly due to the rise in prices of housing services and fuel. Net inflation excluding fuels recorded 4.9%. The extent of shortages and price growth may vary, as does the severity of the resulting supply problems, as specific economic processes shape world supply for certain commodities, but common points can also be identified, forming a kind of post-Covid syndrome in the economy (Karmažin, 2021).

The above list shows that for some goods, the shortage may be caused by another shortage, for example, if there are not enough microchips, there will not be enough cars, since the former is essential for the production of the latter. The rise in the price of construction materials had similar causes: economies suddenly rebounded and the construction industry, as well as other sectors, boomed. In fact, there is no contradiction between the rapid economic recovery and the current problems; indeed, the production and trade problems are partly due to the fact that the global economy has recovered very suddenly, at a pace that exceeds even the most optimistic expectations. According to a September OECD report, global economic output in the second quarter of 2021 reached pre-pandemic levels, but the still uncertain outlook means that stimulative monetary and fiscal measures will need to be maintained even in the current period of buoyant growth (OECD, 2021).

The world market should now be imagined as a man who has broken his leg and at the end of his recovery, when the cast is removed, he jumps to his feet and starts running for joy, but after a few steps he collapses because of his atrophied muscles. In this publication we will look at these processes from the perspective of the European Union. We will look at how the EU has responded to the challenges posed by the pandemic and how this will affect Slovakia and the Czech Republic.

Development and aid practitioners have long equated resilience with damage limitation and risk mitigation. That is, resilience-enhancing investments are typically designed to protect household assets, consumption and livelihoods from a range of stressors such as climate shocks, economic shocks, or in our case, pandemics that affect millions of households in low-income, often fragile environments. The coronavirus crisis poses a challenge to the European economy and to people's livelihoods. During this health crisis, it is essential to protect not only critical sectors of the economy, but also assets, technology and infrastructure, and, more importantly, jobs and workers. The economic impact of a coronavirus crisis varies from sector to sector and from firm to firm depending on a number of factors, including the ability to adapt to disruptions in supply chains and the existence of inventories or dependence on just-in-time production processes. The emergence of coronavirus poses a major challenge for the entire European Union. National, regional and local communities are at the frontline of the fight against this disease and its consequences. Solidarity and

responsibility between societies and EU countries are key to overcoming this challenge. The benefits of collective and coordinated action as a community outweighs individual and partial responses (Cissé & Barrett, 2018).

As Perrings (2006) notes, "*A development strategy is not sustainable if it is not resilient: i.e. if it involves a significant risk that the economy can be flipped from a desirable state into an undesirable state, and if that change is either irreversible or only slowly reversible.*" The EU must act on this basis if it is to be successful in stemming the pandemic. On 27 May 2020, the European Commission responded to the unprecedented crisis caused by the coronavirus by proposing a Next Generation EU Temporary Recovery Instrument and a targeted reinforcement of the EU's long-term budget for the period 2021-2027 (European Commission, 2021a).

It is important to note that Next Generation EU is an aid to Member States that includes grants and loans as well. The effectiveness of aid remains a matter of debate in the literature. Some studies, for example, find that aid promotes growth (Bandyopadhyay et al., 2015; Dalgaard, Hansen, & Tarp, 2004), while others are sceptical about the positive correlation between aid and growth (Easterly, 2007; Rajan & Subramanian, 2008; Young & Sheehan, 2014). The literature has identified a number of factors that may have contributed to poor aid performance in recipient countries. These factors include misappropriation of funds or widespread corruption. However, aid effectiveness may also depend on how concessional loans and grants are distributed within the total aid envelope. Grants are free transfers, while loans are generally project-specific types of aid. Some previous studies (Collier, 2006) have compared the two types of aid in detail, but this is not our aim here.

The aim of the work is to present the European Union's Next Generation package and to analyse the Slovak and Czech parts of it. The Recovery and Resilience Facility (RRF) is part of the EU's Next Generation Recovery Plan (NGEU), but as it accounts for 89.7% of the NGEU, countries are mainly focused on exhausting this package, and that is why we are also looking at the RRF from the Slovak and Czech sides. Partial goals are the presentation of the Next Generation package, and a list of the other programmes covered by the package, together with the amount of money involved and the circumstances in which the stimulus package was adopted. The next partial goal was to look at the difference between the amount of Slovak and Czech subsidies per capita.

2. Methodology

In order to achieve the stated objectives, we have identified the main object of study. The main object of our investigation was the European Union's Next Generation package and the two countries we chose, Slovakia and the Czech Republic. As we mentioned in the aims chapter, we need to focus on the Recovery and Resilience Facility, as countries have also put their emphasis on this. In the introduction and in the literature review we addressed the issue of the impact of the coronavirus on the EU economy and the response to the situation, where we obtained a large amount of information. Subsequently, we had to understand and analyse the information obtained. We then organized all the information we obtained into logical results through synthesis. Very often the information was drawn from internet sources, mainly because they were the most up-to-date and accessible. By internet sources we mean

the documents of the EU organizations, the Slovak and Czech recovery plan documents, most of the data and information was obtained from these sources. In order to achieve the stated goal of the research, it was necessary to determine the methods, especially analysis, comparison, deduction. In the conclusion chapter, we have calculated the aid to Slovakia and the Czech Republic in proportion to their population as follows: we have taken the last official statistics on population and divided this by the amount of aid in euro granted to both countries. Finally, it is important to note that this is a very topical issue, which is shaping the everyday life of the European Union today. We have worked with data and information known up to 10 January 2022. It is possible that certain details may change or be amended at the time of publication and presentation.

3. Results

Next Generation EU is a temporary recovery facility of more than EUR 800 billion to help repair the immediate economic and social damage caused by the coronavirus pandemic. A post-Covid19 Europe will be greener, more digital, more resilient and better prepared for the challenges of today and the future (European Union, 2021).

Table 1. Breakdown of Next Generation EU funding (European Commission, 2021b)

Names of aid	Aid amounts [billion euro]
Recovery and Resilience Facility (RRF)	723.8
of which, loans	385.8
of which, grants	338.0
React-EU	50.6
Horizon Europe	5.4
InvestEU	6.1
Rural Development	8.1
Just Transition Funds (JTF)	10.9
RescEU	2
Total	806.9

The EU budget has three main sources of revenue: customs duties, value added tax (VAT)-based contributions collected by Member States and direct payments from national budgets (based on each Member State's Gross National Income). A new source of revenue, the "own resource" based on the volume of non-recycled plastic, was introduced from 1 January 2021 and the EU institutions agreed to consider introducing other new sources of revenue for the EU budget that are closely linked to policy priorities. Revenues from competition and other fines and taxes on the salaries of EU officials will continue to make up a small part of the EU budget (European Commission, 2021b).

To finance Next Generation EU, the European Commission, on behalf of the European Union, will borrow on the markets at more favourable rates than many Member States and redistribute these sums. The European Commission is already issuing bonds to finance loans to the EU and third countries under four programmes, including up to 100 billion. The Commission will use a diversified financing strategy to raise around EUR 800 billion in

current prices by 2026 for Next Generation EU on the best financial terms – 5% of EU GDP (European Commission, 2021c).

The Slovak Republic's NextGenEU package is part of the EU countries' joint response to the sharp economic downturn caused by the new pandemic of the coronavirus. The Slovak economy fell by a historic 6.7% in 2020. However, Slovakia must meet the long-term challenge of avoiding the risk of stagnation in living standards. A combination of investment, reforms and effective public policies will allow the country to start to catch up again with the EU average and achieve significant and sustainable improvements in key areas affecting the quality of life in Slovakia. Slovakia has stagnated over the last decade. The rapid catching-up with advanced economies experienced between 2004 and 2008 is now a thing of the past. The economic model based on cheap labour and foreign investment is exhausted. Living standards in Slovakia are a quarter below the EU average. The main areas lagging behind are health and education. The education system's cornerstone is based on theoretical knowledge, which is just as important as practical training, however the latter is not as well implemented as in the western European countries. Slovak entrepreneurs face more complex regulation. The main challenge is to continue the catching-up process with advanced EU countries. The Recovery Plan measures are a combination of reforms and investments. Slovakia has committed to adopting numerous key reforms to improve quality of life by 2026. These include solutions ranging stemming from long-standing European Commission recommendations: reform of the pension system; integration in pre-school education; reform of the education curriculum; overhaul of the hospital network; reform of science and research governance; reforms to reduce emissions and improve the environment. The Slovak government has committed to raising living standards to 92% of the EU average by 2030 (European Commission, 2021d).

The proposal provides EUR 6.3 billion in aid to Slovakia. The measures in the Recovery and Resilience Plan are based on three pillars. They respond both to the immediate consequences of the crisis and to systemic weaknesses in the Slovak economy. By using all three pillars, the Recovery Plan can make a significant contribution to restarting rapid and sustainable economic growth and quality of life. An innovative economy is the engine for sustainable growth in living standards, based on the investment in research and development and the use of new knowledge and technologies in all areas of life. As well as supporting convergence towards more advanced countries, the innovative economy improves labour productivity growth, thereby mitigating the negative effects of demographic change, and enables workers to acquire sufficient skills and know-how to be able to respond to current labour market changes such as automation and digitalization. A modern public administration that effectively protects the rights and interests of citizens, relentlessly combats corruption and crime, while delivers high quality public services in line with the principle of value for money, which is a prerequisite for a quality of life and an innovative business environment. The Recovery Plan is a way to tackle the transformational debt that separates this ideal from the reality. A healthy country ensures the conditions for the full exploitation of human and natural potential throughout life and across generations. Alongside economic growth, that creates the basic material conditions and resources, the

health of people, public spaces and the environment is an integral part of quality of life (Ministry of Finance of the Slovak Republic, 2021a).

Figure 1. Potential impact of EU aid on different indicators in Slovakia (European Commission, 2021e)

Recovery and Resilience Plan is projected to increase Slovakia's GDP by 1.8% and employment by 1.5% by 2024. The impact on GDP will follow the trajectory of individual investments and will be mainly driven by fixed capital formation. Investment is expected to be almost 8% higher in 2024 thanks to the Recovery Plan. Consequently, its impact on investment and GDP will moderate at the end of the period with the end of the drawdown. The labour market will react to the stimulus with a slight lag. Total employment will be 1.5% higher in 2024, but the effect is still projected to amplify slightly towards the end of the drawdown horizon. The potential of the Slovak economy will be 2.4% higher in 2026 thanks to the Recovery and Resilience Fund. Of this, 0.7 percentage points is the contribution of higher capital formation, which is almost 1.3% higher in 2026 due to the implementation of the Recovery Plan spending. However, more capital will also lead to a more efficient allocation of resources in the economy and higher productivity. In this way, the investments from the Recovery Plan can increase total factor productivity at the end of the spending horizon and thus the potential of the Slovak economy by an additional 1.7%. The potential growth of the Slovak economy between 2022 and 2026 will be almost 20% higher compared to the „no fund" scenario (Ministry of Finance of the Slovak Republic, 2021b).

Table 2. Change in the value of individual variables compared to the evolution without recovery plan (%)

	Real GDP	Real investments	Total employment
2021	0.2	0.7	0.0
2022	1.4	6.5	0.2
2023	1.8	6.7	0,8
2024	1.8	7.9	1.5
2025	1.3	5.7	1.8
2026	0.7	2.6	1.7

The Czech Recovery plan provides a comprehensive and balanced response to the pandemic crisis. Not only does it make explicit reference to the six pillars and how measures address them, but it also includes elements that contribute to at least one or more of the pillars. The plan consists of investments and reforms focusing on key areas such as digitalization, green

transformation, education and training, access to finance, culture, research, innovation and health. Furthermore, the plan foresees progressive measures that will facilitate the digital transformation and green transformation of the Czech economy. Such measures include the expansion of e-government, including open data and e-health services, investment in the digitization of the country's justice system, the expansion of high capacity 5G networks, improvement of digital skills, and the digitization of industries. The plan aims to increase the share of sustainable transport modes, save energy and reduce greenhouse gas emissions, while contributing to climate change mitigation and adaptation objectives, nature conservation, restoration and circular economy solutions. The measures will address the specific socio-economic challenges facing the Czech Republic by innovation of the ecosystem, development of skills in education, while taking into account social inequalities, and by taking into account social inequalities (Ministry of Industry and Trade of the Czech Republic, 2021).

Following an unprecedented pandemic crisis, the Czech Republic's Recovery and Resilience plan responds to the urgent need to promote a strong recovery and prepare the Czech Republic for the future. The reforms and investments in the plan will help the Czech Republic to become more sustainable and resilient, and better prepared for the challenges and opportunities of the green and digital transition. To this end, the plan includes 91 investment measures and 33 reforms. These are supported with EUR 7 billion in funding. 42% of the plan supports climate objectives and 22% supports the digital transition. The transformational impact of the Czech Republic's plan is the result of a powerful combination of reforms and investments that respond to the specific challenges facing the Czech Republic. Reforms address bottlenecks to sustained and sustainable growth, while investments aim to accelerate the transition to a low-carbon and climate-resilient economy, maximize the benefits of the digital transformation and improve the quality of public administration. The plan also aims to promote social cohesion and resilience by improving access to and quality of health care, addressing inequalities in education and investing in pre-school facilities. All reforms and investments will have to be implemented within a tight timeframe, as they have to be completed by August 2026 under the Recovery and Resilience Instrument Regulation (Ministry of Industry and Trade of the Czech Republic, 2021).

Figure 2. Potential impact of EU aid on different indicators in the Czech Republic (European Commission, 2021f)

The plan will promote economic growth and create jobs. The Czech Republic will increase its gross domestic product by 0.8% to 1.2% by 2026. The economic recovery could create jobs for up to 18,000 citizens. The Czech Republic will benefit significantly from the recovery and adaptability plans of other Member States, for example through exports. These spill-overs will amount to 0.3 percentage points of GDP in 2026. This shows the added value of joint and coordinated action at European level. These estimates do not include the potential positive impact of structural reforms, which could be significant (European Commission, 2021f).

According to the Statistical Office of the Slovak Republic, as of 30 June 2021 the Slovak Republic had 5,449,652 inhabitants. The aid allocated to Slovakia is EUR 6.3 billion, and if we divide this by the population, we get EUR 1,156.0371 per capita (Slovak Statistics and Demography, 2021).

According to the Statistical Office of the Czech Republic, the Czech Republic had 10,702,942 inhabitants as of 30 June 2021. As before, this is offset by the aid granted, which in the case of the Czechs is EUR 7 billion, so we get EUR 654.026 per capita (Czech Statistical Office, 2021).

If we subtract the two figures, the difference is EUR 502.01 per person in favour of Slovakia. The amount of the total allocation per section of the Recovery Plan is determined in detail by a Regulation of the European Parliament and of the Council of the EU. In addition, the total allocation is divided into two parts. Seventy per cent of the financial contribution has been calculated on the basis of the population, the inverted value of GDP per capita and the relative unemployment rate of each Member State. Thirty percent of the contribution would be calculated later, in 2022, on the basis of the economic performance of the Member States in 2020 and 2021. The amount of the total allocation is therefore given as an approximation in the long term. The final allocations will not be known until June 2022 (Eurostat, 2021).

4. Discussion

Slovakia's Recovery and Resilience Plan is expected to contribute significantly to the recovery from the COVID-19 crisis and to economic, social, and territorial cohesion, and can be seen as a comprehensive and adequate response to the challenges Slovakia is facing. The plan addresses long-standing challenges in the areas of education, childcare, health, research, development and innovation through comprehensive measures to address the most serious gaps. The implementation of the Recovery and Resilience Plan is expected to contribute significantly to economic growth and job creation in Slovakia, while strengthening economic, social and institutional resilience. This would facilitate the country's transition to an economic model focused on high value-added activities and more competitive in the face of automation and digital change. In addition, the Czech Recovery and Resilience Plan introduces measures aimed at structural changes. The plan sets out an ambitious agenda for digitizing businesses and strengthening the innovation ecosystem to support the recovery, fostering sustainable growth and boosting the Czech Republic's competitiveness. The significant investments are expected to bring lasting changes to the Czech economy. Investments in sustainable transport

modes, such as railways and in energy-efficient renovation of housing and public buildings should reduce air pollution, help the green transition and contribute to territorial cohesion. Investments in innovative start-ups, SMEs and large companies through different financing schemes, such as public-private partnerships and investments in very high-capacity networks. The planned investments in the digital transformation of the Czech justice system offer a good opportunity to strengthen the efficiency and flexibility of the system and improve access to justice. Health reforms will be supported by investments in specialized care, e-health, screening programmes and comprehensive rehabilitation care, as well as in excellent research in selected health areas that can improve health outcomes. Investments in education, training and social care will help social cohesion and contribute to cushioning the potential impact of changing labour market trends and demographic changes. In the introduction, we listed several studies that show that subsidies are associated with an increase and others that are sceptical about this claim. In a follow-up study a few years later, we would like to examine who was right in this case.

Conflict of interest: none

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Optimization of Document Workflow in Academic Organizations from Project Management Perspective

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Abstract: This paper discusses issues related to document workflow in academic institutions (universities) related to the project preparation activities. The problem is analyzed primarily from the perspective of a project manager. The analysis is focused on the identification of various given limits (mostly derived from law or procedural requirements), typical problems occurring during the document preparation and processing, and various time constraints related to specific activities within the discussed workflow. A generalized case study is presented to illustrate these problems (process workflows of project initiation and contract preparation). Concluding discussion presents the examples of the best practice and highlights critical moments during the project preparation, as well as suggestions of possible improvements. The comparison with similar process workflows in SMEs, and public institutions is a part of the discussion as well.

Keywords: project management; document workflow; process optimization; BPMN

JEL Classification: D23; D73; M10

1. Introduction

Currently, the project management represents a very topical issue discussed within various types of organizations. The project management often requires the coordination of a lot of people as well as processes. This work and responsibility flow remain challenging even though particular methodologies are both available and applicable according to particular contexts.

The workflow and process flow of information, knowledge, documents, contracts, and the other necessary parts needed for project proposal preparation can accelerate as well as slow down the projects in their very beginning. The limitations and barriers which might occur are discussed within this paper together with specific recommendations and suggestions of countermeasures. The efficiency of these processes influences the motivation to propose and prepare the projects. This is obvious within various types of institutions within which the bureaucratic barriers significantly discourage potentially valuable, beneficial, and sustainable projects. If higher attention is paid to internal processes, the requirements connected with their management and administration, more time might be allocated to the projects themselves from the professional perspective (Shijun, 2020).

The efficiency of a documents` workflow within any organization may prove to be a challenging problem, usually further increasing in complexity in larger institutions (Marbach et al., 2019). This paper is focused on the efficiency of such documents` workflow (DW)

related to the project preparation activities. This problem is analyzed from the project management perspective, e.g. from the position of a project manager who is generally responsible for successful project preparation.

This problem is discussed over a model case study of research project preparation within which all important participants play their respective roles during approving steps. The case study, visualized with BPMN (Business Process Model and Notation) diagrams (Havey, 2005), highlights the important weak spots, mandatory steps, and the roles of individual participating entities. Another important information contained in these diagrams are the processes of creating, maintaining, and modifying data objects for respective steps during preparation phase of the project.

The discussion follows the BPMN analysis and is focused on the possible improvements and increase of efficiency of DW (Šramová et al., 2021). Obviously, many steps are mandatory, legally required, and cannot be avoided. On the other hand, there is often unnecessary large portion of workload handled by a project manager himself/herself and amendments ensuring to ease such bureaucratic burdens can and should be taken.

2. Methodology

From the methodological point of view, BPMN collaboration diagrams are used to capture the documentation workflow (Havey, 2005). There are many participants from various departments either collaborating on preparation of given documents or they serve as supervisors, maintaining control over processes at hand (Barendsen et al., 2021). Unfortunately, quite a large number of these participants are mandatory, while others seem to be crucial for internal functioning of processes within universities. As it is shown below, the process is not simple and the majority of the work related to document preparation is a responsibility of the project management team (or project manager himself/herself).

To support the discussion, an illustrative case study is presented in the form of two processes analyzed in detail in section 3 Results. These are related to the domain of project management. The first process shows workflow of initiation of the project, the second one captures the process of contract preparation and its signature by rector and submission via data box.

3. Results

In this section, two illustrative examples of process workflows are analyzed in detail. Analysis is divided into two processes:

- Process of project initiation (see Figure 1).
- Process of contract preparation (see Figure 2 and Figure 3).

The following schemes depict the processes experienced at the example university. These show and prove the current situation. The presented situation might vary institution to institution which should be considered as well. Nevertheless, but it can be anticipated that the general idea will be in crucial points similar to the mentioned examples.

According to project management methodologies such as PRINCE2, the project initiation phase is the first stage of project preparation process. Its main purpose includes three steps: (1) obtain project mandate for project manager, (2) obtain approval of the project concept from the representative of the faculty management, and (3) fulfill initiation conditions to be able to begin with detailed preparation (specified budget, project plan, project team, work breakdown structure, etc.). The whole process of project initiation is shown in Figure 1.

3.2. Process of Contract Preparation

During various stages of the project, many formal contracts are required to be signed by all relevant stakeholders. The bureaucratic workload might be eased through use (after necessary modifications) of previous contracts, usually from similar project calls. Before obtaining signature of the main organization representative (in this case, the rector of the university), the document workflow goes through many departments or people with specific project roles. The most important participants during the contract approvement activities are the legal department, vice-dean office, principal investigator, executive secretary of the faculty, vice-rector for science and creative activities, and, finally, the rector office.

Although the flow of documentation might seem to be unnecessarily complex, all participating departments are on the contrary necessary and cannot be avoided. The main factors which might prove to be most efficient in increasing effectiveness seems to be use of digital signatures, and speed of process workflow as a whole. This complexity is prevalent characteristic for all larger institutions, because majority of large municipal institutions or corporate companies have processes of similar complexity as well. This makes situation even more complicated because the contract must be signed by at least two (in some project calls even more) parties. Moreover, the process is repeated for all relevant contracts, such as co-operation agreement with the project partner, contract with application guarantor, and contract with grant provider. These contracts serve only as examples in discussed case but are usually required in projects of Czech Science Foundation projects, Technology Agency of the Czech Republic projects, or departmental projects (of various ministries). It can be expected that situation will worsen in the case of large international projects with multiple participating institutions (including necessary translations and consultations of legal documents).

4. Discussion

The paper reveals the differences between and among institutions considering the document workflow. Based on the case study, these might be perceived as a bit complicated and inoperable in relation to the academic institutions. Within the workflow, particular extent of rigidity occurs. Partly, this is given by the fact that some of the processes must follow the sequence strictly and unavoidably given by the laws and regulations (both official and if relevant internal too) which defines and sets also the conditions for particular approvals, signature retrievals, etc.
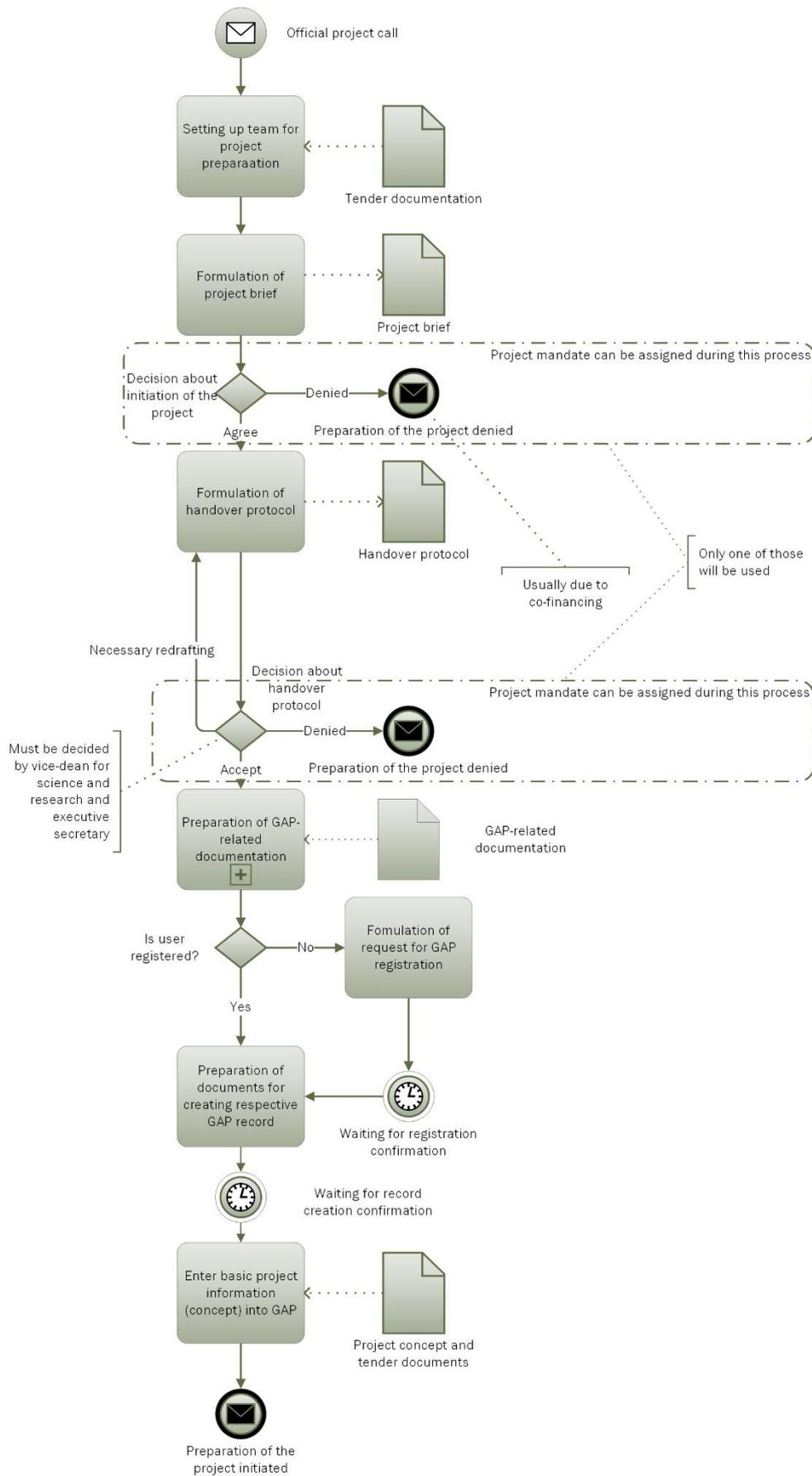
Figure 1. Process of project initiation
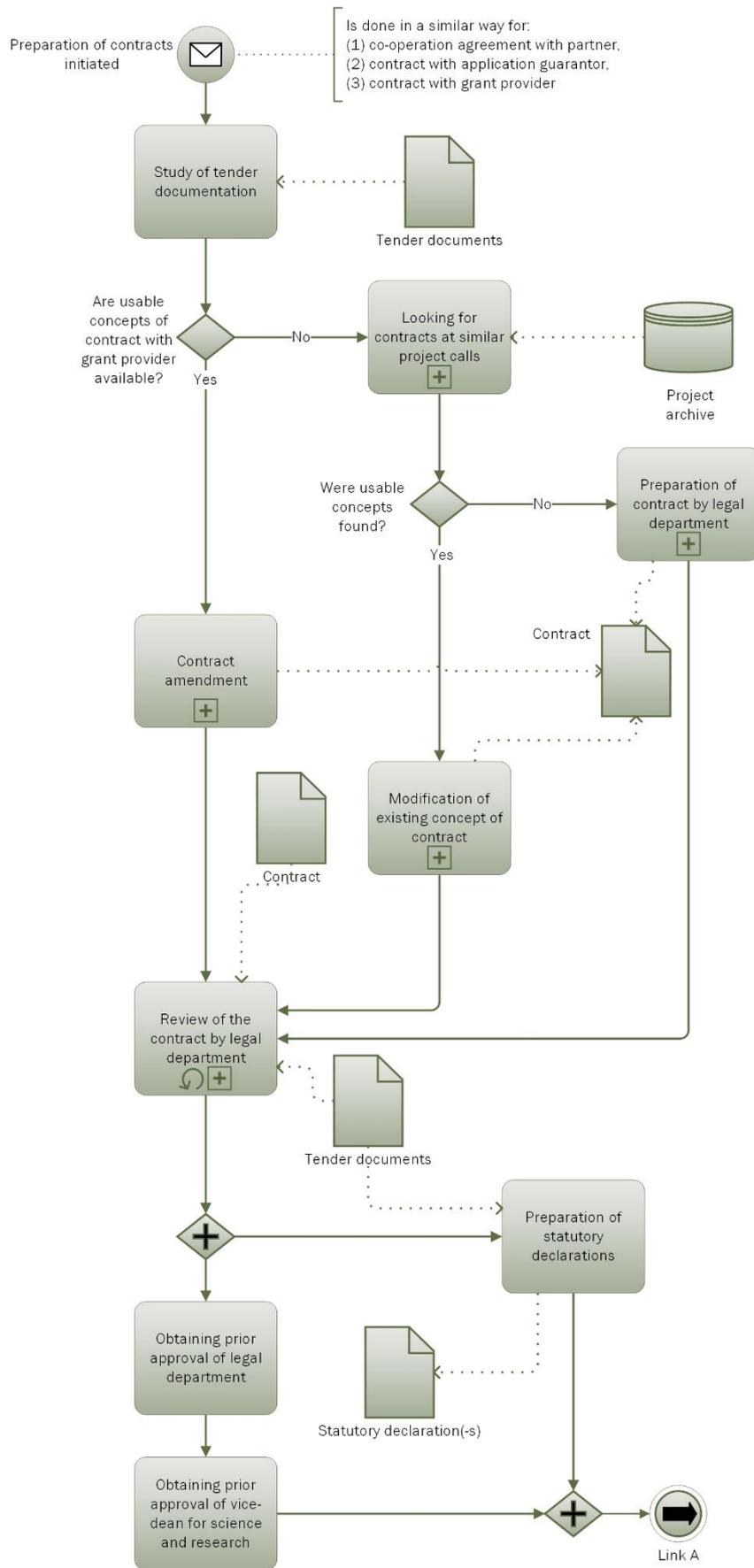
Figure 2. Process of contract preparation (part 1 of 2)

Figure 3. Process of contract preparation (part 2 of 2)

The comparison with other types of organizations might help to understand the current situation. There are significant differences between public and private sector. Then, the size of organization matters. Except from the beforementioned, the field of business plays its role. Mostly, the corporate organizations and public sector (including academic one) are quite similar. Their inflexibility matters during the negotiations with the external partners, but also within the organization itself. In that realm, the SMEs (small and medium sized companies) have mostly the competitive advantage (Arturo-Delgado & Díaz-Piraquive, 2021). The communication, information and data flows are simply affected. Nevertheless, even this advantage is usually eliminated due to missing administrative support and organizational project workflow codification which might help to clarify these processes on the other hand.

The limitations of this paper include the fact that the specific academic institution environment is considered within the case study. Nevertheless, from the author's experience, similar conditions and requirements are required at the other institutions. This leads to further limitation represented by the national environment which imply particular cultural, social, legal, economical and other conditions.

5. Conclusions

The orchestration as well as synchronization of the processes will enable the promptness and smoothness of the document workflow (Lau, 2021). Nevertheless, some mentioned variations are shaped by the given or deeply established practices, and these can be hardly changed quickly and without any further consequences. At the university level, it is a long-term issue which should be managed at the managerial level. The proper and well-planned reengineering represents one of the solutions. The processes should not be unifyingly perceived as there are in most cases similar stakeholders involved. Another approach will include the currently promoted and employed efficient agile methods (Miller, 2020; Oprins et al., 2019).

Furthermore, the reengineering sometimes implies the necessary organizational, departmental, team as well as individual changes or amendments. As generally known, a lot of people struggle with the change acceptance and implementation no matter which beforementioned level they feel majorly to be. Therefore, the potential reengineering and change management of the organizational processes ensuring their higher presence require a lot of both attention and patience. The implementation of the changes connected with those processes will take some time and sometimes legal or internal regulation scheme changes delay the overall efficiency increase. Consequently, these remain a challenge for the future.

Conflict of interest: none

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Design of the Smart City Domain Concept in the Czech Republic

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Abstract: The concept of a Smart City is a highly debated topic worldwide, the main weakness of which is the broad diversification of the concept itself. Individual solutions show a high degree of inconsistency in the processes involved in the Smart City concept. In order to effectively design and operate the Smart City concept, it is essential to establish process domains defining the scope of activities and services, all in accordance with cybersecurity. The Smart City initiative has evolved from the vision of sustainable development defined in global strategy documents dating back to 1992 when Agenda 21 for the 21st Century was adopted at the United Nations Conference. The Czech Republic (then Czechoslovakia) has also committed itself to fulfilling the objectives set out in this document and, in particular, the latest update, Agenda 2030, is the basis of current national and regional strategies. The purpose of the paper is, based on an analysis of European and national development strategies and guidelines concerning Smart City, to design a unified domain model, together with the characteristics of the key areas representing the Smart City concept for the needs of higher territorial administrative units of the Czech Republic.

Keywords: smart city; smart region; development; domain model; Czech Republic; cybersecurity

JEL Classification: O21; O32; O44

1. Introduction

The concept of a Smart City (SC) is a very trending topic not only in the Czech Republic but all over the world. Despite the huge interest and attention paid to the concept, no uniformly accepted characteristics, clearly defining the key domains of SC and their content, has been published so far. However, there are many different definitions, views, and models for SC that attempt to do so (Eremia et al., 2017; Dustdar et al., 2017). In general SC is described as: "The use of modern technologies and the best possible approaches to improve the quality of life of residents." Conceptually, SC is also associated with the vision of sustainable development, which has a significant role in the current SC initiative, but terms "smart" and "sustainable" cannot be used interchangeably. A city can be sustainable without being smart, but it cannot be smart if it is not sustainable, which is why the term "smart sustainable cities" has emerged (Ahvenniemi et al., 2017). It is the vision of sustainable development, along with the rapid technological advances, mainly in ICT and IoT, that are the basis for the current SC concept.

Global, as well as regional development, is influenced by a large number of initiatives and megatrends, based on which national strategies are created. National strategic plans in the Czech Republic are being developed in full compliance with these global initiatives and documents. Following the example of current national documents, at the turn of 2020-2021, strategies began to emerge at the level of individual territorial administrative units, which will be analyzed in this paper. So far, the implementation of smart solutions is most visible at the level of cities. The *Modrožlutá kniha Smart Písek* (Svítek et al., 2015) is considered to be the very first SC strategy in the Czech Republic. Currently, there are already a large number of such documents, but it is certainly worth mentioning a very well developed strategy called *Strategy #BRNO2050* (2020).

2. Global and National Influences

Agenda 21 (United Nations Conference on Environment and Development, 1992) is the most important document that sets out a development plan for the 21st century not only for individual countries, but for the whole world, and which has a significant contribution in the current form of the SC vision in the Czech Republic as well. It is also applicable to smaller local authorities, as highlighted in chapter 28 - Local authorities' initiatives in support of Agenda 21, which calls on local and regional authorities to implement this global plan in the form of their own agenda (CENIA, 2017). As a result, a development programme called Local Agenda 21 (MA21, 2006) was created in the Czech Republic, under the direct responsibility of the Ministry of the Environment. MA21 is and instrument, that translates the principles of sustainable development into practice, designed for municipalities and individual territorial administrative units, and to ensure a good and sustainable quality of life and environment in a specific territory.

Other global plans were developed in direct relation to Agenda 21, the most important of which is the United Nations (UN) Millennium Declaration (2000), which consists of eight Millennium Development Goals (MDGs). These set out the content of the current UN global program for the upcoming years Agenda 2030 (*Transforming Our World: The 2030 Agenda for Sustainable Development*, 2015), the core of which is seventeen Sustainable Development Goals (SDGs) for the period 2015 to 2030. All strategic documents worldwide therefore should be developed in line with and in order to meet these seventeen goals. This also applies to documents aimed at supporting the SC initiative. In the EU it started with Europe 2020 (European Commission, 2010), also called Digital Agenda, which is a ten-year strategy aimed at promoting smart and sustainable growth. Based on this, international activities called Smart Cities and Communities in 2018, and a year later The European Innovation Partnership on Smart Cities and Communities (EIP-SCC) were established, thanks to which the concept for Smart Cities was given a basic structure (*Smart Cities Methodology*, 2018).

The Czech Republic has also committed itself to the goals set out in the Agenda 2030 and the Strategic framework Czech Republic 2030 (Kárníková, 2017) was created based on this fact. It is an overarching strategic development document issued by the Government of the Czech Republic. It is followed by the Regional Development Strategy of the Czech Republic 2021+ (SRR21+, 2019), which sets goals at the national level for a horizon of seven

years, i.e., for the period 2021 to 2027. The SRR21+ itself states that the main purpose of the document is to identify a specific approach based on the needs of individual regions and to identify specific interventions to balance competitiveness between them while supporting sustainable development.

Another key document is the *Innovation Strategy of the Czech Republic* (Havlíček, 2019) for the period 2019 to 2030. This is a strategic plan for the Czech Republic's policy in the field of research, science, development, and innovation, which aims to move the Czech Republic among the most innovative EU countries. In this context, the strategy also introduced a new brand, under which the Czech Republic presents itself at the international level, Czech Republic: The Country for the Future. It is the systematic support of research, science, and education that can help meet all the seventeen development goals from Agenda 2030. This area also plays an important role in the development of the SC initiative. Especially *National research and innovation strategy for the intelligent specialization of the Czech Republic 2021-2027 (RIS3*, 2021) is a strategic document focused on the effective use of European and national resources to support research and innovation in priority areas set out in SRR21+.

In accordance with all the above-mentioned national and European documents, based on global trends and in order to meet the development goals, the Czech Republic has decided to include the Smart concept in strategic planning for the next years. The first document which serves as direct support for the implementation of the SC concept at the level of cities, municipalities, and higher administrative units, is *Smart Cities Methodology* (2018) from the Ministry of Regional Development, which is an update of the older *Methodology of the concept of intelligent cities* (Bárta et al., 2015). In the document, the primary goal of the SC is defined as "Ensuring a quality of life for residents, where modern technologies are used as a tool to influence the quality of life in the city, and subsequently to achieve the economic and social goals of the city."

Based on this methodology, and to fulfill the mentioned Innovation Strategy, RIS3 strategy, and measure No. 55 from the SRR21+, the current overarching document Smart Cities Concept (MMR ČR, 2021) was created. The document looks at the issue from the perspective of municipalities, cities, and higher administrative units and presents a proposal of areas for new solutions that will ensure a quality of life for citizens and competitiveness at the international level. The structure and content of the Smart Cities Concept also show the impact of the recent European Green Deal (European Commission, 2019), which affects all proposed areas, especially energy, the environment, and transport.

In accordance with this concept and all of the above-mentioned documents, new development and Smart strategies with the outlook for the following years, most often until 2027, were created in individual regions of the Czech Republic at the turn of 2020-2021. These documents, together with the already existing Smart strategies of some regions, are that are the main subject of investigation in this paper.

3. Analysis of Regional Development and Smart Strategies in the Czech Republic

In order to design a unified domain model for the SC concept, applicable in Central Europe and especially in the Czech Republic, an analysis of regional development and Smart strategies of thirteen of the fourteen official higher administrative units of the Czech Republic is carried out. The fourteenth region is the capital city of Prague, which was omitted from the analysis because it approaches strategic planning more from a city perspective and therefore differs from others in certain characteristics, such as the absence of rural areas and rural communities. The aim of the analysis is to find out whether the individual administrative units are involved in the implementation of the SC concept in their territory, or whether this concept is included in their respective development strategies for the current period. Furthermore, based on this analysis, identify the key domains of the SC and possibly propose new domains that should be part of the model. Finally, the proposed model is compared against individual analyzed strategies to verify its meaningfulness.

The first step is a basic analysis of the structure of development strategies in terms of formulation, number, and content of priority areas (PA, see Table 1). Already at this stage of the analysis, the first results appeared. The strategy of twelve of the thirteen reviewed regions is, at least to a minimum extent, in line with the SC concept. Six of these twelve regions even have a separate strategy for Smart Region development (marked in green in the Table 1) from earlier years. Just one region does not have a development strategy for the current period to match the terms of the current national documents. For this reason, this region is also omitted from the analysis, as its strategy is not relevant to the objective of the paper.

The number of PAs ranges from four, in Ústí nad Labem and Pardubice regions, to ten, in the case of the Central Bohemian Region, with the largest representation being six and seven PAs. Already from the name and formulation of individual domains in some strategies, the influence of the Czech Smart Cities Concept is clearly evident. These basic domains are often supplemented by areas typical for that region, e.g., spas in Karlovy Vary Region. Other regions, on the other hand, have followed the traditional SC domains proposed in the study Mapping Smart Cities in the EU (Manville et al., 2014) published by the European Parliament. Based on a similar analysis of European cities, it defined six core SC domains, namely: Smart Governance, Smart Economy, Smart Mobility, Smart Environment, Smart People, and Smart Living. The PAs defined in the strategies of the Zlín and Liberec regions are closest to this concept. The remaining regions have taken a different path in formulating the PAs, but they still cover all key areas thematically, although in some cases only in the form of specific objectives.

However, education, science, research, and innovation were generally represented in all regional strategies (marked in yellow in the Table 1). This is a consequence of the influence of the Innovation Strategy, mentioned in the introduction, more specifically the RIS3 strategy, which focuses on this area. This demonstrates the importance of this domain and also supports the claim in the Innovation Strategy that education, science, research, and innovation help with fulfilling all of the seventeen SDGs.

Table 1. Priority areas in individual regional development strategies – Part 1

The development strategy of the Central Bohemian Regional District 2019-2024	The "Smarter Region" concept for the Liberec Region	The Development Strategy of the Olomouc Region 2021-2027	The strategy for the development of the Smart Region of the Zlín Region 2030	The concept of Hradec Králové Region – Smart Region	The Karlovy Vary Region Development program 2021-2027
Economic development, Science, and Research	Smart economic development and tourism	Economics and Innovation	Smart economy, smart business, innovation, tourism	Knowledge economy	Economically prosperous and attractive region
Human resources, Education	Smart education	Education and Employment	Smart people - education, community development, culture	Public space and housing	Education and sport
Transportation	Smart transportation	Sustainable mobility and transport infrastructure	Smart mobility	Transportation	Transportation
Energy infrastructure	Smart technical infrastructure	Environment and technical infrastructure	Smart energy	Energy	Environment, Agriculture, Energy
ICT infrastructure	Smart administration	Public administration, development management, and security	Smart public administration	Public administration	Territorial administration, protection, and development
Healthcare	Smart healthcare	Healthcare and social services	Smart housing, social services, and healthcare	Services	Healthcare and Social services
Social services	Smart social services	Sport, Culture, Tourism	Smart environment	Environment	Spa, tourism, and culture
Environment	Smart environment				
Tourism					
Culture					

Table 2. Priority areas in individual regional development strategies – Part 2

Transformation plan of the Ustí na Labem Region 2021-2027	The development strategy of the Pardubice Region 2021-2027	The development strategy of the Vysočina Region 2021-2027	Development Strategy of the South Moravian Region 2021+	The development program of the South Bohemian Region 2021-2027	The Development Strategy of the Moravian-Silesian Smart Region 2017-2023
Business, Research, Innovation	Economics - knowledge economy, tourism, transport	Competitive economy and employment	Competitiveness, entrepreneurship, innovation, and research	Effective territory management and innovation	More enterprising and innovative region
Competent people and Smart Region	Human resources - education, quality of public services	Quality and affordable public services	Education, sports, and extracurricular activities	Mobility	More educated and more employed region (Education)
New energy and efficient use of resources	Territorial development and cooperation - public administration	Modern infrastructure and mobility	Transport infrastructure and accessibility	Energy	A more connected and smarter region (Transport, accessibility)
Revitalization of the territory	Environment - ecology and energy	Healthy environment and sustainable countryside	Healthcare and social affairs	eGovernment and digitization	Cleaner and greener region (Environment, energy)
		Attractive cultural and historical heritage and tourism	Environment, technical infrastructure, rural development, and agriculture	Healthcare and Social services	A healthier and more cohesive region (Health and social services)
			Tourism and culture, public administration, civic amenities, and security (including cybersecurity)	Environment	More attractive and cultural regions (Culture and tourism)

4. Design of Unified SC Domain Model

The results of the analysis show a total of six domains, which we afterwards expanded by one more domain to a total of seven key domains for the implementation of solutions from the SC concept from the perspective of higher administrative units. Based on the proposed model, there are five vertical domains representing the basic areas of interest on which the regional administration should focus. These are complemented by two horizontal cross-cutting domains, namely Systematic science, research, education, and innovation, which emerged from the analysis as vital, and Cybersecurity, which was added to the model. Both cross-cutting domains strongly support and influence the processes and services in all other domains. It can be stated that they are the key to all future implementations, and therefore the regions should pay special attention to them.
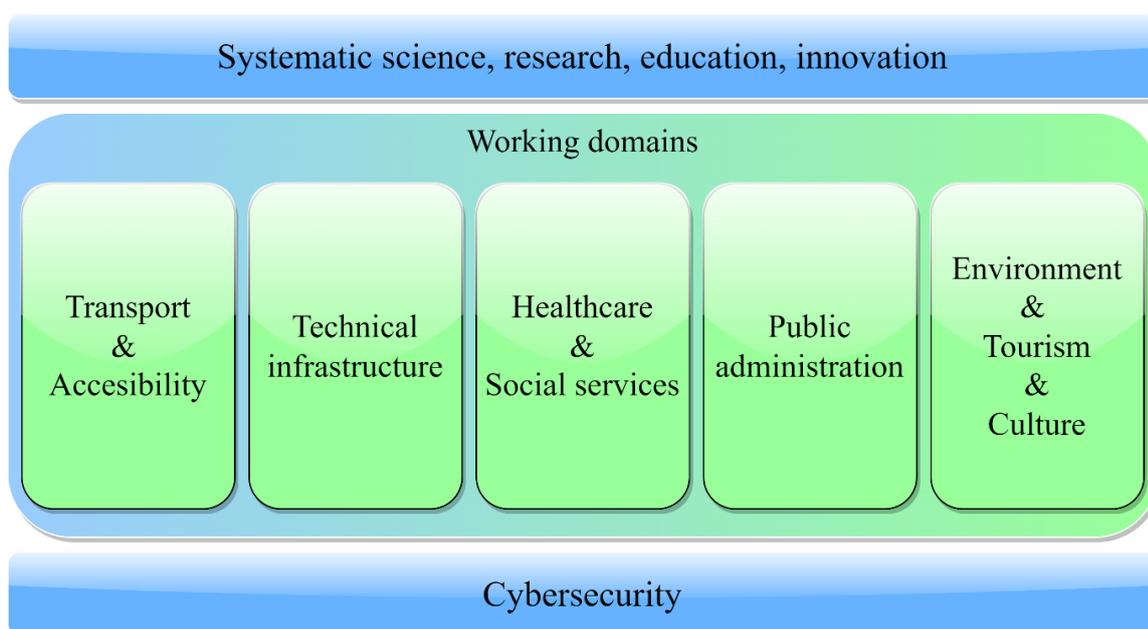
Figure 1. Scheme of proposed domains of the Smart City concept

The first cross-cutting area is, in all analyzed regions, based on regional RIS3 strategies. The supporting tool for growth and capacity development in the field of research, development, innovation, and know-how at the regional level is currently the program called Smart Accelerator II, which is part of the Operational Program for Research, Development, and Education (OP RDE) from the Ministry of Education and Physical Education. All regions are part of and benefit from this program, especially in the form of financial support. Specific activities typical for this domain are support for all levels of the education sector, talent development, improving the equipment of schools, laboratories, etc., support for the innovation environment, new solutions, small businesses and startups, coaching programs, and public awareness, digital education and more.

This domain has a large overlap with the second horizontal area of Cybersecurity. The concept of Smart Cities is entirely built upon the use of appropriate and modern technologies and is strongly influenced by global megatrends, such as the Internet of Things (IoT), OpenData, BigData, artificial intelligence, and more. However, as the technologies evolve

and their use grows, so does the threats and the level of risk. With this, the need to secure these solutions not only at the level of individual implementations but also at the level of the entire SC is growing in importance. The more surprising was the finding that the issue of cybersecurity was almost non-existent in regional strategies. Two exceptions are Karlovy Vary and Zlín regions. Other strategies included only mentions and claims that cybersecurity is important or that the threats need to be taken into account. However, they did not contain any specific measures, activities, or at least visions, together with reference to national documents dealing with this issue. The Zlín region paid the most attention to cybersecurity, and its strategy included specific goals and visions, together with ongoing or already implemented projects. It should be noted that the Cybersecurity domain does not only include security implementations and measures. It is here that these two horizontal areas intersect. Education, public awareness, and regular training of responsible people and employees are also very crucial.

Clear boundaries cannot be drawn for other domains either. Even though they are shown separately, their scope also overlaps. A typical example is air quality from the Environment domain and the issue of transport or even energy. Their representation in the form of individual domains is only for the sake of better clarity and simplicity. Examples of solutions from the Transport and Accessibility domain are, for example, smart parking, smart bus stops, smart public transport, vehicle sharing, electromobility, monitoring and evaluation of traffic, increasing the attractiveness of public transport, and more. Two major areas are included in the Technical infrastructure domain, namely Energy and ICT technologies. These include a high-speed data network, maximum IoT coverage, regional data, and analytical centers, digitization support, eGovernment in terms of technologies, smart buildings, smart lighting, renewable energy sources, smart grid, cogeneration of energy, and more. Great benefits for residents bring the domain of Health and Social services, which can contain improving the quality of care services, eHealth, mHealth, prevention and prediction with the use of appropriate technologies, homecare, support for sports activities, support for young families, immediate assistance systems, improving integrated rescue system services and more. The domain of Public administration is important mainly because it plays an important role in the implementation of solutions in other domains and the SC concept in general. However, from the point of view of citizens, this is the area of eGovernment, communication within the municipality, electronic services, OpenData, portals for citizens, and so on. The last domain, that could be described as the image of the region at the interregional and international level is the Environment, Tourism, and Culture. Environmental quality is closely linked to the whole SC concept and represents, for example, improving air quality, waste management, protection against elements, circular economy, waste and rainwater management, green infrastructure, renewables, regeneration of brownfields (land and real estates that are underutilized or neglected) and others. In the case of Culture and Tourism, it is about the promotion of the region, taking care of historical monuments, support of culture, etc.

5. Cybersecurity and Smart City

As mentioned above, the area of cybersecurity is an integral part of the design, implementation, management, and operation of all systems operated within the SC concept, and its goal is to ensure adequate parameters in the area of Confidentiality, Integrity, and Availability (CIA) of individual data assets that are part of the SC. A detailed framework for cybersecurity management across the EU is defined by Directive (EU) 2016/1148 of the European Parliament and of the Council (2016) – Concerning measures for a high common level of cybersecurity across the Union and the related Proposal for a Directive of the European Parliament and of the Council: on measures for a high common level of cybersecurity across the Union (2020), repealing Directive (EU) 2016/1148. Specific procedural and technical solutions at the EU level are set by the European Union Agency for Cybersecurity (ENISA) established by Regulation (EU) 2019/881, repealing Regulation (EU) No 826/2013. ENISA defines standards and recommendations for addressing current vulnerabilities and associated risks, as reported in Risk Management Standards (Eckmaier et al., 2022) and Guideline on security measures under the EECC (Milenkovic et al., 2020b).Then, in terms of the SC domains defined above, there are important publications on individual cross-cutting topics, such as energy and solutions for its time synchronization, where ENISA has issued a set of recommendations called Power sector dependency: Attacks against time-sensitive services (Stergiopoulos et al., 2020) for addressing risks in this area. Last but not least, ENISA also addressed the issue of security measures for 5G technology in its publication 5G supplement to the guideline on security measures under the EECC (Milenkovic et al., 2020), which has a high potential within the SC concept (Chuang & Tseng, 2021; Gohar & Nencioni, 2021; Zhao et al., 2021).

An integral part of the Smart City concept, according to the analysis, are eGovernment systems, i.e., public administration using modern electronic tools that will make public administration more citizen-friendly, accessible, efficient, faster, and cheaper. Among other things, its aim is to ensure that citizens can handle official matters at any time and from anywhere with an Internet connection using the maximum level of digitization, thanks to which most public agendas can be handled electronically without the need to go to the office. This entails the need to implement an EU-wide recognized electronic identity that will allow uniform access for authentication and authorization across the EU. Ensuring an adequate level of cybersecurity for both the agendas and the aforementioned generally available Internet connection is a necessary part for the full implementation of the eGovernment principles.

Another important part is undoubtedly to ensure the availability of integrated rescue system (IRS) services, which for its effective operation uses not only communication systems, automatic location systems, but also, for example, intelligent traffic management systems, status information, and throughput of individual routes, available online and with the appropriate level of confidentiality. Another key area of an SC is also intelligent, reliable, and safe management of energy systems, especially the distribution of electricity, gas, and water. Approaches to ensuring maximum diversification of these resources and their ecological context form the point of view of the European Green Deal, also belong to this area. The

framework for ensuring the cybersecurity of all the above-mentioned components of the SC concept is defined by the Czech national legislation, in particular Act No. 181/2014 Coll. (Cybersecurity law), Decree No. 82/2018 Coll. (Decree on Cybersecurity), Act No. 127/2005 Coll. (Electronic Communications Act), Act No. 240/2000 Coll. (Crisis Act), Decree No. 317/2014 Coll. (Decree on significant information systems and their determining criteria), and a Government Regulation No. 432/2010 Coll. (Government decree on criteria for determining a critical infrastructure element). This national legislative framework applies to defined systems included among the so-called "critical information infrastructure" or "important information systems" which are identified in Directive (EU) 2016/1148. However, the forthcoming change in Proposal for Directive (EU) 2016/1148 from 2020 makes it more than obvious that it will be necessary to expand the group of these specific systems and to include secondary systems, which may play the role of a source of information or be processors of information. To achieve this goal, it is necessary to build a comprehensive data model. Based on the security classification of data, it is then necessary to build a multi-level system to ensure cybersecurity. Considering the specifics of the data of the individual domains of the SC concept, providing comprehensive and systematic education and considering the requirements defined by the ISO/IEC 17799:2000 standard, safe operation of the SC concept as a whole will be achieved.

6. Conclusions

The aim of the article was to design a domain model based on the analysis of relevant national and regional development strategies. The analysis itself confirmed that a major problem of the Smart City concept is the high degree of diversification of its conception, and that this is not a problem that occurs only at the international level, but also at the level of higher administrative units. Based on the results of the analysis, five working domains were identified, representing the different Smart City areas of interest from the perspective of higher administrative units, and one cross-cutting domain, which supports the overall development of the Smart City concept and is the basis for all future implementations. This initial model, containing a total of six domains, was further complemented by an additional horizontal domain providing Cybersecurity, addressed across all processes and services of the defined model. Another strength of the proposed model is the possible implementation of process management using the PDCA cycle, where the "Plan" phase is applied within the Systematic science, research, education, and innovation domain, i.e., outputs from this domain serve to verify existing conditions and set Smart City goals. The "Do" phase, the implementation of the created plan, is implemented in individual working domains. The "Check" phase has its place within the Cybersecurity domain, the aim of which is not only to verify security but also partial functionalities and impacts on working domains. And lastly, the "Act" phase is again being implemented in the first domain, as it aims to find mitigation measures based on the previous phase. This makes the proposed model resistant to implementation errors and ensures its continuous improvement. In the end, these seven domains were validated against the analyzed development strategies to verify the validity and meaningfulness of the proposed model.

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Corporate Social Responsibility Activities Through the Employees' Lenses: Evidence from the Czech Brewery Sector

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Abstract: The paper discusses study in the area of Sustainability and particularly Corporate Social Responsibility practices, which are perceived by the employees in Czech Breweries. Study emphasize on the importance of implementing CSR practices across Czech breweries, as the sector has been emerging throughout the recent years, where many investors have been brought in. The findings and their implications are discussed in the broadest context possible. Future research directions have also been highlighted. The paper has limitations such as sample of selected companies, firm size, time-series, methods employed etc. Paper results show that Czech breweries are the least motivated due to the fact that Corporate Social Responsibility practices are only optional but not mandatory. Paper outlines that not all CSR practices have been positively perceived by the employees from the perceptive of internal corporate communication.

Keywords: employee perception; corporate social responsibility; brewery; Czech

JEL Classification: M14; M15; M19

1. Introduction

Several authors deal with the issue of corporate social responsibility (CSR), specifically in transitional countries. Visser et al. (2015) argue that the CSR concept is usually practiced by large, multinational and national firms. CSR tends to be less institutionalized and formalized and is more associated with charity and philanthropy, as well as a successful way for a company to generate revenues. On the other hand, Lindgreen et al. (2009) claim that the spread and the case of CSR activities in transitional and developing countries do not differ distinctly from the models of developed countries, and they even do not concentrate only on charity and philanthropy. Badulescu et al. (2018) deal with the case of Romania and they examined the relationship between firm age and implementation of CSR activities. They found that age was not the determining factor of CSR practices.

2. Literature Review

The significance of corporate social responsibility (CSR) for business, society and governance is now undisputed and is seen as an important factor of sustainable growth (Fombrun & Shanley, 1990). The CSR approach means the integration of an enterprise´s

social, ethical, environmental and philanthropic responsibilities towards society into its processes, operations and core business strategy. Applying CSR practices does not have to be just a concept that promotes personal responsibility and a path to a sustainable society. In essence, it can represent a significant competitive advantage and contribute to the growth of business performance (Glonti et al., 2020).

Following the stakeholder theory approach, the involvement of CSR could increase with the ageing and size of the company. The older firms are much more responsible in the case of diversity and environmental awareness (Campbell & Bohdanowicz, 2016). On the other hand, young companies need to build their image, possibly through CSR activities and then get larger marginal benefits from CSR inputs (Akben-Selcuk, 2019). In terms of company size, the broadly accepted view is that larger firms are more likely social responsible driving the fact that they are more visible. According to institutional theory, they face higher pressures to apply CSR concepts (Boulouta, 2013; Cabeza-García et al., 2018; Bengtsson et al.,2020). From the resource perspective, the implementation of CSR principles is usually associated with additional costs. It also provides more in-depth knowledge in the field of CSR. Large firms can benefit from not so limited resources, and even higher specialization applied in business management (Withisuphakorn & Jiraporn, 2016; De Vaus, 2002). On the other hand, smaller companies are more flexible, and they adapt better to the market environment. The application of CSR should be faster in these companies (Guerrero-Villegas et al., 2018).

The results of empirical studies are mixed, showing positive, negative and also no relationship between CSR, firm age and firm size. Jeppesen et al. (2012) found a positive link between firm age, firm size and participation of the company in CSR. Also, Trencansky and Tsaparlidis (2014) concluded that older firms more probably applied CSR practices (e.g. philanthropic and voluntary activities) examining the relationship in Sweden. Amato (2007) found the relationship between charitable giving and firm size. The study of Al-Gamrh and Al-Dhamari (2016) presented a positive influence of firm age, firm size and government ownership and CSR. On the contrary, Badulescu et al. (2018) concluded that the firm age was not the determining factor of CSR actions proving the relationship between firm age and CSR in Romania. Also, Wiklund (1999) argued that the firm age had no impact on the level of involvement in CSR activities. Orlitzky (2001) identified only a weak relationship between firm size and CSR using the meta-analysis. Udayasankar (2008) suggested the possible non-linearity of firm size and CSR link and claimed that tiny and huge businesses were equally motivated to participate in CSR. However, motivations could be different. Medium-sized companies were the least motivated, so this fact proposes a U-shaped relationship between CSR participation and firm size.

2. Methodology

The authors chose a Czech brewery company, one of the most transparent companies on the Czech market when it comes to CSR reporting and its CSR activities are very diverse, which makes it an interesting enterprise to study. The research question was put up:

Research Question:
What CSR practices have been applied by Czech breweries?

What role does corporate communication of the employee-related CSR activities play in the Czech breweries?

These questions were answered through analysis of thirteen companies' sustainable development reports for year 2019 and in the paper was conducted content analysis of the interviews' transcripts. For the purpose of the study there were sent out questionnaires to 50 breweries in the Czech Republic and thirteen breweries have responded to the survey. To gain respondents for interviews, we used the technique of volunteer sampling, more precisely self-selection sampling, where individuals volunteer to take part in the research in reaction to an advertisement. Tetrevova and Patak (2019) suggest publicizing the need for the cases through appropriate media and subsequent collection of data from the individuals that respond to the advertisement. The study survey was sent to one hundred and five recipients. Thirty-two employees responded positively to this e-mail and 13 were interviewed regarding the limited time frame but also their time constraints and function in the organization. We tried to assure that respondents were from as many different departments and working on as many different levels of hierarchy as possible. The online survey on CSR activities was sent to employees from operational, tactic and strategic levels within the small and medium-sized breweries in Czechia. Respondents job positions varied from customer service representative to senior managers.

3. Results

Our study aims to answer the research question as the two chosen models omitted the role of corporate communication in the process of the creation of employee CSR perceptions and the effect on their subsequent reactions. In the work of El Akremi et al. (2018), what employees know about the company's CSR has an even bigger impact on their reactions than the actual CSR activities of the company that they may not be aware of. Therefore, we present our findings in the area of company's CSR awareness and understanding among company's administrative employees. For the purpose of the study, we identified the most powerful communication channels used to promote CSR practices among the Czech breweries.

We counted at least 21 possible different activities of the company in this field from the CSR reports, which are available either on companies' websites or were provided by companies' representatives. The highest result was 11, which was on corporate volunteering (see Figure 1). However, it was not the aim of the interviews to name as many activities as possible, nor was there time to think about all of them. We could see the activities that came to the minds of the respondents first. On the other hand, we could assess the level of their awareness according to the number of different fields they could think of (see Table 1).

Table 1 depicts how many CSR activities codes have occurred according to the responses of 13 respondents from the respective departments (Top Management, Finance, Human Resource, Marketing, Procurement and Sales). For example, all the respondents from the HR department of the surveyed companies mentioned for the well-being projects as part of the CSR activities in their companies and thus, in the Table 1 is stated 100 percent.

We already showed that the activities aimed at employees were largely forgotten together with the Sustainable Development (SD) strategy.
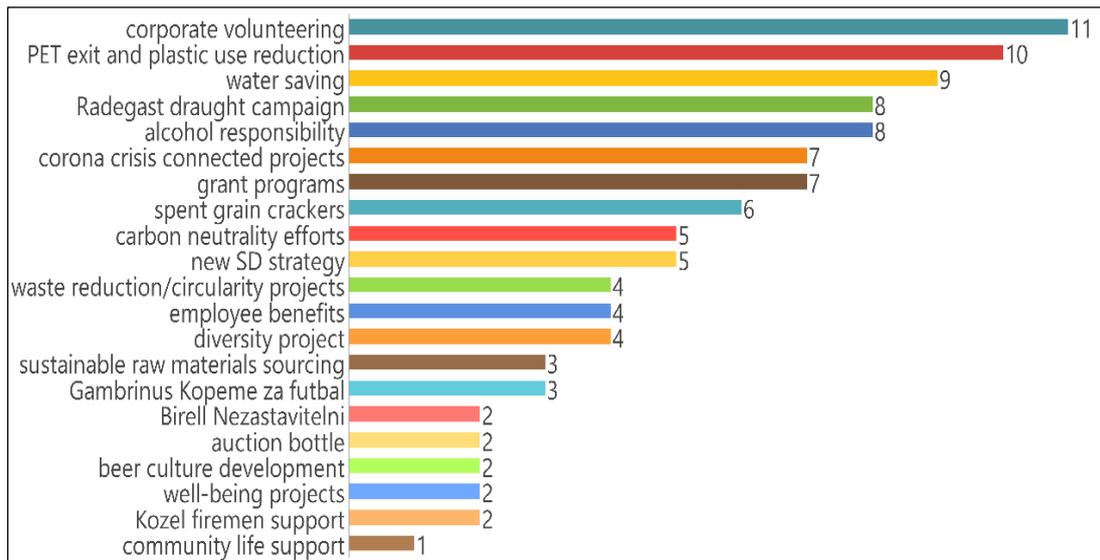
Figure 1. Documents with the CSR activities codes

Table 1. Well-being projects, employee benefits, and diversity project codes occurrence according to documents variable department

	Top Management (Executives)	Finance	HR	Marketing	Procurement	Sales
Company CSR awareness						
Well-being projects			100.0%			
Employee benefits			50.0%	25.0%		25.0%
Diversity project			80.0%			20.0%
N = Documents	1 (7.7%)	1 (7.7%)	4 (30.8%)	3 (30.8%)	1 (7.7%)	3 (23.1%)

Note: N = number of occurrences of CSR activities in the respective department within the surveyed companies.

While conducting the interviews, we noticed that the higher was the position of the employee in the company hierarchy, the more he or she evoked the Sustainable Development strategy and the deeper was their understanding of the company's CSR.

Firstly, from the analysis of the most frequently mentioned CSR activities, it is obvious that respondents were aware of the possibility to participate in corporate volunteering, which was the most popular CSR activity in the responses (see Figure 1). However, their participation does not go hand in hand with their awareness of this topic. Corporate volunteering is followed by activities in the field of environmental protection, such as the reduction of plastic packaging use or water saving in the breweries. On the other hand, in 6 out of 10 cases when the water saving was mentioned, it was only in connection with the Radegast brewery. More than a half of the respondents also knew about alcohol responsibility projects, grant programs, and as the research was conducted during the second wave of the corona crisis, the ad-hoc projects aimed to help the most affected groups of people were very much present in the minds of respondents as well (see Figure 1).

Only five respondents mentioned the new Sustainable Development strategy of the company introduced right before the start of the research. Moreover, in contrast with our presumption, respondents did not seem to associate the projects aimed at them to CSR.

Only four respondents counted in the employee benefits and only two the well-being projects. In addition, those respondents were mostly working in Human Resource, as seen in Table 1, so they were either working on these projects or directly in contact with these topics as a part of their job.

In Table 2 below paper results depict what communication channels codes across companies' documents have been used in the communication with employees as the top three channels are word of mouth (colleagues), mail distributor and companies' web portals.

Table 2. Frequency of the communication channels codes across documents

Code System	Interview Transcripts
Communication Channel	
external	x
internal	x
CSR training	x
Yammer	x
Monthly results	x
Newsletter	-
Colleagues	X
Log on screens	-
Mail distributor	X
Web Portal	X

Note: x-low frequency of communication; X- high frequency of communication

Finally, paper results outline that according to the employee responds the communication codes across the firms' documents have been perceived sufficiently, which leads into positive employee perception on the CSR activities overall (see Figure 3).

In addition, we also asked the interviewees whether they perceived the amount of communication and the information they have about the company's CSR as sufficient (see Figure 3). As the respondents seemed to be overwhelmed by the amount of information they are exposed to every day, the corporate communication about CSR was in the absolute majority perceived as sufficient: "I think that it is enough. We already get too many emails, and we are exposed to too much information." (HR specialist). One respondent described the number of emails as excessive but admitted that this was due to his position and not a mistake of the corporate communication adjustment. The results of this question are visualized in Figure 3.
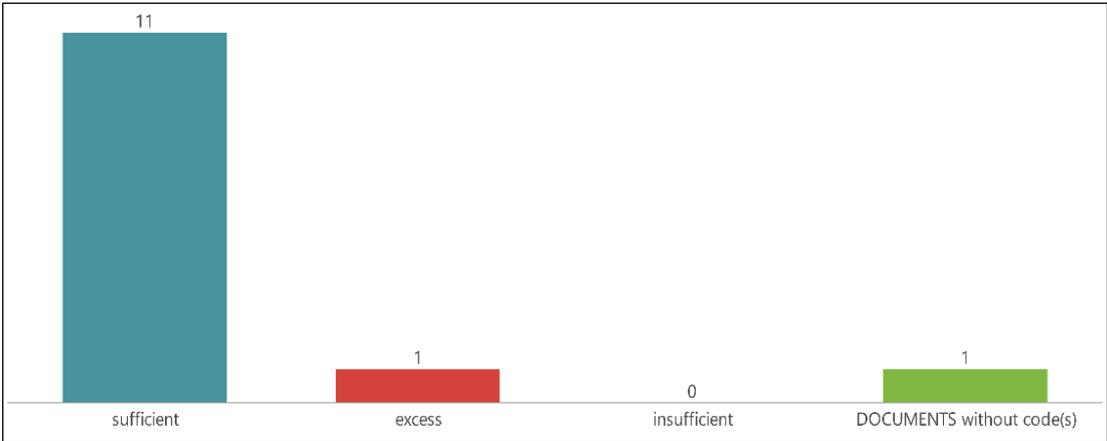
Figure 2. Occurrence of the perceived communication sufficiency codes across documents

4. Discussion

Wilhelm (2015) adds that engaged employees are more productive and more enthusiastic and so, they pursue better organizational goals. This is linked with high job satisfaction and motivation beyond simple pay. Pavlík and Bělčík (2010) see the causal chain as follows: a company is active in CSR that leads to higher motivation and creativity of employees, which causes higher productivity and better quality of products. Barakat et al. (2016) reconcile the ethical and instrumental views on CSR by saying that both employees and companies benefit from CSR, which creates a win-win situation. All these findings lead back to the teaching of Porter and Kramer, who were one of the first to claim that CSR creates shared value, which contributes to the company's competitive advantage (El Akremi et al., 2018)

Previous research by Gupta (2017) suggests the positive correlation of employee engagement to firm commitment and identification by implication of CSR activities. Another study conducted by Turner (2020) on employee engagement suggests that there is even a two-way link between the level of engagement of employees and CSR. Firslty, the employee-related CSR activities could lead to higher employee engagement (Flammer & Luo, 2017). Secondly, highly engaged employees are even more active when it comes to voluntary social service programs or green initiatives and thus, they could boost CSR of a company. Based on these findings, Turner (2020) concludes that employee engagement can be a source of strategic advantage for a company. Similarly, paper results show that the most preferred CSR activities are corporate volunteering, plastic and PET recycling activities and water saving.

Following, wanting to assess the overall level of CSR awareness of the respondents tied with the company, we had a look at the number of different activities that the respondents were able to name as proposed by Hejjas et al. (2019). We would not agree that we found the same as Hejjas et al. (2019), whose respondents' understanding of the company CSR was limited only to few activities.

Secondly, we had a look at the channels through which the respondents got the information about the company CSR through direct questioning, as suggested by Eger and Suchánek (2020). In Table 2, we can see that the most powerful communication channels for our respondents seem to be the internal ones – namely the company intranet or the portal and the mail distributor. However, these are not the only communication channels available to the company, so there are more possibilities to transfer the information to the employees. Some respondents mentioned the monthly results meetings, the internal social network Yammer, the newsletter, or the log on screens to their company laptops, which can be changed centrally, as well.

5. Conclusions

In the paper it was discussed the results and how they have been interpreted by the Czech breweries employees' in perspective of previous studies. However, based on the study results CSR activities implications should be discussed in the broadest context, as at some breweries particular CSR activities are viewed and absorbed differently by the respective employees at their functional departments. Future research directions may also be highlighted, especially into mapping secular CSR approach into recognizing and

incorporating of global CSR initiatives in Czech breweries strategies. Provide an overview of the study limitations i.e. sample size, time-series, methods employed etc. Future research on CSR activities should cover bigger sample of companies and more industries from the Czech Republic, as Corporate Social Responsibility has been emerging throughout the world.

Conflict of interest: none

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Activities of Organizations in the Field of Social Responsibility in the Context of Human Resource Management with a Focus on Age Management

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Abstract: Organizations are expected to be more actively engaged in the current issues within their respective focus field, including, but not limited to, social responsibility. The traditional business approach ignores social issues in management objectives. Determining the direction of the age management development is a criterion for the successful implementation of the concept of corporate social responsibility. Strategic documents support the implementation of age management at the society-wide level but not at the organizational level. Age management represents a specialized approach to management while taking into account the current unfavorable demographic conditions. The main aim of the paper is to identify problem areas of age management in the time of COVID-19 in the selected organizations in the Czech Republic and to make recommendations for their optimization. The research is based on the quantitative questionnaire survey ($n = 183$) and the statistical evaluation of data while looking for relations between the application of management practices with respect to the age of employees and identifying factors of organizations. The key findings of the study reveal that the greatest benefit of collaboration among all generations of employees in organizations lies in improving employee motivation and performance (67%), followed by the increased performance (59%).

1. Introduction

Sustainable operations of organizations can strengthen their competitive position (Lorincová et al., 2018; Chalupa & Petříček, 2020; Pacana et al., 2020; Jankelová & Joniaková, 2021). Organizations that adopt optimal sustainable human resource management and intergenerational learning benefit from maintaining knowledge continuity, using the strengths and potential of different age groups (Blomé et al., 2018), good workplace relationships (Atkinson & Sandiford, 2016), overcoming negative age stereotypes (Dordoni & Argentero, 2015) and age as well as other discrimination. The implementation of age management is a long-term process and starts with the awareness of the organization´s management; yet it is still at the beginning in the specific conditions of individual organizations in all economic sectors (Egdell et al., 2020). It needs to be emphasized that age management is concerned with

all age categories of employees. The 50+ group is currently crucial and decisive in view of the unfavorable demographic development (Dordoni & Argentero, 2015; Joniaková & Blštáková, 2015) and the situation on the labor market. It can be concluded that age management is not simply a management method that takes into account all age categories in organizations across all business sectors. First and foremost, it is a means of how to face the consequences of demographic changes in society well and efficiently and how to extend the active age of the population.

As for the implementation of age management, it is essential to note that the length of working life will further become longer, which will affect both employers and employees (Earl & Taylor, 2015). This implies the need for quite significant changes related to the setting of intergenerational cooperation, organizational culture, and climate (Ciutiene & Railaite, 2015; Joniaková & Blštáková, 2015). However, to be successfully implemented, the continuous learning of both young and talented employees, as well as 50+ employees, must be emphasized. The presented article focuses on the issues of age management and the necessity of solving them in the context of strategic human resource management, and thus achieving a competitive advantage and building the employer brand. The main aim is to identify problem areas of age management in the COVID-19 era in the selected organizations in the Czech Republic ($n = 183$) and to make recommendations to optimize them.

2. Theoretical Part

Age management is a management approach that takes into account the age, ability, and potential of employees (Garavaglia et al., 2021). The benefits (and downsides) of implementing age management can be identified at three levels, namely, social, organizational, and individual (Nilsson, 2016; Blomé et al., 2018). It can be concluded that age management is part of the Corporate Social Responsibility phenomenon (Feißel et al., 2018; Pytel-Kopczyńska & Oleksiak, 2019), specifically, activities focusing on the social pillar of sustainable business (Atkinson & Sandiford, 2016). Age management is vital for all ages of employees (Rašticová et al., 2019); however, for older workers in particular, specific working conditions need to be created with respect to occupational health and safety and increased risks (Dordoni & Argentero, 2015). It is advisable to adapt working hours to the flexible forms of work arrangement (Atkinson & Sandiford, 2016) by including training courses and limiting overtime. However, in the context of the ongoing COVID-19 pandemic, despite the use of home working and flexible forms of work, the labor productivity of employees has been decreasing and there has also been a shift away from the principles of the relatively stable labor market in the past. Nowadays, there are repeated dismissals and stereotyping of 50+ employees.

Harnessing the potential of all workers in the labor market effectively should be an essential strategy for the human resource management of organizations (von Bonsdorff et al., 2018; Birkinshaw et al., 2019). It can be observed that there are some risks for organizations neglecting age-specific human resource management (Fuertes et al., 2013; Joniaková & Blštáková, 2015; Garavaglia et al., 2021). These primarily include the cost of incapacity for work, the loss of qualified employees and their critical knowledge and skills, the training

of new employees after employees retire, and many others (Stacho et al., 2013). The above is summarized in Table 1, which is based on three aspects, organizational, social, and individual.

Table 1. The benefits and negatives associated with the implementation of age management – Part 1

	The benefits of age management implementation	The negatives of age management implementation
Organizational aspect	Building employer brand and prestige	Higher demands on management (Joniaková & Blštáková, 2015)
	Harnessing the employee potential regardless of age (Blomé et al., 2018)	Increased financial demands (Conen et al., 2011; Fuertes et al., 2013)
	Gaining a competitive advantage (Bilinska-Reformat & Stanczyk, 2018)	The necessity to change existing communication models
	Improving the performance and excellence of organizations (Blomé et al., 2018)	The risk of failing to manage age diversity (Joniaková & Blštáková, 2015)
	Improving crisis management	The necessity of organizational change (Joniaková & Blštáková, 2015; Garavaglia et al., 2021)
	Improving organizational culture and climate (Atkinson & Sandiford, 2016)	The need for change in corporate culture (Joniaková & Blštáková, 2015)
	Talent acquisition	Limited personnel capacity for implementation (Blomé et al., 2018)
	Retention of key employees (Blomé et al., 2018)	The inexperience of HR staff in this area.
	Raising awareness and organizational autonomy (Garavaglia et al., 2021)	The need to raise awareness and support for its application at the social and corporate level (Aliaj et al., 2016)
Social aspect	Mitigating the consequences of adverse demographic development (Ciutiene & Railaite, 2015; Joniaková & Blštáková, 2015; Feißel et al., 2018)	The increasing complexity of the business environment
	The emphasis on employee health in the population (Aliaj et al., 2016; Blomé et al., 2018)	The impossibility of employing all age groups in all professions (drivers, police, etc.)
	Better social cohesion and communication (Blomé et al., 2018)	The need for coordination within European policies (Aliaj et al., 2016)
	The possibility of using support programs from the state	Increasing demands on spending (Aliaj et al., 2016)
	Preventing ageism (Fuertes et al., 2013; Atkinson & Sandiford, 2016)	The need for the radical revision of work, pension, health, education, and other processes (Dordoni & Argentero, 2015)
	Preventing women´s poverty before old age (Earl & Taylor, 2015; Aliaj et al., 2016)	The persistent gap between policy and practice (Earl & Taylor, 2015)
	The possibility of solving the problem with less-educated immigrants (Aliaj et al., 2016)	
	Improving the funding of pension system (Aliaj et al., 2016)	The need for coordination within the framework of national employment policy
	Removing obstacles to extending working life (Egdell et al., 2020)	

Table 1. The benefits and negatives associated with the implementation of age management – Part 2

	The benefits of age management implementation	The negatives of age management implementation
Individual aspect	Improving employee motivation (Feißel et al., 2018)	The need to improve communication and social interaction
	The emphasis on employee health and safety, and stress prevention (Feißel et al., 2018)	Increased demands on knowledge transfer
	Integration in the team (Feißel et al., 2018)	Stereotyping behavior and barriers (Fuertes et al., 2013; Dordoni & Argentero, 2015; Garavaglia et al., 2021)
	The employee´s perception of job stability, loyalty, and staying engaged (Joniaková & Blštáková, 2015; Blomé et al., 2018)	Increased demands on individual approach to employees

There are increased financial costs associated with the implementation of age management in connection with new job opportunities (Conen et al., 2011; Fuertes et al., 2013). In this context, Ciutiene & Railaite (2015) highlight recruitment, learning and knowledge management, changing attitudes, flexible working arrangements, health management, work environment, and ergonomics. The increasing interaction of different generations implies the need to set up educational processes in the organization that will encourage the sharing of knowledge and experience between generations of employees (Bolisani & Bratianu, 2017; Aydin & Dube, 2018). By encouraging continuous learning and knowledge sharing across generations, the corporate social responsibility of organizations can be developed. Understanding generational diversity is the best way to overcome negative prejudices against older people.

The COVID-19 pandemic is a "career shock" as Akkermans et al. (2020) put it. In addition to certain negative consequences not only for older workers (Kooij, 2020), the pandemic of COVID-19 also poses a challenge (Akkermans et al., 2020) for the management of organizations to make an intelligent and confident commitment to start placing more emphasis on social responsibility and building the prestige of an employer that is not indifferent to the employee health, safety or belonging together. However, it also depends on the role of the state to create the right conditions for people to be as employable as possible in the labor market, especially now in the time of COVID-19. In the long run, this pandemic can become a stimulus that can provide an opportunity for change and improvement in working with people.

The issues of applying age management in organizations and the effort to maximize the elimination of negative ageism are hot, engaging, and essential topics, unfortunately not only in the Czech Republic, which have been insufficiently discussed so far, as agreed, for example, by Bejtkovský (2015); Joniaková & Blštáková, (2015); Feißel et al. (2018); Urbancová & Vrabcová (2020); Kooij (2020); Garavaglia et al. (2021).

2. Methodology

In preparing for the research, previous publications and other documents related to age management and sustainable human resource management were looked into. The

questionnaire survey was designed to comply with the ethical guidelines and the requirement of anonymity. A Google form was used for implementation purposes, and the questionnaire was completed by the middle or senior management of the organizations, or in the case of smaller organizations, by the owner (n = 183). The survey was conducted from June 2020 to December 2020. The primary identifying questions of the questionnaire survey include the following statistical qualitative and quantitative variables (the so-called identifying factors), see Table 2:

- the sector of business activities (primary, secondary, tertiary),
- the size of the organization by the number of employees,
- the majority ownership (a Czech or a foreign organization),
- the type of the organization (private, public, non-profit), and
- the annual turnover.

Table 2. The organizations that participated in the research – primary data

Characteristics	Categories		
The sector of business activities	Primary	Secondary	Tertiary
	4.4%	41.5%	54.1%
The size of the organization	<50	51–249	>250
	26.2%	28.4%	45.4%
The majority ownership	Domestic	Foreign	
	45.4%		54.6%
The type of the organization	Private	Public	Non-profit
	85.8%	11.5%	2.7%
The annual turnover	<10 mil. EUR	11–50 mil. EUR	>50 mil EUR
	38.3%	37.7%	24.0%

The correlations between the selected qualitative and identifying factors were tested. The Chi-square ($\chi2$) tests of independence in the combination table with (r–1)(s–1) degrees of freedom and Cramer's V at the α = 0.05 significance level were used to test the homogeneity and independence hypotheses. The IBM SPSS Statistics 28 statistical software was used to evaluate the results. The results can only be generalized for the research sample.

3. Results

The questionnaire survey focused on the intergenerational cooperation among generations (X, Y, and Z) and age management in Czech companies (n = 183). Age management is a management method with respect to the age of employees, taking into account their life stages and changing states (competencies, motivation, health, etc.).

The overall majority of the surveyed organizations (55%) stated that they apply human resource management activities involving age diversity. Figure 1 shows the data of age management application in the surveyed organizations with respect to the size of the organization by the number of employees.
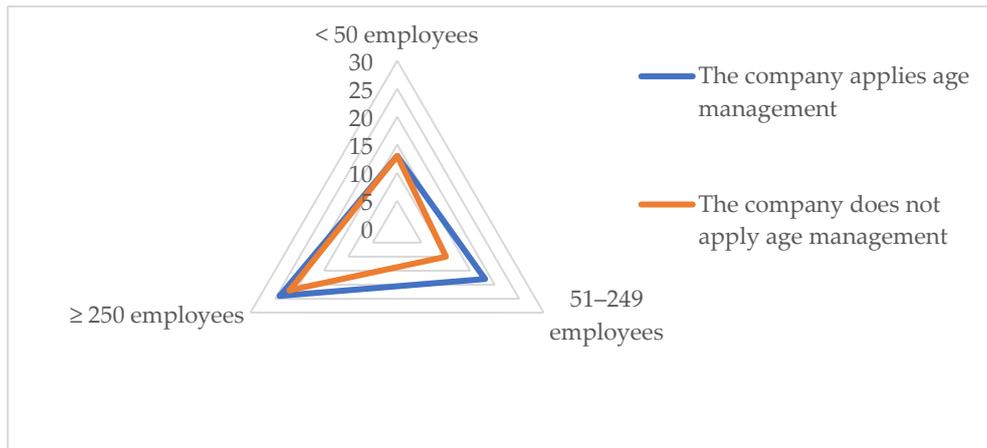
Figure 1. The application of age management and the company size (relative frequencies)

Figure 1 shows that age management is applied by 24% of the observed organizations employing more than 250 employees, by 18% of organizations with 51–249 employees, and by only 13% of organizations with the lowest number of employees. Approximately 80% of these organizations also report having information on how the age composition of their workforce is changing. On the other hand, the absolute majority of organizations report that they do not make plans for the age structure of their workforce within a period of 3 to 5 years and that there has been no difference in the department heads´ approach towards young or older employees in the last 12 months. It can be concluded from the above that the respondents answered the question regarding the implementation of age management in a relatively positive way, while they do not actively implement crucial, or core activities related to age management. The responsibility for actions related to human resources in the organizations lies with the human resources department itself in 69% of cases, middle and senior-level managers in 28% of patients, and line managers in 16%. Table 3 below shows the benefits that respondents perceive when speaking of collaboration among all generations of employees. The respondents could give more than one answer.

Table 3. The benefits of all generations of employees (i.e., students, experienced employees, seniors, etc.) collaborating – relative frequencies

The benefits of all generations of employees collaborating	Relative frequencies p_i
Improving motivation and performance	67.8%
Improving organizational performance	58.5%
Acquiring talented employees	56.3%
Retaining key employees	54.6%
Improving organizational culture	53.6%
Improving organizational climate	47.5%
Building an employer brand	32.2%
Gaining a competitive advantage	32.2%
Improving crisis management	20.8%
Improving the prestige of the organization	16.9%
I don't see any benefits.	1.1%

As can be seen from Table 3 above, the organizations see the benefits primarily in the context of increasing motivation and organizational performance, recruiting talented employees, and, last but not least, retaining key personnel. Table 4 shows the reasons for not applying age management. Again, the respondents were allowed to submit more than one answer.

Table 4. The reasons for not applying age management – relative frequencies

The reasons for not applying age management	Relative frequencies p_i
Managing age-diverse teams in the workplace is challenging for managers	32.8%
Work schedules place greater demands on communication	32.2%
Financial demands placed on management	9.8%
I don´t see any downsides	37.2%

As evident from Table 4, the respondents mainly agreed that this is a management-intensive way of managing the organization, not only in terms of communication and financial requirements. Targeted measures to promote the health and professional development of the 50+ age group are more beneficial to the company than dismissals and early retirements. Such efforts include flexible working arrangements, such as flextime, part-time work, job-sharing, working from home, and, last but not least, condensed working weeks. Furthermore, five hypotheses have been tested at the 0.05 level of significance concerning the selected identifying factors:

1. H_0: The organization´s focus on age management does not depend on the business sector.
2. H_0: The organization´s focus on age management does not depend on the size of the organization.
3. H_0: The organization´s focus on age management does not depend on the majority ownership.
4. H_0: The organization´s focus on age management does not depend on the type of organization (the kind of ownership).
5. H_0: The organization´s focus on age management does not depend on its annual turnover.

Based on the statistical testing, it can be summarized that at the 0.05 level of significance:

1. The organization´s focus on age management is statistically independent of the business sector (p-value = 0.493).
2. The organization´s focus on age management is statistically independent of the organization's size (p-value = 0.314).
3. The organization´s focus on age management is statistically independent of its majority ownership (p-value = 0.482).
4. The organization´s focus on age management is statistically independent of the type of organization (the kind of ownership) (p-value = 0.476).
5. The organization´s focus on age management is statistically independent of its annual turnover (p-value = 0.606).

To conclude, any organization, regardless of its sector, size, ownership, or annual turnover, can engage in age management; the difference between organizations may

be in the depth and scope of implementation. The research findings thus confirm the conclusions of international studies, e.g., Feißel et al. (2018); Kooij (2020); Garavaglia et al. (2021).

Based on the results obtained, it can be stated that organizational processes can only be optimized with a positive effect in any organization if the organization pays attention to its employees. The loyalty to the employer is continuously decreasing on the part of Generation Z and Millennials (Y) compared to Generation X. Therefore, the management of organizations must focus on harmonizing the values of employees and employers.

Therefore, a well-trained, continuously developed, and satisfied team is now all the more necessary in any organization in the time of COVID-19. Every organization must have job descriptions for individual positions and the required competences required of their employees, properly set and communicated KPIs (key performance indicators) always assigned transparently and unambiguously to a process, a service, an organizational unit, the entire organization, from which performance, quality and cost-effectiveness can be generated. Every organization must set transparent administrative processes, understandable strategies that will be communicated to employees. Furthermore, it is necessary to ensure the substitutability of employees not only during the COVID-19 illness but during any other health complications. It is needed to communicate with employees on a daily basis (even if it is online or by phone) and address any new issues promptly and introduce employee development plans, including feedback.

To summarize, in the current state of the labor market, because of COVID-19, organizations must:

- To give priority to enhancing the skills and abilities of all employees, regardless of their age, to fully adapt them to the digital environment.
- To develop cognitive skills and to increase employee responsiveness to the need for change and innovation.
- To develop social and emotional skills to ensure effective collaboration among all generations of employees.
- To develop employees in their skills, abilities, and resilience to the stress that COVID-19 has brought to a greater extent.

4. Discussion

For instance, as shown by the findings of Ayalon et al. (2020); Kooij (2020), the 50+ older workers may be more affected by the COVID-19 pandemic than younger ones. Higher mortality rates from COVID-19 among the elderly prompt some of them to retire early (Akkermans et al., 2020), and the number of employees reducing their working hours due to health problems after suffering from COVID-19 has also been increasing. In the surveyed organizations in the Czech Republic, work teams have been destabilized, and the organizations are understaffed, which threatens the continuity of processes. For younger people, the pandemic may be their first experience with a major global crisis, which can have long-term psychological impacts (Akkermans et al., 2020). In addition to certain serious

health risks, older employees have to work from home because of the measures, which often means using IT technology. The need to upgrade their skills and competencies, especially concerning the use of technology, is highlighted, for example, by Akkermans et al. (2020).

Age management practices were not found to be part of the systematic strategy of the surveyed companies, which is in line with the research of Fuertes et al. (2013); Egdell et al. (2020). Ciutiene & Railaite (2015) add to the above that health management and flexible working arrangements, although these are considered pivotal in human resource management with age diversity, rank among the weakest points in particular organizations. An interesting fact to note is that the age of HR managers does not play a unique role in the implementation of age management initiatives (Principi et al., 2015). Frerichs et al. (2012) did not reveal a general trend towards integrated age management in their analysis of 83 case studies on age management. This implies that the impact of the aging workforce is an international issue (Egdell et al., 2020) and needs to be further addressed at the organizational level.

Despite the worsening economic situation of organizations and the need for layoffs, it is necessary for the management of organizations to focus primarily on the possibility of optimizing the number of working hours (the preference for shared jobs, part-time jobs, etc.) without age discrimination (i.e., for example, the targeted layoffs of 50+ employees, where the risk of sick leave associated with the COVID-19 disease or long-term health consequences after contracting it is expected to be higher).

5. Conclusions

The results from the sample of organizations examined have shown that the factors (size, sector, turnover, etc.) do not influence the application of age management. The benefits of applying age management outweigh the risks. The most significant advantage of having all generations of employees collaborating in organizations is improving employee motivation and performance (67%) and improving performance (59%); however, the management of organizations must primarily concentrate on aligning the values of employees and employers. The risks include the need for increased communication and social interaction, the increased demands on knowledge transfer, or, in the COVID-19 era, the increased negative stereotyping of employees. It is necessary that the area of human resource management becomes an integral part of the strategic orientation of the organization and that individual HR activities are carried out not only at the sub-managerial level but with the comprehensive view of developing the entire organization in the years to come.

The theoretical contribution of the article lies in comparing the benefits and risks of age management identified in international research. The practical contribution of the article consists in presenting the results of age management application and the identification of benefits and risks in the studied Czech organizations. Further research will be aimed at the changes in career planning and management in the COVID-19 era.

Conflict of interest: none

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Financial Instruments of the European Union Supporting the Common Agricultural Policy in the Financial Perspective 2021-2027

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Abstract: In the Financial Perspective of 2021-2027, the European Commission has earmarked an amount of 365 billion euros for agricultural and rural development under the Common Agricultural Policy (CAP), compared to 416 billion euros in the previous Perspective. Of the planned funds in the current financial perspective, EUR 265.2 billion was allocated for direct payments (previously EUR 294.9 billion) and EUR 78.8 billion for rural development (previously EUR 95.3 billion). There was also an additional allocation of EUR 20 billion for market support and EUR 10 billion for the Horizon Europe research program. Overall, the 2021-2027 Financial Perspective budgeted funds from the EU budget at 88% compared to the previous Financial Perspective for actions at CAP. The aim of the article was the analyses of sources of financing for agriculture and rural areas in the scope of the CAP in the years 2021-2027. The research results show that the planned allocation of funds for the years 2021-2027 to support agriculture and rural areas has decreased in comparison with the previous programming period.

Keywords: common agricultural policy; agricultural funds; rural areas

JEL Classification: P3; Q14

1. Introduction

The Common Agricultural Policy comprises measures in the agricultural sector taken by the European Union (EU) to fulfil the provisions of the Treaty on the Functioning of the European Union (TFEU). The CAP was created as the first EU policy. The objectives of CAP are set out in Article 39 TFEU (ex-Article 33 TEC). The basic pillars of CAP are direct payments and rural development. The main source of funding for CAP is the European Agricultural Fund for Rural Development (EAFRD). In the Financial Perspectives 2021-2027, the mission of CAP is to support the transition to fully sustainable agriculture and the dynamic development of rural areas. Simplifications refer to the minimization of the administrative burden (European Commision, 2017). The main assumption of the simplifications are measures aimed at efficiency and the implementation of CAP objectives, rather than excessive compliance with the rules and procedures related to the management of EU funds supporting agriculture and rural areas (Kowalski, 2017). The new perspective 2021-2027 means a change in the orientation of the allocation of EU funds, i.e., an individual approach for each Member State will be apparent and a move away from a universal approach that will improve the functioning of

agriculture in the Member States. Such a change will give more freedom to the Member States to decide on how to use these funds (taking into account the objectives of the CAP), thus meeting the needs of farmers and the rural community (European Commision, 2019). As in the previous financial perspective, an important objective of co-financing will be to support the activities of individual Member States in the framework of the Knowledge and Innovation System in Agriculture (AKIS). The bulk of EAFRD funding will be used to finance activities in the areas of knowledge, innovation and digitization in agriculture and rural areas (EIP). EAFRD will also help improve the efficiency of AKIS farm advisory systems (FAS) in each Member State. In 2018, the European Commission published regulations on the CAP funding rules that will apply in the 2021-2027 financial perspective, setting out procedures to further simplify them (European Commision, 2012). The current legal regulations in the Financial Perspectives 2021-2027 show the continuation of CAP assumptions implemented in the previous Financial Perspectives 2014-2020: smart growth, as well as environmental, climate and rural development goals (Rembisz, 2012). Currently, there is a transition period for the financing of CAP and an adjustment period that ends on January 1, 2023. The normative legal acts in force so far will continue to be applied with some modifications. This period, which covers the years 2021-2022, is defined in Article 1 of Regulation (EU) 2020/2220 of the European Parliament and of the Council of 23 December 2020 laying down certain transitional provisions concerning support from the EAFRD and the European Agricultural Guarantee Fund (EAGF) (Regulation (EU) 2020/2220). This Regulation maintains, with some amendments, the legal solutions provided for in the previous financial perspective, i.e., Regulation (EU) No 1305/2013 of the European Parliament and of the Council of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development. The measures provided for in Regulation No 2020/2220 of 23 December 2020 are intended to assist farmers in setting up mutual funds from which compensation may be paid for losses caused by adverse weather conditions, the occurrence of animal or plant diseases, pest infestations or environmental incidents (Kulawik & Willoc, 2012). A characteristic feature of the regulation in question is the fact that it contains provisions on both direct payments and rural development, i.e., it regulates the financing of the first and second pillars of CAP (Rydin & Falleth, 2006).

2. Methodology

The empirical material on the planned amounts of allocation of funds from the EU budget to the CAP, which was used for the study, concerned 27 EU Member States. The analysis used data published by the European Commission in the current Multiannual Financial Framework (MFF) for two consecutive programming periods, i.e., 2014-2020 and 2021-2027.

The purpose of this article is to analyze the directions of changes and sources of funding for the CAP, broken down by payments under the first and second pillars for agricultural and rural support in the financial perspective 2021-2027, compared to the previous programming period 2014-2020, to the CAP budget and new legal regulations covering payments under the first and second pillars of the CAP, i.e., area payments and rural development programs. The analysis of the sources and principles of funding of CAP was based on EU budget data

published by the European Commission. The provisions of the European Parliament and Council Regulations governing the principles of CAP operation were also analyzed, and the simplifications in the management of EU funds applicable in the Financial Perspectives 2021-2027 were identified. The research tested the research hypothesis, which assumes that:

H1: In the Financial Perspectives 2021-2027, the planned allocation of EAFRD funds for the implementation of the first and second pillar assumptions of CAP related to agriculture and rural areas has decreased for most EU Member States.

The article is structured as follows. The first section explains the essence of the problem in the light of the law and literature (in relation to the CAP assumptions) and presents the research assumptions. The next section presents the research results illustrating the EU financial resources to support CAP agricultural and rural measures in individual EU Member States.

3. Results

The CAP assumptions in the Financial Perspectives 2021-2027 set out the principles of shared management between the European Commission and the Member States, taking into account the greater possibilities of Member States to shape national CAP strategic plans. These rules also apply to the financial instruments supporting agriculture (Massot, 2020). The main task of the new CAP model is to continue the previous assumptions of CAP based on two pillars, i.e., modernized and simplified policy, especially in terms of better public finance management and a reduction of bureaucracy for beneficiaries (Niewiadomska, 2018). The European Commission has set the following objectives and challenges for the CAP for the period 2021-2027, summarized in nine points, reflecting the economic, environmental and social importance of agricultural policy to ensure, among other things, adequate agricultural income and the strengthening of food security, i.e. (1), market orientation and improving competitiveness, including a greater focus on research, technology and digitalization (2), improving the position of farmers in the value chain (3), promoting climate change mitigation and adaptation, and sustainable energy production (4), promoting sustainable development and the efficient management of natural resources such as water, soil and air (5), contributing to biodiversity conservation, improving ecosystem services and protecting habitats and landscapes (6), attracting young farmers and facilitating economic development in rural areas (7), promoting employment, growth, social inclusion, and local development in rural areas, including the bioeconomy and sustainable forestry (8), improving the response of EU agriculture to societal food and health needs, including safe, nutritious, and sustainable food, and animal welfare (9). The listed CAP objectives provide guidance to Member States and beneficiaries in planning and using EAFRD funds to support agriculture and rural areas (World Wildlife Fund, 2017).

The 2021-2027 model CAP departs from the detailed EU-level specifications and delegates more powers to the Member States within the framework of the subsidiary distribution of competences. In this way, Member States will be able to better take into account local conditions and needs against a background of specific CAP strategic plans, which they will have to solve independently on the basis of the objectives and principles set out in the

regulation (Nosecka & Pawlak, 2014). The main objective of CAP in the Financial Perspectives 2021-2027 will be to support a smart, resilient and diversified agricultural sector, while ensuring food security. Supporting activities in agriculture in the field of technological development, digitalization and artificial intelligence (AI) will be of particular importance.

In the next financial perspectives, spending from the EU budget was a priority for the CAP set out in the Multiannual Financial Framework (MFF) and was an important item (Niewiadomska, 2019). A comparative analysis of the implementation of the EU budget showed that the share of spending on agriculture systematically decreased. In the previous financial perspective 2014-2020, the payment ceiling was 37.8%, and in the Multiannual Financial Framework 2021-2027 it reached the lowest level of 28.5% of the total EU budget (Regulation (EU) 2020/2093). The planned allocation for CAP for 2021-2027 is EUR 365 billion, compared to EUR 416 billion in the previous period. The amount for direct payments was set at EUR 265.2 billion, previously EUR 294.9 billion, and for rural development EUR 78.8 billion, previously EUR 95.3 billion. In addition, an amount of EUR 20 billion was earmarked for market support and EUR 10 billion for the Horizon Europe research program. The total amount of the planned allocation from the EU budget under EAFRD in the financial perspective 2021-2027 was set at 88% compared to the previous financial perspective.

The cut in the planned allocation for CAP was viewed negatively by the European Social and Economic Committee. The reduction in the planned allocation of EAFRD funds is approximately 25% compared to 2018 prices. The changes in the planned allocation of funds for the implementation of the objectives of CAP in the financial perspective 2021-2027 did not simultaneously mean an equal reduction in the amounts allocated to each Member State. Other factors were also taken into account when allocating these funds, e.g., historical conditions and the past use of funds. In the vast majority of countries, the planned allocations for agriculture and rural areas were reduced compared to the previous perspective. There were also examples of increased allocations. The increase in funding affected four EU countries, namely Croatia (23.1%) and the Baltic countries, including Estonia (7.2%), Latvia (13.2%) and Lithuania (5.6%) (Figure 1).

In the Financial Perspective 2021-2027, EAFRD funds are used as follows: Direct payments and rural development grants and other grants for industrial producers, which are market instruments. The European Commission has decided that CAP will continue to be based on two pillars, with the first pillar comprising area payments and market instruments, and the second pillar being used to support rural development (Regulation (EU) 1307/2013). There are still differences in the types of interventions and how the European Commission disburses funds to Member States. As in the previous perspective, the first pillar of CAP is financed from EU funds under annual financial frameworks. Payments under the second pillar of CAP are planned and transferred taking into account the multi-annual program, which defines the co-financing of each intervention.
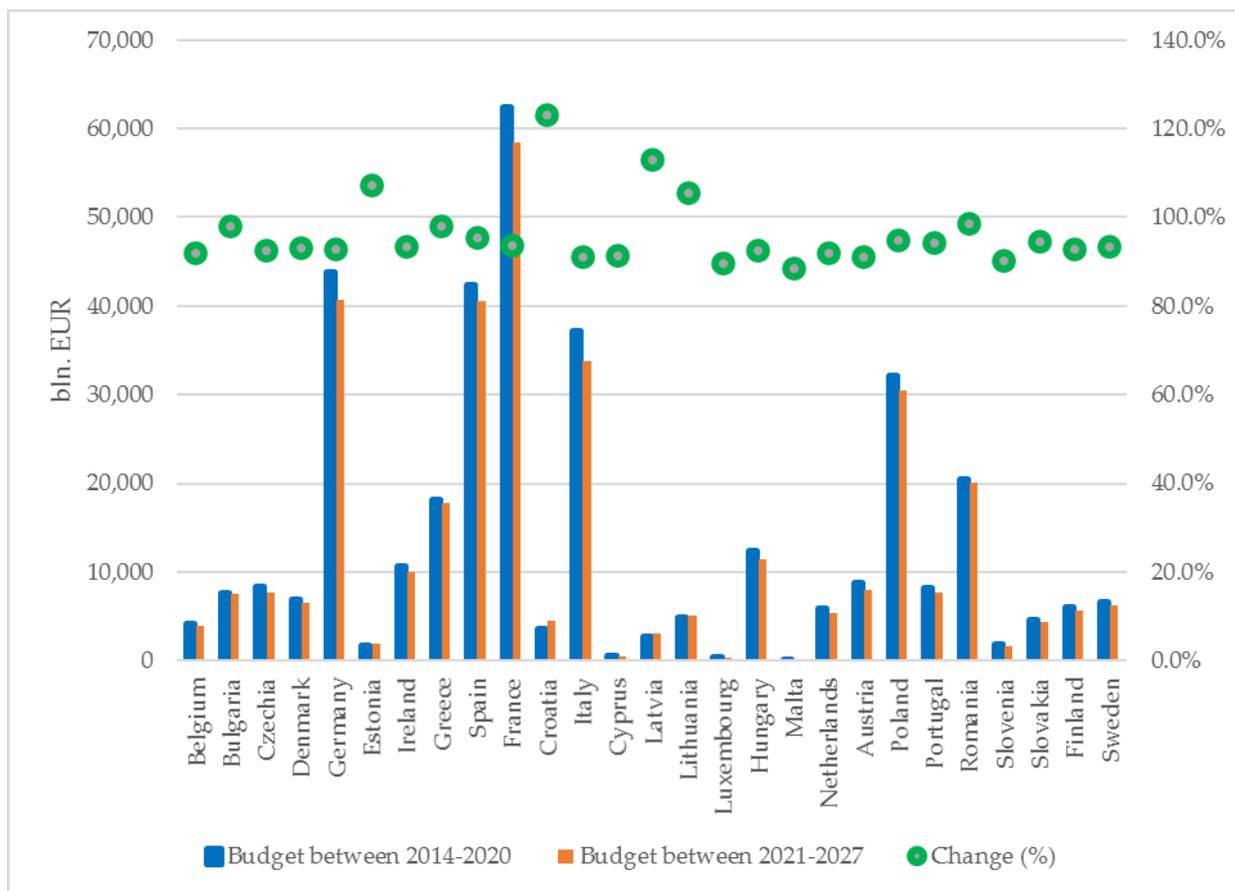
Figure 1. Overall CAP budget in the scope of the multiannual financial framework for 2021-2027 compared to 2014-2020 (in billion euros) with changes in % (Regulation (EU) 2020/2220)

In the current as well as in the previous perspective, the principle of additionality applies, i.e., the co-financing of projects under the second pillar is provided by the EU and the budget of the Member State. In the financial perspective 2021-2027, despite minor changes in this policy, the names of the funds remain unchanged, i.e., for the first pillar of the CAP – the European Agricultural Guarantee Fund (EAGF) and for the second pillar of the CAP – the European Agricultural Fund for Rural Development (EAFRD).

In the financial perspective under discussion, direct payments are one of the main instruments of the implementation of CAP, the aim of which was to support and stabilize agricultural incomes, reduce production costs and maintain production in disadvantaged areas. Direct payments directly support producers in adaptation processes, including market and environmental policies. The purpose of the payments is to stabilize farmer income by reducing the volatility of prices and production. One of the negative phenomena is the concentration of payments, where 80% of these payments go to 20% of farmers (European Commision, 2010).

A comparative analysis of the planned allocation for area payments in relation to each payment period shows that a higher allocation is planned for 10 Member States. The largest increase in planned allocation compared to the previous programming period was recorded in Latvia (29.3%), Estonia (23.4%) and Lithuania (16.1%). The smallest amounts of area payments were planned for Portugal (4.8%) and Greece (2.1%) (Figure 2). The biggest decrease in the

planned allocation in the financial perspective 2021-2027 in comparison with the previous programming period concerned Holland (by 7.2%), Belgium (by 6.9%), Italy (by 6.5%) and Cyprus (by 6.1%). The amounts of planned allocations for area payments should be related to the data published by Eurostat on the evolution of the number of agricultural holdings and agricultural areas in all EU Member States. In the period 2010-2019, the number of agricultural holdings in the EU decreased from 12.0 million to 9.8 million (19.0%) and the agricultural area decreased from 188.1 million ha to 181.5 million ha (3.5%). This problem requires a separate analysis and a presentation of its results in scientific works.
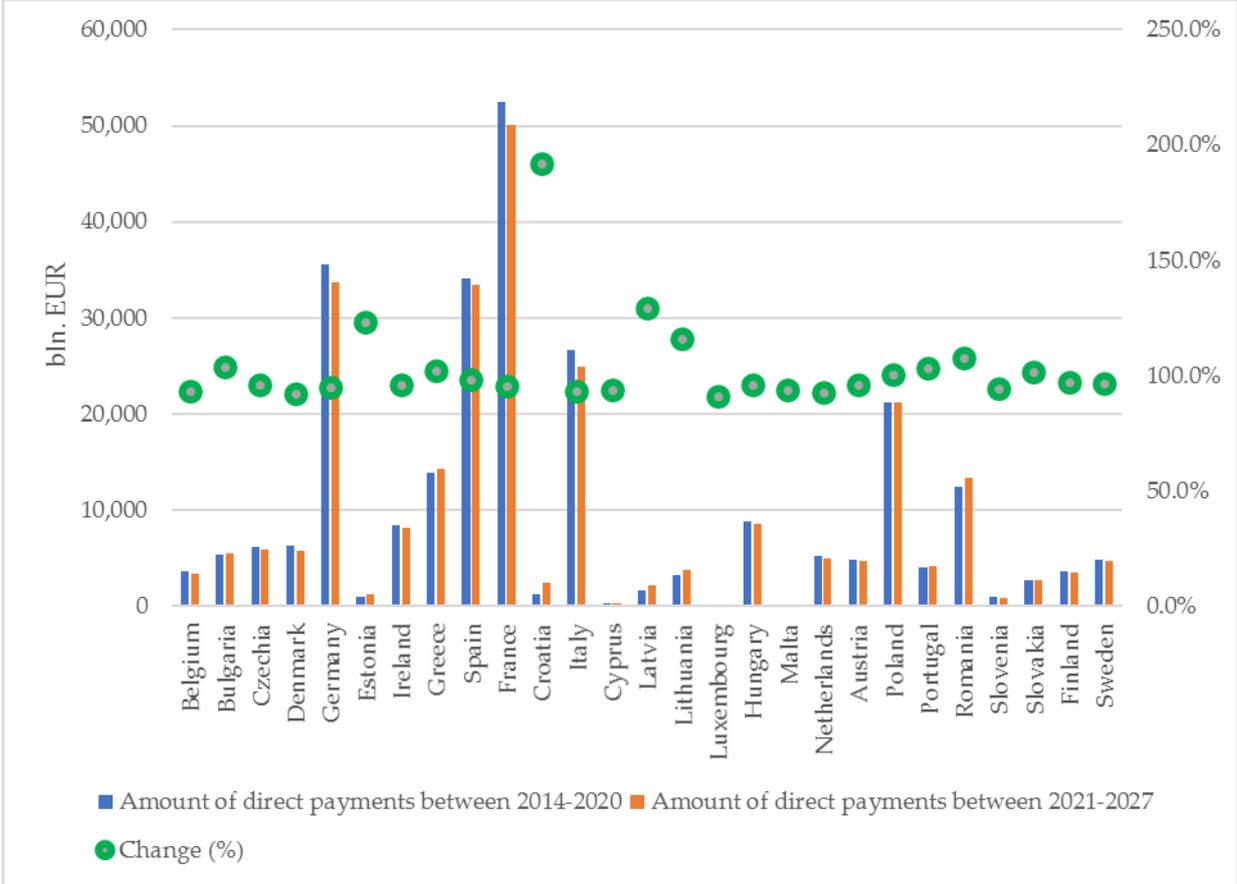
Figure 2. Amounts of direct payments for 2021-2027 compared to 2014-2020 (in billions of EUR) and the amount of payments per 1 ha of agricultural land (in EUR), with an indication of changes in % (Regulation (EU) 2020/2220)

In the 2021-2027 financial perspective, rural development programs (RDPs) are no longer prepared and implemented by individual Member States, as was the case in previous financial perspectives. Instead of the RDPs, national strategic CAP plans are prepared. The strategic CAP plans, which represent a new way of managing EU financial instruments, cover direct payments as well as rural development support, sectoral support and the common organization of agricultural markets. The strategic plans have been developed by individual Member States and take into account country-specific factors, such as a SWOT analysis, a comprehensive needs assessment, a financial plan, a description of management and coordination structures, an ex-ante assessment of conditionalities, etc. The strategic plans of each Member State are designed to achieve the objectives of CAP, i.e., to achieve the

expected results, accelerate modernization and improve the economic, social, environmental and climate balance (Surowiec, 2020). The rules of CAP programming, established by the Regulation of the European Parliament and of the Council No. 2020/2220, mean that each Member State has more possibilities to choose instruments and tools for the implementation of the national strategic plan CAP (Walenia, 2019). The basis for the design of the strategic plans within rural development is the introduction of new concepts for the strategic plans, i.e., the type of intervention, instead of the previously used concepts, such as thematic axes, priorities, measures or sub-measures. In the European Commission regulation, eight types of interventions were distinguished in the strategic planning of CAP in agriculture, which are related to the priorities of the current RDP 2014-2020 (Table 1).

Table 1. Comparison of types of interventions under the strategic plans of CAP 2021-2027 in relation to the priorities specified in RDP 2014-2020 (Regulation (EU) 2020/2220)

RDP Priorities 2014-2020	Types of interventions 2021-2027
Supporting knowledge transfer and innovation in agriculture and rural areas.	Environmental, climate, and other management commitments.
Increasing the viability of farms and the competitiveness of all types of agriculture in all regions, and promoting innovative agricultural technologies and sustainable forest management	Natural or other area-specific constraints.
Supporting the organization of the food supply chain, including the processing and marketing of agricultural products, promoting animal welfare and risk management in agriculture	Adverse area-specific conditions resulting from certain mandatory requirements
Restoring, protecting and enhancing ecosystems in agriculture and forestry	investments
Supporting resource efficiency and the transition to a low-carbon and climate-resilient economy in agriculture, food and forestry	Starting a business by young farmers and setting up rural businesses
Supporting social inclusion, poverty reduction and economic development in rural areas	Risk management tools
	Cooperation
	Knowledge sharing and informing

The types of interventions listed in the strategic plans for 2021-2027 from CAP are more general and universal in nature, and their number has been reduced to eight. In the previous perspective, no less than 69 measures and submeasures were mentioned in the implemented rural development program. In the strategic plans of CAP, a special place is occupied by the measures resulting from environmental, climate and management commitments, which were listed as priority objectives in the cited Regulation No. 2020/2220. The issues related to natural constraints and unfavorable operating conditions in rural areas are of great importance in the strategic plans of CAP as well as in the planned allocation of funds. In the 2021-2027 Financial Perspectives, based on an assessment of its needs, each country will be able to indicate, in the strategic plan, the types of interventions it considers most important for the implementation of the specific objectives of CAP. This can be interpreted to mean that not all intervention types specified in the cited regulation will be mandatorily implemented by a given Member State (Rembisz, 2012). A comparative analysis of the planned allocation of support amounts for individual types of rural development interventions in 2021-2027

and in the previous period 2014-2020 showed that a lower allocation was planned for all Member States. In 2021-2027, the planned co-financing of activities in individual Member States for rural development represents approximately 84-86% of the allocation from the previous programming period (Figure 3).
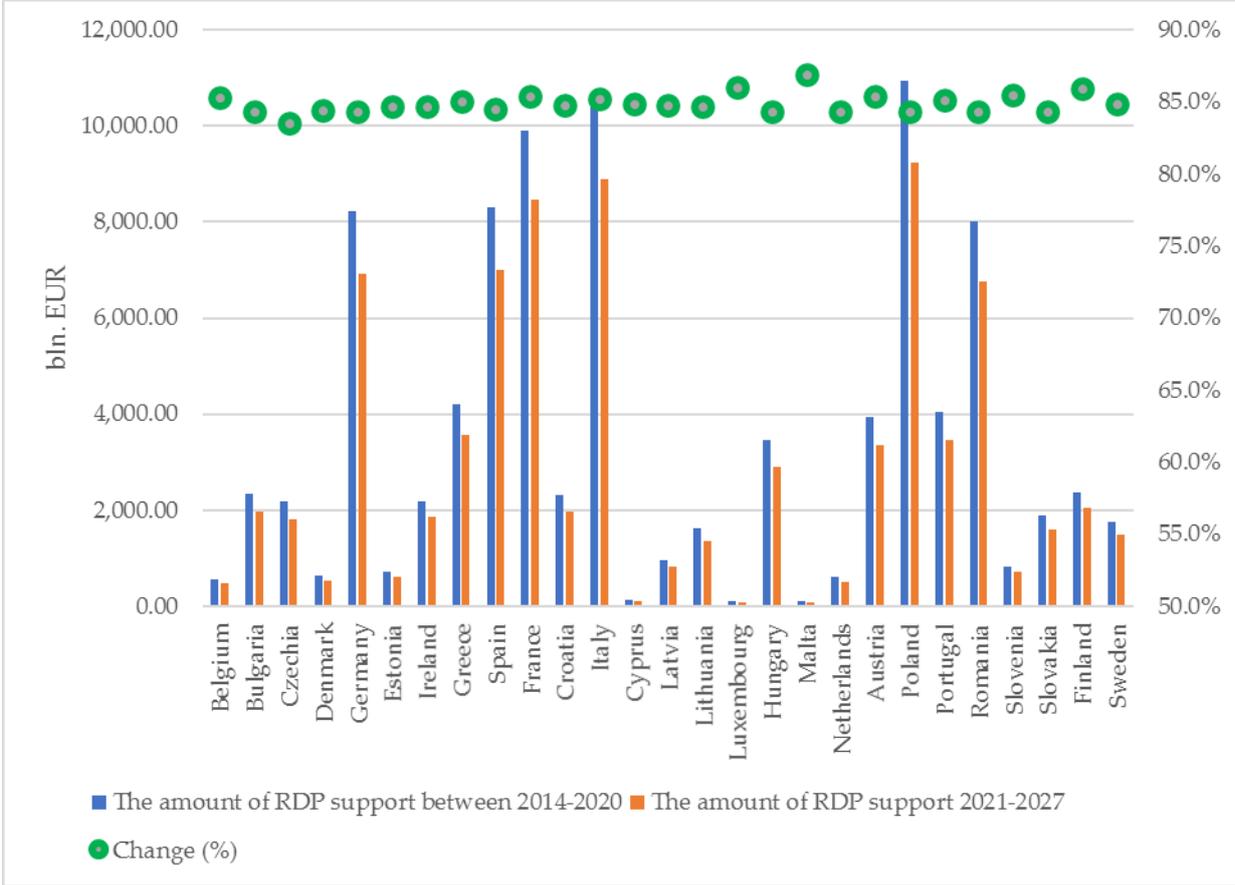
Figure 3. Amounts of direct payments for 2021-2027 compared to 2014-2020 (in billions of EUR) and the amount of payments per 1 ha of agricultural land (in EUR), with an indication of changes in % (Regulation (EU) 2020/2220)

In concluding EU law, it is noted that the European Commission shares responsibilities in the area of management of EU funds with EU Member States. The principle of shared management also applies to EU funds allocated to agriculture at CAP in the Financial Perspective 2021-2027, which sets common objectives and priorities for action. In the citation of the Regulation of the European Parliament and of the Council (EU) No. 2020/2220, the European Commission has defined the objectives of CAP, the types of interventions and the results. Each Member State is responsible for achieving the objectives for agriculture and rural areas set in the strategic agenda CAP. According to the Regulation of the European Parliament and of the Council (EU) No 2020/2220, the Member State is also responsible for the proper use of the financial instruments of CAP, it is accountable for the way the objectives and the agreed final results are achieved. In the following financial perspectives, EAFRD funds were used according to the principle of shared management between the Member States and the European Commission. In the 2014-2020 financial perspective, the EAFRD's share in the co-financing of projects was

63.6%, which required the greater involvement of Member States. During the implementation of the CAP in the period 2021-2027, the share of expenditure from the budgets of Member States increases, i.e., the conditions for the participation of the countries worsen in that the maximum EAFRD contribution will be 43.0% of eligible public expenditure. The minimum EAFRD share may be reduced up to 20%. The main principle in the area of financial management is that Member States shall compensate beneficiaries only for the costs and income foregone resulting from commitments made and transaction costs. For any type of intervention, Member States shall only grant payments for commitments that do not exceed legal management requirements and GAEC standards. No compensation is granted for measures that go beyond the minimum requirements for the use of fertilizers, plant protection products and animal welfare, or for measures that go beyond the conditions for the maintenance of agricultural land (Walenia, 2019).

4. Conclusions

In the Financial Perspective 2021-2027, the amount of funds from the EU budget for the implementation of the objectives of CAP in the field of sustainable agricultural and rural development has decreased compared to the previous programming period. The planned allocation for the current programming period was set at 88% compared to the previous financial perspective. The reduction in the allocation affected both EU funds allocated to support measures under the 1st and 2nd pillars of CAP. A positive phenomenon was the change in the CAP funding rules aimed at simplification and an individual approach for each Member State. Under the new funding rules for the CAP, the European Commission has given more powers to Member States under shared management in order to distribute responsibilities in line with the subsidiarity principle. This change will allow Member States to take greater account of local conditions and needs when linking to CAP strategic plans. However, the basic tasks of CAP, which are to promote sustainable agricultural development and rural development, have not changed much. The guiding principle of CAP for the period 2021-2027 is to give more powers to Member States to define interventions related to the general and specific objectives of CAP in documents prepared by Member States. Financial instruments supporting rural development will focus more on taking into account local conditions and needs as defined by the strategic objectives of the Member State. An unfavorable phenomenon for the implementation of the assumptions of CAP is the reduction of the EAFRD contribution from 63.6% to 43.0%, which is related to an increase in co-financing by Member States. The principle of subsidiarity enshrined in EU law allows Member States to freely allocate funds for selected types of interventions within the framework of a developed strategic plan. In the case of direct payments, it was proposed to introduce lump sum payments for smaller farms (restrictive payments), and the principle of degressivity was introduced, which aims to reduce the amount of direct payments in relation to farms receiving large amounts (from 60 to 100 thousand euros).

Conflict of interest: none

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The Impact of Input Digitalization on the Upgrading of the Global Value Chain of Manufacturing Industry

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Abstract: The development of the digital economy has made the input of digital elements an important factor affecting the upgrading of the global value chain of the manufacturing industry. Based on the WIOD database, this paper measures the Input digitalization index of the manufacturing industry in 42 economies, and then conducts an empirical analysis of the impact of input digitalization on the upgrading of manufacturing GVCs. The results show that input digitalization has a significant positive effect on the GVC participation index and GVC status index of the manufacturing industry, and the effect of digital infrastructure is the most significant; In addition, there are significant differences in the influence of input digitalization from domestic and foreign sources on the GVC index. The research conclusions provide transnational evidence and decision-making reference for promoting the digital transformation of input in manufacturing industry and achieving the goal of climbing to the high-end of GVC.

Keywords: input digitalization; global value chain; manufacturing industry

JEL Classification: C33; C67; F14

1. Introduction

In the era of digital economy, data, as a new "bulk commodity", has accelerated its integration with various industries by means of data mining, data flow, and data sharing, and has played an important role in reconstructing the division of labor and governance patterns in the global value chain (Qiu et al., 2021). The United Nations Industrial Development Organization pointed out in the "2022 Industrial Development Report" that the application of advanced digital manufacturing technology is of great benefit to enhancing economic resilience, emphasizing that countries around the world must improve their manufacturing digital capabilities to cope with an extremely uncertain future. Data is an important basis and prerequisite for the rise of the digital economy, and the input of digital elements is becoming an important factor in determining productivity, promoting the continuous refinement of the international division of production, and driving the upgrade of the global value chain (Goldfarb & Tucker, 2012). Therefore, under the background that the integrated development of the digital economy and the manufacturing industry has become the mainstream trend of global economic development, accurately identifying the global value chain upgrading effect of manufacturing digital elements can provide empirical evidence and policy reference for promoting the digital transformation of the manufacturing

industry, boosting high-quality development, and promoting the upgrading of the global value chain from the perspective of industrial integration.

Global value chain is the current research hotspot in the field of international economics. Existing domestic literature discusses the influence of factors such as manufacturing servitization (Liu et al., 2016), market size (Dai et al., 2017), and factor allocation structure (Li, 2015) on the upgrading of global value chains. With the strong rise of the digital economy, the global value chain upgrade effect of "digital transformation" has become the focus of scholars' attention. The related literature is mainly divided into two branches: one is the theoretical discussion on the effect of digitalization. Jing and Yuan (2019) believes that the digital wave is setting off a new direction that drives the upgrading of the global value chain. Qiu and Guo (2019) believes that the digital economy has become an important driving force for the upgrading of the value chain of small and medium-sized enterprises by means of cost saving, value creation, and value chain governance. Yu (2021) proposed the concept of digital economy value chain. It is believed that data elements make production increasingly refined and change the distribution method of the traditional value chain; at the same time, the adaptation of the platform economy to the manufacturing end makes the global value chain present a structural remodeling. The second is an empirical test on the effect of digitalization. Qi and Ren (2022) constructed an industry-level digital economy penetration indicator, using cross-country panel data to find that digital economy penetration has significantly improved the industry upstreamness of the GVC. Zhang and Yu (2020) used the domestic value-added rate of exports of Chinese manufacturing enterprises as an indicator to test the effect of input digitalization on upgrading the value chain of enterprises at the micro level. Zhang and Yu (2021) added a re-examination to identify the sources of digital element input. He (2020) uses data from China's manufacturing industry to verify the significant improvement of digital input in global value chain participation. Zhang et al. (2022) examined the driving effect of the digital economy based on the depth and breadth of the global value chain. Existing literature provides a wealth of references for this study.

Accurately defining the concept of " input digitalization " is the premise of this study. The concept of input digitalization first appeared in the White Paper on the Development of China's Digital Economy (2017). Referring to Zhang and Yu (2020), this paper defines input digitalization as a process of digital transformation that uses digital infrastructure, digital media and digital transactions and other "data elements" to promote economic structure optimization and efficiency improvement. Based on the above conceptual definitions, the following paper attempts to use country-industry-level data from a cross-country perspective to study the influence of manufacturing input digitalization on GVC upgrades, that is, to assess the degree to which downstream manufacturing producers are affected by the digital sector in the production process.

2. Methodology

2.1. Model Settings

Combined with existing research, this paper sets the following benchmark model:

$$GVC_{cit} = \beta_0 + \beta_1 Dig_{cit} + \beta_2 X_{cit} + \phi_c + \phi_i + \phi_t + \varepsilon_{cit} \quad\quad (1)$$

Among them, the subscripts c、i、t represent the country, industry and year in turn; GVC_{cit} represent the GVC participation index and GVC position index of the i industry in the c country during the t period; Dig_{cit} represents the input digitalization level of the i industry in the c country during the t period; X_{cit} are the control variables of the model; ϕ_c、ϕ_i、ϕ_t are the country, industry and time fixed effects in sequence; ε_{cit} are the random error terms.

2.2. Variable Description

1. Input Digitalization: Referring to Zhang and Yu (2020) screening and definition of digital element industries, this article lists the connotations of major digital elements and their supporting industries based on ISIC Rev4.0 one by one (see Table 1). For the wholesale sector (G-46), retail trade sector (G-47) and publishing sector (J-58), which only partially belong to the digital sector, the split coefficient method was introduced to obtain an input-output system covering 59 sectors. The split weights of G-46 and G-47 are calculated based on the share of online trade agency and internet wholesale revenue in the main business revenue of the wholesale sector and the share of Internet retail revenue in the retail sector's main business revenue. The data comes from the "China Economic Census Yearbook"; J-58 is divided according to the proportion of the sales amount of "electronic publications", "audio-visual products" and "non-publication products" to the total sales amount of the publishing department. The original data comes from the "Guoyanwang" database. Since the proportion of digitalization in the above three departments is relatively small in each country, considering the availability of data, the split coefficients of other countries are also replaced by China's.

Table 1. The connotations of major digital factors and their supporting industries based on ISIC Rev4.0 (Zhang & Yu, 2020)

the Core Elements	Connotation	Supporting Industries
Digital Infrastructure	Telecommunications Equipment and Services	J-61 J-62 J-63
	Computer Software	
	Computer Hardware	C-26
Digital Media	Web Publishing and Distribution	J-58：5820 Distribution of software
	Webcast	J-59 J-60
	Data Streaming Service	
Digital Transaction	Web Agency and Wholesale	G-46：Online trade agency, Internet wholesale G-47：Internet retail
	Internet Retail	

Drawing on the measurement method of "Input Servitization", the input-output method is used to calculate the "direct and complete consumption coefficient" of the

manufacturing industry for the supporting industry of digital elements. Further, referring to Yang (2015), the relative indicator "direct and complete dependence" was introduced to measure the level of input digitalization in the manufacturing industry. The "direct consumption coefficient" a_{ij} reflects the production technology structure of the national economy, which is expressed by the value of the products of the i sector consumed per unit of output value of the j sector: $a_{ij} = \frac{q_{ij}}{Q_j}$. q_{ij} is the input value by department i to department j, and Q_j is the total input value of department j. However, considering the indirect economic and technological links between various sectors, a complete consumption coefficient b_{ij} is introduced to fully characterize the input of sector i to sector j through industrial linkage effects. That is, $b_{ij} = a_{ij} + \sum_{m=1}^{N} a_{im}a_{mj} + \sum_{d=1}^{N} \sum_{m=1}^{N} a_{id}a_{dm}a_{mj} + \cdots$, the second term on the right side of the equation is the first round of indirect consumption of the i department through the m department by the j department. Similarly, the third term is the second round of indirect consumption, and so on. Assuming that the direct consumption coefficient matrix A is obtained by using the input-output method, the complete consumption coefficient matrix $B = A + A^2 + A^3 + A^4 + \cdots + A^k + \cdots$ is easy to obtain through matrix operations $B = (I - A)^{-1} - I$, where I is the unit matrix. The above absolute indicators are difficult to reflect the relative importance of digital input in total input, so "the degree of direct and complete dependence" is introduced to measure the proportion of the consumption of the manufacturing industry to the supporting industry of digital elements to all consumption. a_{dj} is the direct consumption coefficient of the manufacturing industry to the supporting industry of digital elements, b_{dj} is the complete consumption coefficient of the manufacturing industry to the supporting industry of digital elements, a_{kj} is the direct consumption coefficient of the manufacturing industry to any industry, and b_{kj} is the complete consumption coefficient of the manufacturing industry to any industry. The calculation formulas of the degree of direct dependence and the degree of complete dependence are: $Dig^{direct} = \Sigma_d a_{dj} / \Sigma_{k=1}^{N} a_{kj}$ and $Dig^{complete} = \Sigma_d b_{dj} / \Sigma_{k=1}^{N} b_{kj}$. In this paper, $Dig^{complete}$ is used for benchmark regression, and Dig^{direct} is used for robustness test.

2. GVC Index: The decomposition of the total export added value based on the input-output model is the premise of realizing the macro-measurement research on the division of labor in the global value chain (Ni, 2018). Based on the decomposition of Koopman (2014), this paper draws on the method of Huang et al. (2018), and selects the corresponding indicators of the TIVA database for the following calculation.

- Using the GVC position index proposed by Koopman et al. (2010) to measure the position in the global value chain division of labor of a country's manufacturing industry:

$$GVC_{cit}^{pos} = ln\left(1 + \frac{IV}{E}\right) - ln\left(1 + \frac{FV}{E}\right) \tag{2}$$

- Considering that there may be situations where the GVC position index is equal, but the degree of participation is widely different, Koopman et al. (2010) propose a GVC participation index as a supplement:

$$GVC_{cit}^{par} = \frac{IV}{E} + \frac{FV}{E} \tag{3}$$

- The larger the GVC_{cit}^{pos}, the higher the status of the international division of labor, the closer the industry in the country is to the upstream of the GVC division of labor system, and the higher added value is obtained by providing intermediate products to other economies (Wang et al., 2013). Similarly, the larger the GVC_{cit}^{par}, the deeper its involvement in the global value chain.

3. Control Variable: Control variables were selected by referring to relevant literature and considering data availability. Industry size (IS): expressed in terms of total industry output; Industry output per capita (OPH): expressed by the ratio of the total output of each industry to the number of employees in each industry; Industry capital output ratio (CO): expressed as the ratio of industry fixed capital stock to industry total output; Industry capital labor ratio (CL): expressed as the ratio of industry fixed capital stock to industry labor force; Foreign direct investment (FDI): expressed as a proportion of foreign direct investment flows to GDP; Labor Productivity (LP): expressed using constant 2010 per capita national income. In order to reduce the heteroscedasticity and multicollinearity between the data, this paper takes the natural logarithm of the above control variables when building the model. Economic Freedom (EFI): an indicator that combines data on a country's tax rate system, legal system, trade openness, government efficiency, etc.

2.3. Data Sources and Data Processing

This paper selects the world input-output table, which reflects the input-output connection between different countries and industries, to measure the input digitalization indicators at the cross-country-industry level. At the same time, considering the practical significance of the research in this paper and the matching problem with other databases, the largest and latest common divisor of the time span, that is, 2000-2014, is selected as the time range of the sample. The original data of input digitization comes from WIOD (2016); the original data of GVC index comes from the ICIO database of OECD; the labor productivity and FDI data come from the World Bank; the EFI data comes from the Fraser Institute database; The rest of the control variable data are derived from the Socio-Economic Accounts (WIOD-SEA) in the World Input-Output Database.

It should be pointed out that, first, WIOD (2016) contains 44 countries (regions), but TWN (Taiwan, China) and ROW (the rest of the world) lack some data of control variables, so they are excluded. The total number of economies in the sample is 42, and the total number of manufacturing industries is 16. There is a total of 19 manufacturing industries under ISIC Rev4.0, which are integrated into the following 16 industries

according to the research needs of this paper: C10-C12; C13-C15; C16; C17&C18; C19; C20&C21; C22; C23; C24; C25; C26; C27; C28; C29; C30; C31-C32&C33. The structure of the regression data in this paper is the three-dimensional level of "country- industry - year", so the number of observations in this paper is 10,080 (= 42 × 16 × 15). Second, the industry classification standards of the WIOD and ICIO databases are slightly different. This paper integrates the two definition standards and manually matches to obtain the multinational panel data of 16 industries. The descriptive statistical characteristics of the main variables are shown in Table 2.

Table 2. Basic statistical characteristics of each variable

Variable name	Variable meaning	Observations	Mean	Standard deviation	Minimum	Maximum
GVC_{par}	GVC participation index	10,080	0.633	0.102	0	0.970
GVC_{pos}	GVC status index	10,080	-0.006	0.167	-0.572	0.490
Dig	Input digitalization	10,080	0.068	0.071	0	0.578
$\ln CL$	Natural logarithm of industry capital labor ratio	10,002	5.447	2.213	0.083	14.264
$\ln CO$	Natural logarithm of industry capital-output ratio	10,003	-0.629	0.701	-5.497	2.760
$\ln IS$	Natural logarithm of industry size	10,015	9.860	3.410	-2.303	21.429
$\ln OPH$	Natural logarithm of output per industry	10,015	6.151	2.222	1.792	16.539
$\ln LP$	Natural logarithm of labor productivity	10,080	9.883	0.969	6.630	11.566
$\ln FDI$	Natural logarithm of foreign direct investment	9,552	1.195	1.397	-6.523	6.107
EFI	Economic freedom	10,080	7.473	0.670	5.180	8.770

3. Results

3.1. Benchmark Regression

Table 3 reports the benchmark regression results. After Hausman test, we select the fixed effect model for empirical analysis. Columns (1) and (4) only add core explanatory variables and control individual fixed effects. The results show that the regression coefficient of Dig is significantly positive at the 1% level. Columns (2) and (5) gradually added control variables, and introduced individual and time dummy variables. The coefficients and significance of the core explanatory variables did not change fundamentally. Columns (3) and (6) add control variables and introduce industry-level clustering robust standard errors on the basis of columns (2) and (5). The coefficient of Dig is still positive at the 1% significance level. This result shows that input digitization is conducive to improving the GVC participation index and GVC position index, that is, effectively driving the upgrading of the global value chain.

Table 3. Benchmark regression results

	(1) GVC_{par}	(2) GVC_{par}	(3) GVC_{par}	(4) GVC_{pos}	(5) GVC_{pos}	(6) GVC_{pos}
Dig	0.218 ***	0.207 ***	0.174 ***	0.237 ***	0.196 ***	0.241 ***
	(4.97)	(4.95)	(3.96)	(4.89)	(4.74)	(5.39)
$\ln CL$		-0.0496 ***	-0.0517 ***		0.0522	0.0661
		(-8.14)	(-8.43)		(1.36)	(1.56)
$\ln CO$		0.0141**	0.0184***		-0.0427	-0.0569*
		(2.19)	(2.87)		(-1.50)	(-2.00)
$\ln IS$		0.00955***	0.0234***		-0.0420**	-0.0744***
		(3.98)	(8.68)		(-2.61)	(-3.74)
$\ln OPH$		0.0550***	0.0572***		-0.0393**	-0.0464
		(9.10)	(9.47)		(-2.49)	(-0.94)
$\ln LP$			-0.0933 ***			0.260 ***
			(-12.71)			(4.42)
$\ln FDI$			0.00192 **			-0.00373
			(2.44)			(-1.55)
EFI			0.0137 ***			-0.0300
			(5.07)			(-1.47)
Cons	0.618 ***	0.474 ***	1.150 ***	0.383 ***	0.723 ***	-1.335 ***
	(203.42)	(30.00)	(20.22)	(10.76)	(4.52)	(-3.13)
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	No	Yes	Yes
N	10,080	10,002	9,478	10,080	10,002	9,478
R^2	0.00261	0.0778	0.101	0.0647	0.0936	0.107

Note: Values of t-statistics are in parentheses, and * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 4. Replacement indicators and endogeneity problems

	(1) GVC_{par}	(2) GVC_{pos}	(3) GVC_{par}	(4) GVC_{pos}	(5) GVC_{par}	(6) GVC_{pos}	(7) GVC_{par}	(8) GVC_{pos}
Dig			0.0330***	0.178***	0.139***	0.191***	0.0937***	0.368***
			(13.11)	(27.82)	(6.29)	(18.61)	(2.62)	(8.44)
$L.Dig$	0.254***	0.143***						
	(5.56)	(14.05)						
$\ln CL$	-0.0511***	0.0459***	0.0146**	-0.0943***	0.00874	0.0113	-0.0510***	0.0660***
	(-8.12)	(2.77)	(2.54)	(-6.46)	(1.60)	(0.86)	(-8.31)	(3.28)
$\ln CO$	0.0162**	-0.0433**	-0.0352***	0.115***	-0.0282***	0.0130	0.0181***	-0.0809***
	(2.47)	(-2.49)	(-6.07)	(7.80)	(-5.22)	(1.01)	(2.82)	(-3.96)
$\ln IS$	0.0248***	-0.0706***	0.00687***	0.0339***	0.00572***	-0.0114***	0.0238***	-0.0863***
	(8.61)	(-9.28)	(11.50)	(22.31)	(5.02)	(-4.19)	(8.86)	(-11.46)
$\ln OPH$	0.0558***	-0.0446***	-0.0185***	0.0557***	0.0172***	-0.0155	0.0562***	-0.0525***
	(9.08)	(-2.75)	(-3.31)	(3.93)	(3.23)	(-1.21)	(9.31)	(-2.79)
$\ln LP$	-0.0908***	0.218***	-0.0133***	0.0411***	-0.106***	0.183***	-0.0946***	0.180***
	(-11.56)	(10.44)	(-9.12)	(11.06)	(-14.35)	(10.38)	(-12.91)	(9.13)
$\ln FDI$	0.00133	-0.00980***	0.00559***	-0.0140***	-0.00110	-0.00176	0.00106*	-0.00747***
	(1.31)	(-3.65)	(7.83)	(-7.73)	(-1.42)	(-0.95)	(1.78)	(-2.84)
EFI	0.0120 ***	-0.0477 ***	-0.00381 *	0.0144 ***	0.0112 ***	-0.0357 ***	0.0149 ***	-0.0205 ***
	(3.98)	(-6.06)	(-1.85)	(2.74)	(3.16)	(-4.22)	(5.57)	(-2.89)
Cons	1.128 ***	-0.699 ***	0.707 ***	-0.161 ***	1.362 ***	-0.967 ***	1.159 ***	-0.632 ***
	(18.57)	(-4.06)	(58.73)	(-5.27)	(23.65)	(-7.02)	(20.42)	(-4.01)
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	8,857	8,857	9,478	9,478	9,478	9,478	9,478	9,478

Note: Values of t-statistics are in parentheses, and * p < 0.1, ** p < 0.05, *** p < 0.01.

3.2. Robustness Check

- Endogeneity

First, considering that there may be a time lag in the input digitalization effect discussed in this paper, and in order to ensure the causal relationship to a certain extent, the input digitalization index with a lag period of one period is selected to re-regress. The results are shown in columns (1) and (2) of Table 4, which confirms the driving effect of input digitalization on the upgrading of the global value chain of manufacturing. Secondly, for the estimation bias caused by omitted variables, refer to Bai (2009) to add interactive fixed effects to control the heterogeneity of multidimensional shocks. Columns (3) and (4) of Table 4 control the industry fixed effect, the year fixed effect and the industry-year one-dimensional interactive fixed effect. Columns (5) and (6) control the country fixed effect, the industry fixed effect, and the country-industry one-dimensional interaction fixed effect. The results show that the sign and significance of the core explanatory variable coefficients are completely consistent with the benchmark regression, and the previous conclusions are robust.

Table 5. Split the indicator of the core explanatory variable

	(1) GVC_{par}	(2) GVC_{par}	(3) GVC_{par}	(4) GVC_{pos}	(5) GVC_{pos}	(6) GVC_{pos}
Dig^I	0.175***			0.0706***		
	(4.01)			(3.10)		
Dig^M		0.00214			0.0105	
		(0.38)			(1.54)	
Dig^D			0.115			0.415
			(0.39)			(1.18)
$\ln CL$	-0.0439***	-0.0444***	-0.0446***	0.0399***	0.0405***	0.0396***
	(-5.82)	(-5.88)	(-5.90)	(5.43)	(5.50)	(5.37)
$\ln CO$	0.00928	0.00982	0.00987	-0.00783	-0.00830	-0.00784
	(1.21)	(1.28)	(1.29)	(-1.02)	(-1.08)	(-1.02)
$\ln IS$	0.0234***	0.0237***	0.0237***	-0.0185***	-0.0183***	-0.0183***
	(8.30)	(8.42)	(8.42)	(-5.73)	(-5.68)	(-5.66)
$\ln OPH$	0.0499***	0.0499***	0.0501***	-0.0525***	-0.0532***	-0.0524***
	(7.06)	(7.06)	(7.07)	(-7.25)	(-7.35)	(-7.22)
$\ln LP$	-0.0935***	-0.0946***	-0.0947***	0.176***	0.176***	0.176***
	(-12.67)	(-12.81)	(-12.81)	(20.05)	(19.98)	(19.95)
$\ln FDI$	0.00104*	0.00107*	0.00106*	0.00218**	0.00217**	0.00210**
	(1.74)	(1.79)	(1.77)	(2.31)	(2.29)	(2.22)
EFI	0.0137***	0.0150***	0.0150***	-0.00662**	-0.00633**	-0.00630**
	(5.11)	(5.60)	(5.60)	(-2.07)	(-1.97)	(-1.96)
Cons	1.152***	1.162***	1.162***	-1.405***	-1.396***	-1.396***
	(20.24)	(20.41)	(20.41)	(-20.64)	(-20.49)	(-20.51)
FE	Yes	Yes	Yes	Yes	Yes	Yes
N	9,478	9,478	9,478	9,478	9,478	9,478
R^2	0.0999	0.0983	0.0983	0.104	0.104	0.104

Note: In Table 5, Dig^I, Dig^M, and Dig^D represent digital infrastructure, digital media, and digital transactions in sequence.

- Replacement Index

The input digitalization level was remeasured using Dig^{direct} to replace the core explanatory variables. As shown in column (7) and column (8) in Table 4, the sign and

significance of the core explanatory variables have not changed, which further confirms the core conclusion of the previous article.

- Split the Indicator

According to the previous Table 1, the indicator of the core explanatory variable is divided into three types of digital inputs: digital infrastructure, digital media and digital transactions to test the robustness of the benchmark regression results and analyze the different influences of various input digitalization on the upgrading of the manufacturing global value chain.

The estimation results in columns (1) and (4) in Table 5 show that digital infrastructure promotes the improvement of GVC participation index and position index at the 1% significance level. As an important part of input digitalization, the estimated coefficient of Dig^I is significantly positive, which further supports the core conclusion of this paper. The coefficient of Dig in columns (2), (4) and (3), (6) of Table 5 is positive but not significant.

The possible explanations for the above results are: data is a key element of the digital transformation of the manufacturing industry, and digital infrastructure is the fundamental prerequisite for data generation, flow and storage. Its GVC value-added effect and industrial chain integration effect are an important support and guarantee for the GVC upgrading of digital empowerment (Acemoglu & Restrepo, 2019). Digital media and digital transactions must rely on a sound digital infrastructure to play their roles in information flow, resource integration, and cost-plus. In addition, in the sample period of this paper, the former is still in the early stage of development and accounts for a small proportion of the digital inputs in the manufacturing industry, so the statistical results show that its driving effect on the upgrading of the global value chain is not significant.

3.3. Re-examination Based on the Different Input Source

In the context of globalized production, the international division of labor has rapidly expanded into the digital field, and data, as a key production factor, has particularly obvious characteristics of "globalization" and "fragmentation" (Guo & Qiu, 2020). We further divide digital inputs into domestic and foreign sources and re-examine its effect on the GVC upgrading in the manufacturing industry.

Referring to the reported results in Table 6, the GVC_{par} column shows that both domestic and foreign sources of input digitalization significantly improved the GVC participation index. The results of the GVC_{pos} column shows that the input digitalization from domestic sources has significantly improved the GVC_{pos}, while the coefficient of Dig^{for} is significantly negative. It shows that the input digitization from foreign sources not only does not help a country's manufacturing industry to climb the high-end of the GVC, on the contrary reduces its GVC division of labor status.

The possible explanations are: Generally speaking, the input digitalization from domestic sources in the manufacturing industry of each country accounts for an absolute proportion, and the foreign sources is relatively low. Therefore, the input digitalization from domestic sources is likely to promote the GVC upgrading of the manufacturing due to its

dominant force and localization advantages. The increase of input digitalization from foreign sources means that intermediate products from other countries will be used in downstream production links for production. Foreign digital factor occupy the first-mover advantage in technology, which will make it easy for them to "squeeze" high profits by virtue of their monopoly position and increase the purchase price of intermediate products in downstream domestic industries (Xu & Xia, 2020); Over-reliance on key high-end elements is not conducive to domestic innovation security, and it is easy to be "stuck in the neck" and hinder the improvement of GVC division of labor status (Zhang & Yu, 2021); At the same time, the input of advanced foreign digital factors may need to be run in with domestic high-skilled labor factors to match, and "acquisition" will cause a time lag, so it will not immediately manifest as an improvement of GVC division of labor status (Wu & Ma, 2020).

Table 6. Test results of re-examination based on the different input source

	GVC_{par}			GVC_{pos}		
Dig^{for}	0.0955 ***		0.0886 ***	-0.134 ***		-0.134 ***
	(3.89)		(3.59)	(-34.00)		(-33.95)
Dig^{dom}		0.101 ***	0.0866 **		0.226 ***	0.201 ***
		(2.93)	(2.51)		(5.52)	(5.22)
$\ln CL$	-0.0440 ***	-0.0443 ***	-0.0439 ***	0.0371***	0.0428***	0.0375***
	(-5.83)	(-5.87)	(-5.82)	(4.37)	(4.75)	(4.41)
$\ln CO$	0.00985	0.00898	0.00904	-0.0169**	-0.0118	-0.0188**
	(1.29)	(1.17)	(1.18)	(-1.97)	(-1.29)	(-2.18)
$\ln IS$	0.0238***	0.0232***	0.0232***	-0.0260***	-0.0204***	-0.0273***
	(8.44)	(8.20)	(8.23)	(-8.19)	(-6.05)	(-8.57)
$\ln OPH$	0.0496***	0.0501***	0.0497***	-0.0449***	-0.0543***	-0.0445***
	(7.01)	(7.09)	(7.04)	(-5.64)	(-6.43)	(-5.61)
$\ln LP$	-0.0952***	-0.0936***	-0.0943 ***	0.146 ***	0.179 ***	0.148 ***
	(-12.90)	(-12.67)	(-12.77)	(17.51)	(20.29)	(17.76)
$\ln FDI$	0.000989 *	0.00106 *	0.000982	0.00243 ***	0.00268 ***	0.00240 ***
	(1.65)	(1.77)	(1.64)	(3.61)	(3.75)	(3.58)
EFI	0.0146 ***	0.0146***	0.0143***	-0.00629**	-0.00725**	-0.00719**
	(5.49)	(5.45)	(5.35)	(-2.10)	(-2.27)	(-2.40)
Cons	1.163***	1.153***	1.155***	-0.973***	-1.420***	-0.992***
	(20.44)	(20.24)	(20.28)	(-14.92)	(-20.85)	(-15.20)
FE	Yes	Yes	Yes	Yes	Yes	Yes
N	9,478	9,478	9,478	9,478	9,478	9,478
R^2	0.0998	0.0992	0.100	0.209	0.108	0.211

Note: Dig^{for} and Dig^{dom} represent input digitalization from foreign sources and from domestic sources in turn.

4. Discussion and Conclusion

China's manufacturing industry has been trapped in the "low-end lock-in" dilemma for a long time, and the strong rise of the digital economy has become an excellent opportunity to climb the middle and high end of the global value chain. This paper uses the manufacturing industry data of 42 economies from 2000 to 2014 to measure the country-industry level of input digitization indicators. Based on this, this paper conducts an empirical analysis on the effect of input digitalization on the upgrading of the global value chain of the manufacturing industry. The main research conclusions are as follows: input digitization

significantly promotes the improvement of the GVC participation index and GVC position index of the manufacturing; Splitting the input digitalization indicators shows that the driving effect of digital infrastructure is the most significant, and digital media and digital transactions may need rely on the former to better play its driving effect. This conclusion is consistent with the research conclusion of Zhang and Yu (2020) at the micro-enterprise level. After further analysis, it was found that digital inputs from domestic and foreign sources both contributed to the improvement of the GVC participation index, but digital inputs from foreign sources showed an inhibitory effect on the GVC position index. This conclusion supports the research of Zhang and Yu (2021) to a certain extent.

Compared with the existing literature, the characteristics and innovations of this paper are reflected in the following two aspects: First, the related research on input digitalization measurement is close to blank, and the existing articles are limited to the scope of China's manufacturing industry. This paper measures the input digitalization level of manufacturing industry in 42 countries (regions) included in WIOT, which enriches the data system of existing research. Second, few studies have explored the impact of input digitalization on the upgrading of the global value chain, and some relevant studies have started from micro-enterprises in China's manufacturing industry, and there is a lack of research at the cross-country level. This empirical analysis based on cross-country-industry-level data looks to fill this gap. Needless to say, limited by the availability of data, the time span of empirical research is only 2000-2014. Therefore, we look forward to further research in the future.

This paper's research based on a transnational perspective provides some implications for the development of China manufacturing's input digitalization and related policy formulation. First of all, in the process of participating in the global value chain, it is necessary to pay full attention to the accumulation of data elements, be good at integrating knowledge resources in the upstream and downstream connections, drive the digital and intelligent transformation of the manufacturing industry, and then climb the middle and high-end of the global value chain. Secondly, the matching mechanism between digital infrastructure and other digital inputs should be fully optimized, and a complete and systematic manufacturing digital support system should be built. Finally, rationally treat the impact of input digitalization from foreign sources on the GVC division of labor status, and enhance the ability to use the spillover effect of foreign digital elements to promote the development of the domestic digital industry.

Conflict of interest: none

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Non-linear Relationship Analyses about Urbanization, Economic Growth and Carbon Emissions in China Based on Semi-parametric Fixed Effects Model

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Abstract: At present, China is in a period of important historical opportunity to achieve the goal of "peak carbon and carbon neutral" and consolidate the achievements of poverty eradication. So, it is important to investigate the changes of carbon emissions in the process of economic development and urbanization to achieve high-quality development. Based on the Kuznets curve hypothesis, using the China's provincial panel data from 1997 to 2018, the semi-parametric fixed-effects model was applied to simultaneously explore the nonlinear relationship about the three and their regional differences. The results illustrate that the trajectory of carbon emissions presents an inverted U-shape in the past economic development and urbanization process at the national level. There are significant differences in carbon emission trajectories among regions. The carbon emission Kuznets curve exists in the economic growth and urbanization of the eastern region, while it does not exist in the other two regions. In addition, carbon emissions in western region show a monotonically decreasing pattern with the advancement of urbanization.

Keywords: economic growth; urbanization; carbon emission Kuznets curve; semi-parametric fixed effect model

JEL Classification: R11

1. Introduction

China's GDP has exceeded 100 trillion by 2020, and the urbanization rate has increased from 17.9% in 1978 to 60.6% in 2019. However, it cannot be ignored that China's rapid economic growth in the past was mainly based on the model of high energy consumption, high pollution and high emissions. In 2020 alone, China emits 30.15% of the world's carbon, a whopping 10.251 billion tons. In order to achieve the synergy between high-quality economic development and high-level ecological protection, in September 2020, Chinese Government announced that China will strive to achieve peak $CO2$ emissions by 2030 and carbon neutrality by 2060. How to transform the economic development model and scientifically control carbon emissions has become an urgent issue. Specifically, different regions in China are at different stages of economic development and urbanization, which

may have varying effects on carbon emissions. This paper discusses the influence of economic growth and urbanization on carbon emissions at both the national and regional levels, which is critical for China to tailor carbon reduction plans to local conditions and precision.

Interaction between economic development and environmental quality has always been a hot issue of concern to economists. In the 1990s, Grossman and Krueger (1991) first proposed that environmental pollution will increase with the growth of income at low-income levels, and decrease with income increase at high income levels. Panayotou (1993) calls this "inverted U-shaped" form between income and environmental deterioration the Environmental Kuznets Curve (EKC). Since then, the existence of EKC curves between different pollutants has been discussed extensively. It is generally agreed that economic growth is one of the largest drivers of carbon emissions, but there is clear divergence on the pattern of environmental Kuznets curve for carbon emissions (CKC). Most of studies reveal that the CKC curve present an "inverted U-shaped" (Saboori, 2013), "N-shaped" (Martínez-Zarzoso & Bengochea-Morancho, 2004) or monotonically rising shape (Azomahoua & Vanc, 2006).

Early studies on CKC patterns in China used national time-series data at most, and the findings concluded that the CKC curve was not valid in China (Hu et al.,2013). In recent years, the analysis using panel data mostly support the existence of an inverted U-shaped CKC curve at the national level (Li et al., 2016), but there are obvious differences in the curve shape and its inflection point location at the regional level (Xu & Song, 2013). In addition, some scholars have questioned this conclusion (He et al., 2012; Deng, 2014).

Another important direction of research on the CKC curve is incorporating other factors that affect carbon emissions into the CKC hypothesis' research framework. The level of urbanization has become a key element influencing carbon emissions as the urbanization process continues to progress in China. Early studies suggested that there is a straightforward linear relationship. Liddle and Nelson (2010) discovered a positive relationship, Fan et al. (2006) believed that urbanization can curb carbon emissions. In subsequent studies, scholars discovered that there may be a more complex nonlinear relationship between them. Wang et al. (2015) used semi-parametric fixed effects models to study the relationship between them in OECD countries, suggesting an inverted U-shaped relationship. Using geographic data analysis methods, Xiao et al. (2021) investigated the association of economic growth, air pollution and urbanization in the Yangtze River Delta, finding that the relationship is "positive U-shaped".

By combing through the relevant research literature, we find there is still room for expanding the research on the relationships about economic growth, urbanization and carbon emissions as follows: First, from the perspective of data acquisition, most of the data used by scholars are calculated from the emission factors recommended by the IPCC, which undoubtedly leads to an overestimation of carbon emissions (Liu et al., 2015). Therefore, we will use the latest provincial carbon emissions dataset (1997-2018) calculated by Shan et al. (2017), measuring China's carbon emissions more scientifically. Second, most of the research methods in existing literature make strong assumptions on model setting, which may lead to large "setting errors". Therefore, we propose to use a semi-parametric fixed-effects model to

investigate the nonlinear link about the three. Finally, in terms of research substance, most literature focus on the relationship between economic growth and carbon emissions, only a few papers studied the influence of urbanization on carbon emissions. The relationships about them are addressed in depth in this research. Further, the regional heterogeneity is investigated by the STIRPAT model.

2. Data and Methodology

2.1. Model Building

The STIRPAT model is extended from the IPAT model (Dietz, 1997) proposed by Ehrlich and Holdren (1972), inheriting the advantages of simple form of model setting and breaking the constraint of linear influence of each factor on environmental quality. We take the STIRPAT model as a theoretical framework to study the nonlinear relationship among carbon emissions, economic growth and urbanization, the benchmark model is of the following form:

$$I_i = aP_i^b A_i^c T_i^d \varepsilon_i \tag{1}$$

where i represents regions. The variable I_i denotes environmental impact, P_i denotes demographic factors, A_i denotes affluence factors, and T_i denotes technical factors. a, b, c, d respectively represent the estimated coefficients of the corresponding variables, ε is the error term. To further test the existence of the CKC curve between them, The STIRPAT model is extended to include quadratic components for economic growth and urbanization variables. Based on this, the equation (1) is deformed as:

$$LnCE_{it} = \alpha_0 + \beta_1 LnP_{it} + \beta_2 LnA_{it} + \beta_3 (LnA_{it})^2 + \beta_4 LnEI_{it} + \beta_5 US_{it} + \delta_t + \mu_i + \varepsilon_{it} \tag{2}$$

$$LnCE_{it} = \alpha_0 + \beta_1 LnP_{it} + \beta_2 LnA_{it} + \beta_3 LnEI_{it} + \beta_4 US_{it} + \beta_5 US_{it}^2 + \delta_t + \mu_i + \varepsilon_{it} \tag{3}$$

where i is region and t is year, CE_{it} is the carbon emissions of province i in year t; P_{it} is the population size, representing the demographic factor; A_{it} is the per capita GDP, representing the degree of wealth, IE_{it} is the energy consumption intensity, representing the technical level; US_{it} is the urbanization rate; δ and μ respectively represent the time fixed effect and the regional fixed effect, α_0 is a constant term, and ε is a error term.

Under the above framework, we first use the parametric panel fixed effects model to inspection whether there is an CKC curve between them. Then, the semi-parametric fixed effects model proposed by Baltagi and Li (2002) is used to further test whether there is a nonlinear relationship between them. The model is as follows:

$$LnCE_{it} = \alpha_0 + \beta_1 LnP_{it} + f(LnA_{it}) + \beta_2 LnEI_{it} + \beta_3 US_{it} + \delta_t + \mu_i + \varepsilon_{it} \tag{4}$$

$$LnCE_{it} = \alpha_0 + \beta_1 LnP_{it} + \beta_2 LnA_{it} + \beta_3 LnEI_{it} + f(US_{it}) + \delta_t + \mu_i + \varepsilon_{it} \tag{5}$$

where the function $f(\bullet)$ represents the non-parametric estimator. In order to eliminate the fixed effect of the above equation, differential processing is performed on both sides of the equation:

$$LnCE_{it} - LnCE_{it-1} = \beta_1(LnP_{it} - LnP_{it-1}) + [f(LnA_{it}) - f(LnA_{it-1})] +$$

$$\beta_2(LnEI_{it} - LnEI_{it-1}) + \beta_3(US_{it} - US_{it-1}) + \varepsilon_{it} - \varepsilon_{it-1} \tag{6}$$

$$LnCE_{it} - LnCE_{it-1} = \beta_1(LnP_{it} - LnP_{it-1}) + \beta_2(LnA_{it} - LnA_{it-1}) +$$

$$\beta_3(LnEI_{it} - LnEI_{it-1}) + [f(US_{it}) - f(US_{it-1})] + \varepsilon_{it} - \varepsilon_{it-1} \quad (7)$$

Baltagi and Li (2002) use the function sequence $p^k(LnA_{it}, LnA_{it-1})$ and $p^k(US_{it}, US_{it-1})$ to approximately replace $[f(LnA_{it} - LnA_{it-1})]$ and $[f(US_{it} - US_{it-1})]$. $p^k(LnA_{it}, LnA_{it-1})$ and $p^k(US_{it}, US_{it-1})$ are the first k terms of the function series $[p^1(LnA_{it}, LnA_{it-1}), p^2(LnA_{it}, LnA_{it-1}), \cdots]$ and $[p^1(US_{it}, US_{it-1}), p^2(US_{it}, US_{it-1}), \cdots]$. The value of intercept α_i can be calculated after the β_i in equations (6) and (7) are estimated. We can obtain:

$$\hat{\mu}_{it} = LnCE_{it} - \hat{\beta}_1 LnP_{it} - \hat{\beta}_2 LnEI_{it} - \hat{\beta}_1 US_{it} - \hat{\alpha}_i = f(LnA_{it}) + \varepsilon_{it} \quad (8)$$

$$\hat{\mu}_{it} = LnCE_{it} - \hat{\beta}_1 LnP_{it} - \hat{\beta}_2 LnEI_{it} - \hat{\beta}_1 LnA_{it} - \hat{\alpha}_i = f(US_{it}) + \varepsilon_{it} \quad (9)$$

Finally, local linear regression is used to estimate $f(\bullet)$. What needs to be pointed out is that, drawing on the research of the existing literature, this paper chooses $k = 4$ for regression in the empirical analysis.

2.2. Variable and Data

We control the influence of demographic factors and technological factors on carbon emissions according to the STIRPAT model. The detailed variable settings are shown in Table 1.

1. Carbon emissions (LnEC). Because official data is limited, Shan et al. (2017) estimated the total carbon emissions of all provinces except Tibet and Taiwan based on the default emission factors provided by IPCC. So, we use their estimation results as the Carbon emissions data.

2. The degree of economic development (LnA). As is usual practice in the current research, using the logarithmic value of per capita GDP measures the amount of economic progress. Per capita GDP is adjusted to a constant price based on 1997 to exclude the effects of pricing factors.

3. Urbanization rate (US). The fraction of urban residents in each region's resident population is used to assess population urbanization. We use the findings of Chen and Zhou (2005) to repair and augment the urbanization data from 1997 to 2000 by the S-shaped logistic curve method.

4. Other variables. (1) Population factor (LnP). The logarithm of the permanent population in each region is used to express the population size. (2) Technical factors (LnEI). The logarithm of energy consumption intensity (the ratio of total energy consumption to real GDP) is used to measure the level of technology.

5. Data Sources. The initial sample is panel data from 1997 to 2018 of 30 China's provinces (municipalities and autonomous areas). Taking into account the missing data, Tibet is excluded from the sample. The original data were obtained from the China Statistical Yearbook, China Energy Statistical Yearbook, CEIC database and China Carbon Emissions Database (CEADs) in previous years. Descriptive statistics of the main variables are presented in Table 2.

Variable	Meaning	Formula
LnEC	Log value of carbon emissions	Ln (carbon emissions)
LnA	Log value of real GDP per capita	Ln (real GDP per capita)
US	Urbanization level	(urban permanent residents/ the permanent residents) ×100
LnP	Log value of permanent population	Ln (permanent population)
LnEI	Log value of energy consumption intensity	Ln (total energy consumption/real GDP)

Table 2. Descriptive statistics of main variables

Variable	Observations	Mean	SE	Minimum	Maximum
LnEC	660	5.076	0.881	1.974	6.816
LnA	660	9.683	0.794	7.712	11.506
LnA^2	660	94.395	15.369	59.472	132.398
LnP	660	8.149	0.764	6.207	9.337
LnEI	660	0.328	0.528	-0.740	1.648
US	660	49.029	15.889	21.530	89.610
US^2	660	2,655.875	1,764.793	463.541	8,029.952

3. Estimation Results

3.1. Benchmark Analysis

The regression results between economic growth and carbon emissions are shown in models (1) and (2) in Table 3. The results of Model (1) indicate that the coefficients of energy consumption intensity and population size are both significantly positive at the level of 1%. Specifically, carbon emissions will increase by 0.995% and 0.629% respectively with each 1% increase in population size and energy consumption intensity. The coefficient of urbanization is not significant at the level of 10%. In addition, the coefficient of economic growth and its quadratic terms are significant at 1% level, which implies an inverted U-shaped CKC relationship between the two.

The estimation results of Model (2) reveal the coefficients of the semi-parametric fixed-effects model remain significantly positive at the levels of 5% and 1% for population size and energy consumption intensity. The coefficients of urbanization are not significant, and their size and direction of the estimated coefficients have changed. Specifically, in the semi-parametric model, the coefficient of population size is larger, the coefficient of energy intensity is less than that of parametric model. Besides, the left panel of Figure 1 provides a proof that the fitted curves reveal gradually flatten. In summary, both models prove the existence of CKC curves between economic growth and carbon emissions.

The effects of urbanization on carbon emissions are shown by Models (3) and (4) in Table 3. The coefficients of population size, energy intensity, and economic growth do not change significantly by compared the outcomes of different model. However, the coefficients of the quadratic term of urbanization is significantly negative in the 10% level, indicating a non-linear relationship between the two. As reported in the right panel of

Figure 1, a semi-parametric fit of urbanization and carbon emissions demonstrates a clear inverted U-shape, and the former has a restraining effect on the latter when the urbanization rate exceeds 70%. The results indicate an inverted U-shaped CKC relationship between the two.

Table 3. Estimated of the impact of economic growth and urbanization on carbon emissions

	Economic growth Models (1)	Economic growth Models (2)	Urbanization Models (3)	Urbanization Models (4)
c	-12.5995***		-9.1275***	
	(1.7103)		(1.2698)	
LnA	1.5462***		0.9709***	0.7256***
	(0.1830)		(0.0596)	(0.2175)
LnA^2	-0.0293***			
	(0.0084)			
LnP	0.6292***	0.8101**	0.5284***	0.6697**
	(0.1024)	(0.3423)	(0.1046)	(0.3393)
LnEI	0.9952***	0.4638***	1.0062***	0.4746***
	(0.0299)	(0.0577)	(0.0302)	(0.0571)
US	-0.0005	0.0041	0.0050	
	(0.0015)	(0.0046)	(0.0032)	
US^2			-0.0001*	
			(0.0000)	
Time fixed effect	Yes	Yes	Yes	Yes
Regional fixed effect	Yes	Yes	Yes	Yes
Observations	660	630	660	630
R²	0.9731	0.5434	0.9727	0.5469

Note: (1) Standard errors are in parentheses; (2) ***, **, * represent the significance level of 1%, 5%, and 10% respectively.
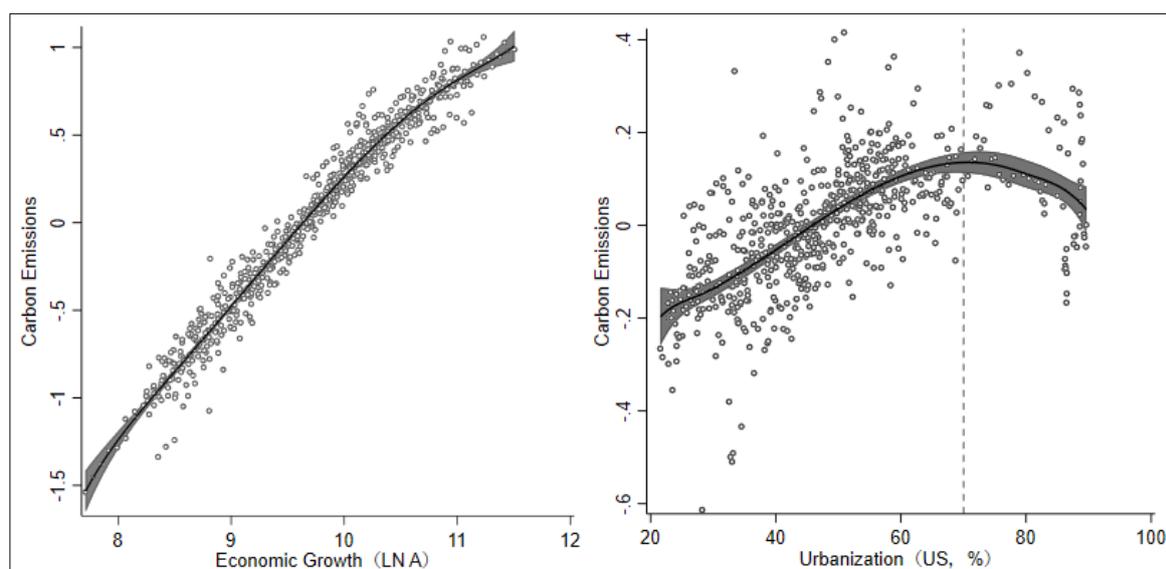
Figure 1. Semi-parametric fit plots of carbon emissions and economic growth (left), urbanization (right)

Note: The points in the figure are the estimated partial residuals of carbon emissions; the curve represents the fitted values of the adjusted effects of other explanatory variables in the model, and the shaded part represents the 95% confidence interval.

3.2. Spatial Heterogeneity

Considering the difference of industrial development and policy strength in different regions, sample is divided into three parts: eastern, central and western regions. We want to know whether there is spatial heterogeneity about the nonlinear relationship. When the sub-regional study was conducted, the panel type changed from short panel to long panel, and the three groups of models were tested to select the appropriate estimation method, the results are shown in Table 4.

The problems of groupwise heteroscedasticity, autocorrelation within panel and contemporaneous correlation present significantly in all regions, and autocorrelation within panel also presents in the eastern and central regions. Therefore, the comprehensive FGLS method is estimated for the eastern and western regions, and the PCSE method is estimated for the central region.

Table 4. Long panel model correlation test

	Groupwise heteroscedasticity			Autocorrelation within panel			Contemporaneous Correlation		
	Eastern	Central	Western	Eastern	Central	Western	Eastern	Central	Western
Economic Growth	224.96***	52.68***	591.09***	21.89***	1.81	3.91*	124.30***	48.76***	118.66***
Urbanization	252.42***	56.95***	574.38***	28.95***	1.89	3.92*	127.46***	58.73***	125.70***

Table 5. The impact of economic growth on carbon emissions: spatial heterogeneity

	Eastern		Central		Western	
	Models（1）	Models（2）	Models（3）	Models（4）	Models（5）	Models（6）
c	-12.9030***		-22.3742***		-22.0082***	
	(3.6824)		(3.7581)		(3.8172)	
LnA	2.0987***		3.2658***		1.8656***	
	(0.4503)		(0.8504)		(0.4447)	
LnA^2	-0.0576***		-0.1249***		-0.0454**	
	(0.0187)		(0.0457)		(0.0203)	
LnP	0.2004	0.8910*	0.9716***	0.7817	1.7874***	0.5035
	(0.1776)	(0.5017)	(0.2130)	(0.7434)	(0.2414)	(1.0210)
LnEI	0.7060***	0.2734**	0.7569***	0.7120***	0.7201***	0.4609***
	(0.0569)	(0.1064)	(0.0728)	(0.1247)	(0.0491)	(0.1084)
US	0.0031*	0.0071	-0.0065*	0.0190*	-0.0146***	-0.0127
	(0.0016)	(0.0058)	(0.0037)	(0.0097)	(0.0038)	(0.0140)
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	242	231	176	168	242	231
Adjusted R^2	-	0.6524	0.9899	0.6761	-	0.5109

Note: (1) Standard errors are in parentheses; (2) ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

Table 5 lists the impact of regional economic growth on carbon emissions. There is a significant positive impact from the population size in the central and western regions, but not in the eastern region. Urbanization has a significant negative impact in the western region but a positive impact in the eastern and central regions. The coefficients of energy consumption intensity do not differ significantly among regions. Overall, the estimation results indicate the presence of significant regional heterogeneity. The coefficients of economic growth and its quadratic term are significant in all three regions, suggesting the existence of the CKC curve in all regions.
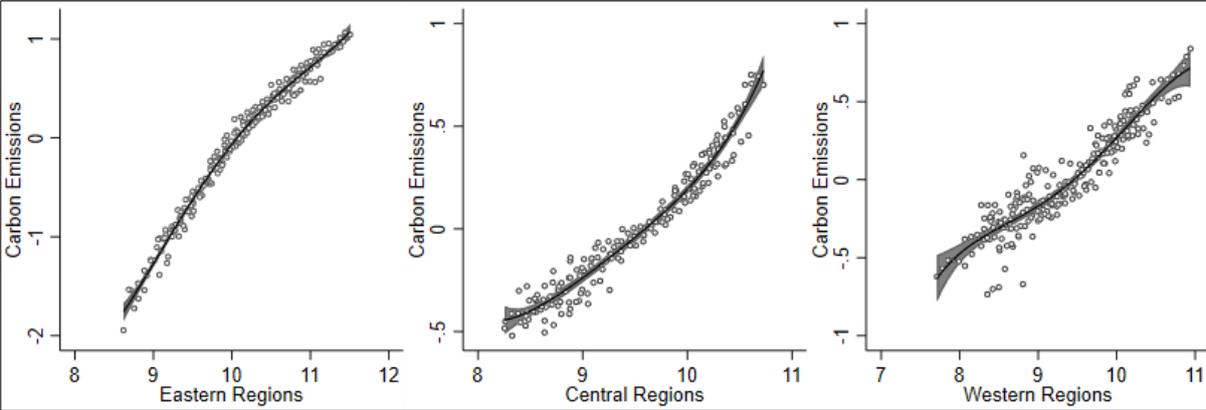
Figure 2. The impact of economic growth on carbon emissions: spatial heterogeneity

Note: The points in the figure are the estimated partial residuals of carbon emissions; the curve represents the fitted values of the adjusted effects of other explanatory variables in the model, and the 95% confidence interval is shaded.

We plotted semi-parametric fits of carbon emissions and economic growth for three regions, as shown in Figure 2. Figure 2 illustrates that the curve in the eastern region tends to flatten, meaning that it is close to the turning point of the CKC curve. While the economic growth in the western and central regions is still some way from reaching the turning point, remaining the cost of high pollution and high emissions.

Table 6 compares the regression results of the effect of urbanization on carbon emissions by regions. We can see, the effects of population size and energy consumption intensity are similar to the regression results in Table 5. The coefficients of urbanization and its quadratic term are significant and consistent with the CKC hypothesis in the eastern and central regions, indicating existence of the CKC curve between the two.

The semi-parametric fitting results as shown in Figure 3 provides a proof existing a clear inverted U-shaped relationship between carbon emissions and urbanization in the eastern region, but not the other two regions. In the eastern, taking the urbanization rate of 69% as the boundary, carbon emissions increase along with the urbanization rate before reaching the boundary. Conversely, it decreases. In the central region, differed significantly from those of the parametric regression, the right part of the curve is steeper than the left part, illustrating that the carbon emissions increase with the accelerated urbanization process. In western region, the fitted curve presents a decreasing trend and the right side is steeper than the left side, implying that carbon emissions decrease with the improvement of urbanization.

Specially, carbon emissions decrease faster when the urbanization rate over 55%, the reason may be that the urbanization process in western region realizes the spatial agglomeration of population, capital and technology generating economies of scale.

Table 6. The impact of urbanization on carbon emissions: spatial heterogeneity

	Eastern		Central		Western	
	Model（1）	**Model（2）**	**Model（3）**	**Model（4）**	**Model（5）**	**Model（6）**
c	-10.0278***		-14.6927***		-21.4582***	
	(0.9545)		(2.2814)		(3.4599)	
LnA	1.0804***	0.8904***	0.9200***	0.5362	1.1461***	0.5866
	(0.0584)	(0.3199)	(0.0996)	(0.4408)	(0.1230)	(0.4817)
LnP	0.3978***	0.6297	1.2975***	0.8491	2.0137***	1.1340
	(0.0809)	(0.5021)	(0.2074)	(0.7012)	(0.3087)	(0.9670)
LnEI	0.7291***	0.3073***	0.7712***	0.6812***	0.7386***	0.4596***
	(0.0521)	(0.1069)	(0.0768)	(0.1153)	(0.0497)	(0.1046)
US	0.0127***		0.0192***		0.0094	
	(0.0045)		(0.0052)		(0.0110)	
US^2	-0.0001**		-0.0003***		-0.0003**	
	(0.0000)		(0.0001)		(0.0001)	
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	242	231	176	168	242	231
Adjusted R^2		0.6473	0.9900	0.6781		0.5183

Note: (1) Standard errors are in parentheses; (2) ***, **, and * indicate significance levels of 1%, 5%, and 10%.
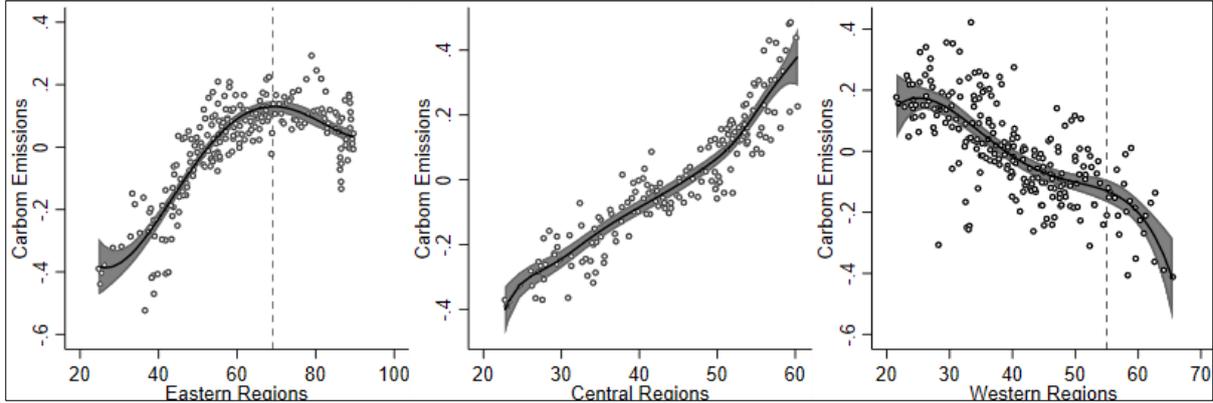

Figure 3. The impact of urbanization on carbon emissions: spatial heterogeneity

Note: The points in the figure are the estimated partial residuals of carbon emissions; the curves represent the fitted values of the adjusted effects of other explanatory variables in the model, and the 95% confidence interval is shaded.

4. Conclusions

Based on the carbon emission Kuznets curve hypothesis, this paper empirically investigates the nonlinear relationship about carbon emissions and economic growth, urbanization, using a semi-parametric fixed-effects model under the framework of the STIRPAT model by using the China's provincial panel data from 1997 to 2018. The results illustrate that the relationship about urbanization, economic growth and carbon emissions present an obvious U-shape at the national level, and carbon emissions decline with the rise of urbanization level when the urbanization rate crosses 70%. The regional level presents obvious heterogeneity. In addition, carbon emissions are also influenced by the size of the population and the intensity of energy consumption.

Based on the research results, we put forward some policy recommendations:

Firstly, with formulating and coordinating carbon emission reduction policies, it is essential to comprehensively consider the characteristics of different regions' economic development, resource endowments, and emission reduction potentials. The eastern region is near the inflection point of the CKC curve, meaning that it may be the first to realize the "decoupling" development of economic growth and carbon emission. Therefore, the eastern region might be treated with high standards and requirements to play a leading role. Conversely, the curves of the central and western regions maintain a monotonically rising trend, illustrating that they are still in the mid-stage of industrialization. Therefore, green low-carbon technologies should be actively developed and utilized to improve energy utilization efficiency, promoting the ecological civilization construction.

Secondly, we must practice the concept of green development with advancing the process of urbanization. The results of the study reveal that the scale effect on population, industry, technology and capital agglomeration have achieved roughly in the eastern region. Therefore, the eastern region should actively play the guiding function to promote the urbanization level of small and medium-sized cities crossing the inflection point. The central region should focus on the transformation and upgrading of resource-based cities and urban ecological management, increasing ecological environmental protection in the process of urbanization. The western region should continue to accelerate the new urbanization, improve infrastructure and enhance environmental management to improve the ecological carrying capacity of cities.

Conflict of interest: none

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Multidimensional Poverty Measurement and Poverty Reduction Effect Analysis — Based on the Survey Data of H County in Southern Shaanxi

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Abstract: This paper takes Southern Shaanxi, a national demonstration area of relocation for poverty alleviation, as the research object, uses the survey data of relocated farmers for poverty alleviation in southern Shaanxi, and uses the double boundary model (A-F model) to measure the Multidimensional Poverty Situation of local farmers before and after relocation, and analyzes the poverty reduction effect of relocation for poverty alleviation on relocated farmers. The study found that, on the whole, the relocation policy for poverty alleviation can effectively block the connection between farmers and the bad geographical capital of the relocation place, realize the spatial reconstruction, increase the disposable income of farmers, improve the accessibility of medical, educational and social entertainment activities, and realize the growth of the living capital and the enhancement of the livelihood ability of relocated farmers. Thus, it can effectively improve the Multidimensional Poverty Situation of relocated farmers, and has a significant poverty reduction effect. However, for different dimensions of poverty, the poverty reduction effects of relocation are quite different.

Key words: relocation for poverty alleviation; multidimensional poverty; poverty measurement; poverty reduction effect

JEL Classification: Q01; Q10; R10

1. Introduction

Poverty has always been an unavoidable major issue in human history. Similarly, poverty is also a major issue that hinders China's development and people's happy life. Shaanxi Province is a key province for poverty alleviation in China, with a large number of poor people, wide distribution and deep poverty degree. Especially in Hanzhong, Ankang and Shangluo cities in southern Shaanxi, because they are located in Qinba mountain area, they are invaded by natural disasters all year round, and the problem of poverty is particularly serious. The perennial natural disasters make the local ecology more fragile, and the safety of people's lives and property is threatened. The post disaster reconstruction also puts a heavy burden on families and the government, "it is difficult for one country to feed the people there". The harsh natural environment is accompanied by the poverty of the local people, and the accumulation cycle. The traditional way of poverty alleviation has encountered a bottleneck here. Relocation has become a historical and realistic necessity.

In the context of targeted poverty alleviation, Shaanxi, as a national demonstration site for relocation of relocation for poverty alleviation, officially started the relocation project of relocation for poverty alleviation in southern Shaanxi in May 2011. Now, the large-scale poverty alleviation and relocation work in southern Shaanxi has come to an end. At this time node, this paper first uses the first-hand research data in southern Shaanxi and uses the A-F double boundary method to measure the multidimensional situation of relocated farmers; Secondly, according to the measurement results, the multi-dimensional poverty changes of relocated farmers before and after relocation are obtained, which intuitively shows the poverty reduction effect of relocation of poverty alleviation in southern Shaanxi on relocated farmers, so as to provide an objective basis for the benefit evaluation of relocation of poverty alleviation and even targeted poverty alleviation; Finally, based on a deep understanding of the relocation difficulties faced by the relocated people in the first two steps, we put forward targeted countermeasures and suggestions to find a more reasonable and sustainable relocation plan. It is conducive to the relocated farmers with dual identities of farmers and immigrants, deal with the uncertainty caused by the change of living environment after relocation and resettlement, and further optimize the long-term benefits of relocation policies for poverty alleviation.

2. Literature Review

At present, the methods of poverty measurement are mainly divided into fuzzy set method (Cheli & Lemmi, 1995), axiomatic method (Bourguignon & Chakravarty, 2003), input-output efficiency method (Ramos & Silber, 2005), principal component analysis, multivariate correspondence analysis and other statistical methods. The fuzzy set method mainly includes three poverty fuzzy measurement methods, namely TFA complete fuzzy method, TFR complete fuzzy relative method avoiding the use of arbitrary threshold, and IFR comprehensive fuzzy relative method combining income cumulative distribution function with income Lorentz curve (Betti et al., 2006); Axiomatic method mainly measures multidimensional poverty by constructing indexes, which is the mainstream method of multidimensional poverty measurement at present, mainly including watts index (Chakravarty & Silber, 2008), FGT index (Foster et al., 2010), H-M index (Hagenaars, 1987), HDI human development index and HPI human poverty index (UNDP, 1997) Multidimensional Poverty Index MPI (UNDP, 2010), Ch-m index (Chakravarty et al., 1998, 2003; Tsui, 2002), F-M index (Chakravarty et al., 1998, 2003; Tsui, 2002), W-M index (Deutsch & Silber, 2005), multidimensional poverty assessment tool MPAT (Alasdair, 2010), A-F "double boundary" method (Alkire & Foster, 2011), etc. Among them, the Multidimensional Poverty Index MPI is a widely used multidimensional poverty measurement index system. A-F multidimensional poverty measurement method is also widely used because its measurement results are intuitive, easy to empirical analysis and insensitive to weight selection.

Some scholars in China are also constantly trying to explore and optimize the multidimensional poverty measurement method and index system. In terms of measurement methods, Li & Xu (2019) believe that the existing literature generally does not consider the impact of time factors on poverty characteristics, the subjective randomness of threshold setting

and unreasonable weight setting. In view of these three problems, the author improves the A-F method and complete fuzzy set method, and adjusts the weight coefficient at the same time. This makes it possible to highlight the impact of a certain dimension. In terms of index system, domestic scholars have expanded the HDI and MPI index system and added the dimensions of income, consumption and medical insurance on the basis of health, education and living standards (Long & Xie, 2018). Other scholars have paid attention to social capital (Liu & Xu, 2015) and subjective welfare, future confidence, life satisfaction and other dimensions (Xie, 2017).

3. Multidimensional Poverty Measurement and Poverty Reduction Effect Analysis of Relocated Farmers in Southern Shaanxi

By combing the literature, it can be found that the existing research mainly focuses on the qualitative research in the macro aspect, and the quantitative research in the micro aspect is relatively few. Based on this, this paper intends to take the relocated farmers for poverty alleviation in southern Shaanxi as the research object, measure and decompose their multidimensional poverty status by using the A-F method, compare the specific changes of farmers' Multidimensional Poverty Index before and after relocation by using the basic statistical analysis method, and analyze the actual poverty reduction effect of relocation on relocated farmers.

3.1. Data Sources

The data used in this paper comes from the farmers' relocation data obtained by the research group during the investigation of H county in southern Shaanxi in 2019. The investigation is conducted in the form of household questionnaire. A total of 167 questionnaires are distributed, 167 are recovered, 18 invalid questionnaires are excluded, and 149 valid questionnaires are left. The questionnaire contains 83 questions, mainly related to the basic situation of relocated farmers' families, annual income, personal development and social integration after relocation. The questions are mainly multiple-choice questions, and the options are "yes" or "no" and "very satisfied", "satisfied", "uncertain", "dissatisfied" and "very dissatisfied". Strive to fully reflect the changes in the production and life of relocated farmers before and after the relocation, so as to reflect the implementation status and existing problems of the relocation policy for poverty alleviation, and provide guidance for the next step.

3.2. Measurement of Multidimensional Poverty Index of Farmers

1. Introduction to the measurement method of A-F

The A-F method is proposed by Alkire and foster. The method is divided into three steps: first, identify the poverty object. In the process of identification, first set the poverty dimension and boundary. This boundary is divided into two layers: the inner boundary of the dimension and the outer limit of the dimension. The first boundary considers whether the identified object is deprived in each dimension. The second boundary determines whether they fall into multi-dimensional poverty by combining the deprivation results of each dimension. For this reason, this method is also called "double boundary method". Second, sum up the identification status

of multidimensional poverty. When summing up, first set the weight between each dimension in combination with the research purpose and data characteristics, so as to reflect the relative importance between different dimensions. Generally, the A-F method generally adopts the equal weight method in terms of indicators and dimensions, so as to calculate the poverty index on this basis. Third, decompose the poverty index and consider the contribution rate of each dimension to poverty. A-F method overcomes the insensitivity of FGT method to different

Table 1. Framework and critical value of multidimensional poverty index in rural areas

Dimension	Index	Indicator interpretation	Critical value (1 is assigned below the critical value)
Income (1/4)	Per capita net income (1/4)	Per capita net income is divided by the total household income by the number of households, and the specific value is adjusted to 2011 according to the price index.	Adopt the latest poverty line 2300 yuan (constant price in 2010) established by the government. If it is lower than this standard, it will be regarded as income poverty, and it will be assigned as 1, otherwise it will be assigned as 0.
Health (1/4)	Medical insurance (1/16)	Whether to join the new agricultural cooperative medical insurance.	Qualitative variables, "No" is assigned to 1, and "Yes" is assigned to 0.
	Pension insurance (1/16)	Whether to join the new agricultural cooperative endowment insurance.	Qualitative variables, "No" is assigned to 1, and "Yes" is assigned to 0.
	Nursing home/elderly service center (1/16)	Is there a nursing home or elderly service center in the new residence?	Qualitative variables, "No" is assigned to 1, and "Yes" is assigned to 0.
	Health status (1/16)	Self-evaluation of health status.	Qualitative variables, very unhealthy, unhealthy are assigned 1, and healthy, very healthy are assigned 0.
Education (1/4)	Years of education (1/8)	The highest years of education among family members.	If the highest educational years of family members are lower than the national legal compulsory education years (9 years), the value is 1; otherwise, the value is 0.
	Children attend school (1/8).	Have children aged 6-16 dropped out of school?	There are dropouts assigned as 1, and no dropouts assigned as 0.
life （1/4）	Domestic water (1/16)	Domestic water source: tap water, well water or others.	Qualitative variables, others are assigned as 1, and "tap water, bottled water, purified water and filtered water" is assigned as 0.
	Power-on condition (1/16)	Power-on condition: whether there is power-on or frequent power-off.	Qualitative variables, "no power" and "frequent power failure" are assigned as 1, while "occasional power failure" and "almost no power failure" are assigned as 0.
	Sanitation facilities (1/16)	Types of toilets: flush toilets, dry toilets and no toilets.	Qualitative variables, "dry toilet or no toilet" is assigned as 1, and "flushing toilet with water" is assigned as 0.
	Cooking fuel (1/16)	Main cooking fuels: firewood, coal, gas, natural gas, solar energy, biogas, electricity, etc.	Qualitative variables, "use firewood" is assigned as 1, and others are assigned as 0.

deprivation degrees among various dimensions of Multidimensional Poverty, and realizes the decomposability of Multidimensional Poverty aggregate index, which has very good quality.

2. Definition of dimensions and indicators

This paper refers to the structure of MPI in the Millennium Development Goals and human development report proposed by the United Nations, and describes Multidimensional Poverty from four dimensions of income, health, education and life, including 11 indicators, combined with the characteristics of the survey data (see Table 1 for details).

3. Identification of one-dimensional poverty

One dimensional poverty identification refers to determining whether an individual I is poor in a single dimension. Let I represent the sample individual, n represents the total number of samples, J represents a specific dimension of the study, and K represents the total dimension of poverty in the study design. If a critical value is set for each dimension, it can be used to judge whether individual I exceeds the critical value in dimension J. If it exceeds the critical value, it can be judged that individual I is poor in dimension J, which is recorded as 1. If it does not exceed the critical value, it is determined that individual I is non poor in dimension J, which is recorded as 0. In this way, n individuals can be determined.

This paper describes the Multidimensional Poverty Situation of relocated farmers for poverty alleviation in southern Shaanxi from the four dimensions of income, health, education and life. Therefore, the value of k is 4. Taking the family as the unit, the relocation data of 149 households are investigated, so the value of n is 149. When the element value is 1, it indicates that the household is poor in this dimension. When the element value is 0, It indicates that the household is non poor under this dimension.

Let q represent the number of individuals judged to be poor in dimension j, then the incidence of poverty in this dimension is H = q/n.

Table 2. Incidence of one-dimensional poverty in H county in southern Shaanxi

Poverty dimension		Income	Health	Education	Life
Incidence of poverty	Before relocation	11.24%	9.14%	8.98%	14.43%
	After relocation.	0.84%	7.42%	8.98%	2.01%

According to the above calculation method, we can calculate the poverty incidence rate of relocated farmers for poverty alleviation in southern Shaanxi in various dimensions. Specifically, the proportion of living poverty before relocation is the highest, followed by income poverty, and the incidence of health poverty and education poverty is basically the same, ranking third. After the relocation, the income poverty and living poverty decreased significantly, indicating that the relocation of poverty alleviation plays a significant role in alleviating the income poverty and living poverty of farmers, but the improvement of health poverty and education poverty is not obvious.

4. Identification and summation of multidimensional poverty

Multidimensional Poverty identification refers to determining whether an individual i is poor when multiple dimensions are investigated at the same time. Suppose d is the number of poverty dimensions examined at the same time. When studying Multidimensional Poverty, $d = 2, 3, 4,..., k$. Let c_i be the dimension number of Multidimensional Poverty of individual i. If $c_i \geq d$, it is determined that individual i is d-dimensional poverty, which is recorded as 1. If $c_i < d$, it is determined that individual i is non-poverty in d dimensions, which is recorded as 0.

On the basis of multidimensional identification, we can calculate how many individuals are in poverty under a certain dimension d. this process is called poverty aggregation.

On the basis of Multidimensional Poverty identification and aggregation, in order to enhance the sensitivity of the calculation results to the increase of poverty dimension, A-F method introduces a new parameter – average deprivation share A, which is used to express the average deprivation degree of individual i.

$$A_k = |c_i(k)|/(dq) \tag{1}$$

In formula (1), $c_i(k)$ represents the sum of the highest number of dimensions deprived of all individuals n under a specific number of dimensions k. It is easy to see that equation (1) averages $c_i(k)$ twice. The first time, that is, divide by d, averages all poverty dimensions faced by each individual i, and the obtained result represents the average deprivation degree of the individual in each dimension. The second time, i.e. dividing by q, is to average the poverty dimension level faced by all poor individuals, and the result represents the overall average deprivation degree of all individuals falling into poverty.

The Multidimensional Poverty Index M_0, $M_0 = AH$ can be obtained by combining the average deprivation share a with the incidence of poverty H.

Table 3. Multidimensional poverty index table of H county in southern Shaanxi

	d	Number of poor households q	Degree of poverty dimension $c_i(d)$	Incidence of poverty H	Average share of deprivation A	Multidimensional poverty index M_0
1	Before relocation	149	453	1.000	0.760	0.760
	After relocation	143	245	0.960	0.428	0.411
2	Before relocation	145	449	0.973	0.774	0.753
	After relocation	95	197	0.638	0.518	0.331
3	Before relocation	116	391	0.779	0.843	0.656
	After relocation	4	15	0.027	0.938	0.025
4	Before relocation	43	172	0.289	1.000	0.289
	After relocation	3	12	0.020	1.000	0.020

Through the above methods, combined with the survey data, we can calculate the Multidimensional Poverty Index Table of H county in southern Shaanxi (Table 3), which comprehensively reflects the poverty incidence, average deprivation share and

Multidimensional Poverty Index of relocated farmers in different dimensions, as well as the changes of these variables before and after relocation. Specifically, when d = 2, the incidence of poverty H in the relocation area before relocation is 0.973, that is, 97.3% of families are deprived in two or more dimensions, with an average deprivation share of 0.774, belonging to the multi-dimensional poor population, and the multi-dimensional poverty index M_0 is 0.753. When d = 3, the incidence of poverty H in the relocated area is 0.027, the share of poverty deprivation is 0.938, and the Multidimensional Poverty Index M_0 is 0.025. It can be seen that with the implementation of the relocation policy, the Multidimensional Poverty Index under different dimensions decreased significantly before and after relocation.

5. Decomposition of Multidimensional Poverty

The A-F Multidimensional Poverty Index has the excellent property of decomposability. Through decomposition, the contribution rates of different dimensions to the index can be calculated, so as to further analyze the specific impact of each dimension on poverty.

If the contribution of different dimensions to the Multidimensional Poverty Index is M, there is:

$$M = \sum_{i=1}^{n} \frac{c_i(k)}{nd} \qquad (2)$$

Where $c_i(k)$ represents the sum of the highest dimension number of all individuals n deprived under a specific dimension number k, n is the total number of individuals, and d is the number of poverty dimensions investigated at the same time. According to equation (2), the contribution rate of each dimension to the Multidimensional Poverty Index under different d values is calculated as follows (Table 4).

Table 4. Contribution rate of each dimension to multidimensional poverty index under different D values (%)

d		M_0	Income	Health	Education	Life
1	Before relocation	0.760	14.79	32.89	23.62	28.70
	After relocation.	0.411	2.04	53.06	43.67	1.22
2	Before relocation	0.753	14.92	32.29	23.83	28.95
	After relocation.	0.331	2.54	48.22	47.72	1.52
3	Before relocation	0.656	16.11	29.67	26.09	28.13
	After relocation.	0.025	26.67	26.67	26.67	20.00

According to the decomposition results of Multidimensional Poverty Index, the Multidimensional Poverty of relocated poverty alleviation farmers in southern Shaanxi has the following characteristics:

a) Before the relocation, the internal contribution rate to poverty in each dimension showed a stable trend, and this trend remained stable in different dimensions. For example, in the income dimension, when d = 1 before relocation, the contribution rate of this dimension is 14.79%, when d = 2, the contribution rate of this dimension is

14.92%, and when d = 3, the contribution rate of this dimension is 16.11%, showing a fairly stable trend, which also exists in the other three dimensions;

b) Before relocation, the contribution rate of each dimension to the Multidimensional Poverty Index was relatively average. For example, when d = 1, the contribution rate of income dimension is 14.79%, the contribution rate of health dimension is 32.89%, the contribution rate of education dimension is 23.62%, and the contribution rate of life dimension is 28.70%. The contribution level is basically maintained at around 25%, and there is no significant change with the increase of poverty dimension;

c) After the relocation, the internal contribution rate of each dimension changed significantly. When d = 1 and d = 2, the change of income dimension and life dimension is the most significant. When d = 1, the contribution rate of income dimension decreased from 14.79% to 2.04%, a decrease of more than 85%, and the contribution rate of life dimension decreased from 28.70% to 1.22%, a decrease of more than 95%, indicating that the relocation of poverty alleviation plays a significant role in reducing the income poverty and living poverty of relocated farmers; This law is also applicable when d = 2;

d) After the relocation, the contribution rate of each dimension to the multidimensional poverty index changed significantly. Take d = 1 as an example. When d = 1, the contribution rate of income dimension is 2.04%, the contribution rate of health dimension is 53.06%, the contribution rate of education dimension is 43.67%, and the contribution rate of life dimension is 28.70%. This law also appears when d = 2;

e) Among all dimensions, the contribution rate of health dimension and education dimension is the most prominent, and the contribution rate increases slightly after relocation. It can be seen that the contribution rate of health and education dimensions is basically maintained at about 30%, sometimes even 50%. The comprehensive contribution of health and education dimensions to poverty basically accounts for more than half of the total poverty index. The reason is that the relocation policy can only improve the availability of medical resources for relocated farmers in a short time, but cannot improve the health status of farmers in a short time, which has a lag effect. At the same time, the respondents in this survey are generally over 40 years old, and their education level is generally low, resulting in a large contribution rate of educational poverty to the Multidimensional Poverty Index, which cannot be changed in the short term by the relocation policy of local poverty alleviation;

f) The contribution rate of health dimension and life dimension to poverty before relocation is large, and the contribution rate of health dimension and education dimension to poverty after relocation is large, indicating that relocation can effectively reduce the living poverty of relocated farmers, but has no significant effect on reducing health poverty. At the same time, it can be seen that relocation for poverty alleviation also plays a significant role in reducing farmers' income poverty.

4. Conclusion and Policy Recommendations

4.1. Research Conclusion

Based on the field survey data of H county in southern Shaanxi, this paper uses the A-F multi-dimensional poverty measurement method to measure the multi-dimensional poverty status of relocated farmers before and after relocation, and obtains the multi-dimensional poverty index, which intuitively explains the impact of the relocation policy of poverty alleviation on the multi-dimensional poverty status of relocated farmers. On this basis, the Multidimensional Poverty Index is decomposed to obtain the impact proportion of different dimensions on Multidimensional Poverty, and effectively identify the impact of relocation of relocation for poverty alleviation on each dimension of poverty. The main conclusions are as follows:

1. On the whole, the relocation policy has a significant impact on Farmers' multidimensional poverty. The relocation policy of poverty alleviation can effectively block the connection between farmers and the bad geographical capital of the relocation place, realize spatial remodeling, significantly improve the overall livelihood capital level of relocated farmers, enhance the sustainable livelihood ability of relocated farmers, and have a significant effect on poverty reduction;

2. However, for different dimensions of poverty, the poverty reduction effects of relocation are quite different. Specifically, relocation for poverty alleviation has a significant positive effect on reducing poverty in income dimension and life dimension, but it has no significant impact on poverty in health dimension and education dimension;

3. Different from the "intervention" poverty of relocated farmers caused by relocation due to large-scale projects, relocation for poverty alleviation can significantly improve the Multidimensional Poverty of farmers by increasing their disposable income, improving the accessibility of medical, educational and social entertainment activities, as well as housing and quality of life.

Overall, the relocation of poverty alleviation in southern Shaanxi in the past decade has achieved remarkable results, successfully achieved the goal of poverty reduction, and the situation of relocated farmers has been greatly improved. We explored a relocation path of poverty alleviation combined with the actual situation, and found a sustainable relocation way of poverty alleviation.

4.2. Policy Recommendations

The implementation of the relocation policy can be roughly divided into two stages: one is how to make poor farmers willing to move and how to move, so as to "move and live stably". The second is how to help farmers get rid of poverty and integrate into the resettlement site after relocation, so as to "get rich and integrate well". At present, the task of the first phase of the relocation project has been basically completed. The implementation of targeted Poverty Alleviation Policies, policy performance evaluation and policy optimization should focus on the second stage, that is, helping poor farmers achieve stable poverty alleviation and social

integration after relocation, and doing a good job in the "second half of the article" of poverty alleviation and relocation in other places. Based on this, combined with the effect of poverty reduction, the relocation policy for poverty alleviation should be optimized in the following three aspects:

a) In the post poverty alleviation era, we should continue to strengthen relocation poverty alleviation, strengthen sustained policy support, give full play to the leading role of the government, take employment and income increase as the core, enhance the endogenous development ability of farmers, build a long-term mechanism for poverty reduction and development, reduce the risk of returning to poverty of vulnerable farmers, and completely solve the situation of "people poor" due to "land poverty";

b) In view of the fact that relocation has no significant impact on health and education poverty, in the process of poverty alleviation in the future, we should launch corresponding targeted measures to improve the accessibility of medical and educational resources of the relocated people in the relocated areas, and connect the basic social security such as the new rural cooperative medical system, the new rural social security system and the minimum living security system for the relocated farmers, Ensure that the basic social security of relocated farmers is not lower than the level of resettlement sites, and build high-quality and reliable schools in the centralized resettlement areas to further eliminate poverty caused by education and health;

c) We should actively integrate the relocation project for poverty alleviation with the Rural Revitalization Strategy, consolidate and improve the results of targeted poverty alleviation of the relocation project, and realize the stable lifting of relocated farmers out of poverty.

Conflict of interest: none

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The Forecast and Analysis of Peak Carbon Dioxide Emissions in China

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Abstract: China's commitment to carbon emission peak in 2030 has been universally recognized by the international community, but some foreign research institutions and media still question whether China can reach the peak on time. In view of this, this article is based on the STIRPAT model, using national energy consumption and economic development data from 2000 to 2018, to predict China's carbon emission peak under five scenarios: low-carbon scenario, baseline scenario, high-energy consumption scenario, industrial structure optimization scenario, and technological energy saving scenario. The study found that: under the baseline scenario, China's carbon emission will reach peak in 2032, later than the 2030; under the low-carbon scenario, China's carbon emission will reach peak in 2028; and under the high-energy scenario, China's carbon emissions will peak in 2028. Carbon emissions cannot reach its peak before 2040; the peak year of the industrial structure optimization scenario and the technological energy-saving scenario are the same. The peak value of the industrial structure optimization scenario is 409 million tons lower.

Keywords: STIRPAT model; carbon emission; scenario analysis; carbon emission peak forecast

JEL Classification: C51; O14; Q56

1. Introduction

In the face of increasingly severe climate change and the resulting catastrophic impacts, how to effectively deal with global climate change and achieve win-win results in ecological environment and economic development is an important issue of general concern to all countries and regions. As the world's leading carbon emitter, China is also contributing to the fight against climate change and is committing to the world that "China's co-emissions efforts will peak by 2030 and achieve carbon neutrality by 2060".To this end, the Chinese government has formulated a policy system of '1+N' to achieve carbon peak and carbon neutrality from the national-regional-industry level, and has further promoted co-emissions from ten aspects, such as optimizing the energy structure, promoting industrial optimization and upgrading, developing circular economy and green finance, and promoting economic and social development based on the efficient use of resources and green and low-carbon development. We will accelerate the realization of green revolution in production and lifestyle, and push China's carbon peak target to be achieved by 2030.

The forecast analysis of China's carbon emission trends is now focused on the following two aspects. First, scholars use different economic models (Zhu Yongbin et al., 2009; Martin et al., 2016) or energy models (Jiang Kejun, 2009) to predict China's future carbon dioxide emissions. Using the STIRPAT model, Qu Shen-ning (2010) predicted the peak of carbon emissions in China in the future and concluded that if China's economic and social development while maintaining a continuous decline in carbon intensity, the peak time of carbon emissions should be between 2020 and 2045. Second, researchers analyze the carbon dioxide emission trend in China under different scenarios from the national level (Lin Boqiang et al., 2015), the regional level (Deng Xiaole et al., 2016; Pan Dong et al., 2021) and the industry level (Guo Juan et al., 2011; Guo Chaoxian, 2014; Liu Tian et al., 2015; Wang Yong et al., 2019). Yuan Xiaoling et al. (2020) forecast the carbon emissions peak of China's Ministry of Industry as a whole and eight sub-sectors, and believed that under the low-carbon scenario, all industries could reach the peak by 2030.

To sum up, scholars from different levels, and use a variety of forecasting models, came up with a lot of predictions about China's carbon emission peak and peak time, but specifically for the national level of carbon emission peak forecast, the existing literature set the peak scenario is more single and general, failed to accurately identify the structure and technology and other factors of the emission reduction effect. At the same time, existing literature has been used coal consumption as a proportion of primary energy consumption to set energy structure indicator, the assessment of the impact of energy structure may be biased. Therefore, on the basis of selecting the proportion of non-fossil energy as the index of energy structure, this paper effectively identifies the effect of structural factors and technical factors on China's carbon peak by refining the low, medium and high development scenarios at the national level.

2. Methodology

2.1 Model Building

Originally proposed by Ehrlich and Holden in 1971, the IPAT model is widely used to test the environmental impact of human activities, with the expression:

$$I = P \times A \times T \tag{1}$$

Among them, I represents environmental pressure, generally expressed in terms of resources energy consumption and greenhouse gas emissions; P indicates population size; A is the degree of affluence, in terms of the level of economic development; T stands for the level of technology.

However, formula (1) is only a simplified form of measuring environmental pressure, with certain limitations, it defaults that different factors contribute the same to environmental pressure, which contradicts the environmental Kuznets curve hypothesis. To overcome the limitations of this model, Dietz and Rosa (1997) based on the IPAT model and propose the STIRPAT model with the expression:

$$I = aP^b A^c T^d e \tag{2}$$

In order to facilitate the study, logarithms are generally taken on both sides of the model at the same time to obtain:

$$lnI = lna + blnP + clnA + dlnT + e \tag{3}$$

Where *I* represents environmental pressure, *P* represents population size, *A* indicates the degree of affluence, *T* represents technical level; *a* is the model coefficient, and *b, c, d* represent the elasticity coefficients of P, A and T respectively, and *e* is the error term.

In addition to population size, level of economic development and technology, environmental pressure is also affected by many social factors. In view of this, many scholars have expanded the STIRPAT model to include factors such as urbanization rate, industrial structure, energy structure and energy intensity. Therefore, on the basis of reference to previous studies, this paper selects population, per capita GDP, urbanization rate, industrial structure, energy intensity and energy structure as the factors affecting China's carbon emissions, and at the same time, in order to verify the nonlinear relationship between carbon dioxide emission and economic growth, the quadratic term of GDP per capita is added to the model, and the final expression of STIRPAT model is:

$$lnI = lna + blnP + clnA + d(lnA)^2 + flnU + glnIS + hlnEI + jlnES + lne \tag{4}$$

Where *I* represents carbon dioxide emission, *P* is population size, *A* is GDP per capita, *U* is urbanization rate, *IS* is industrial structure, *EI* is energy intensity, *ES* is the energy structure, *a* is the model coefficient, *b, c, d, f, g, h* and *j* are the elasticity coefficients of each variable, and e is a random error term.

Table 1. Description of China's carbon emissions forecast model variables

variable	symbol	indicator description	unit
carbon emissions	I	energy-related CO2 emissions	100 million tons
population size	P	year-end resident population	100 million people
GDP per capita	A	gross regional product/resident population	10 thousand yuan
urbanization rate	U	proportion of urban residents to the total population	%
industrial structure	IS	output value of the secondary industry / the GDP of the region	%
energy intensity	EI	energy consumption per unit of GDP	%
energy structure	ES	non-fossil energy consumption / the total energy consumption	%

2.2 Data Sources

This paper uses data at the national level from 2,000 to 2018, in which data on population size, GDP per capita, urbanization rate and industrial structure are derived from the China Statistical Yearbook, and data on energy consumption are derived from the China Yearbook of Energy Statistics, and the energy consumption is used to calculate the carbon dioxide emission at the national level from 2000 to 2018.

In order to calculate China's overall carbon emissions, this paper divides the carbon emissions from energy consumption into two parts, one is the direct carbon emissions from the combustion of eight fossil fuels, such as coal, coke, crude, gasoline, kerosene, diesel, fuel

oil and natural gas, and the other is the indirect carbon emissions from electricity consumption. Referring to the calculation method in the IPCC National Greenhouse Gas Inventory Guide 2006 to measure the carbon emissions from China's energy consumption using the carbon emission coefficients of various energy sources, the specific calculation formula is as follows:

$$C = 44/12 \times \sum_{j=1}^{8} E_j \times F_j \times W_j \tag{5}$$

where C is carbon emissions, 44/12 represents the mass fraction of carbon in CO2, E_j is the consumption of the j-th energy source, and F_j is the jth the discount coal coefficient of the energy source; W_j is the carbon emission coefficient for the jth energy source. The discount coal coefficient and carbon emission coefficient for 8 types of energy and electricity are derived from the calculation of Li Xinyun et al. (2014).

Table 2. Discount coal and carbon emission coefficient for each category energy

	coal	coke	crude	gasoline	kerosene	diesel fuel	fuel oil	natural gas	electricity
The discount coal coefficient	0.7143	0.9714	1.4286	1.4714	1.4714	1.4571	1.4286	1.33	0.1229
Carbon emission coefficient	0.7559	0.8556	0.586	0.5538	0.5743	0.5919	0.6185	0.4483	0.2678

3. Results

3.1 Analysis of Regression Result of STIRPAT Model

Considering the multicollinearity between the influencing factors in the STIRPAT model, this paper fits the model through ridge regression, which improves the algorithm based on the least squares method and eliminates the collinearity between factors by adding factor *k* to the main diagonal of the elements of the standardized matrix, thus effectively improving the estimated stability.

Using SPSS26 to regress the model and observe the ridge trace diagram, it can be found that when k is 0.1, the change of the respective variable ridge map tends to be stable, the decisive coefficient of the model R2 is 0.986, and the Goodness of Fit is high. It is shown that the model regression is ideal, and the regression result is:

$$lnI = 4.3798lnP + 0.211lnA + 0.0482(lnA)^2 + 2.4703lnU + 4.888lnIS \tag{6}$$
$$- 0.3559lnEI - 1.8028lnES - 9.8675$$

Through the results of the regression, it can be found that the population, per capita GDP, industrial structure and urbanization rate have positive impact on carbon emissions, especially the population and industrial structure have a strong positive impact on carbon emissions, and for every 1% increase in population and industrial structure, carbon emissions will increase by 4.3798% and 4.88% respectively. The coefficient of energy structure is negative, which indicates that the increase of non-fossil energy consumption can effectively reduce carbon emissions. The square term coefficient of GDP per capita is positive, indicating

that there is no significant "inverted U" relationship between carbon emissions and economic growth.

3.2 Settings for Different Carbon Emission Scenarios

In order to explore China's carbon emission path under different economic development situations, this paper uses scenario analysis to forecast China's future carbon emissions. First of all, set the change range of population, per capita GDP, urbanization rate, industrial structure, energy structure and energy intensity according to the low, medium and high values, and then according to the magnitude of change to calculate the prediction of the various factors, and finally substitute the forecast value of each factor into the regression model to obtain the predicted value of carbon emission. In the median, the rate of change for each influencing factor from 2021 to 2025 is set in reference to the 14th Five-Year Plan and the rate of change after 2025 is set by reference to the 2035 long-term plan. After that, the median is adjusted appropriately to obtain the rate of change of the influencing factors in the low and high values. Five scenarios are created based on three different levels of change, as shown in Table 3.

Table 3. Settings of carbon emission scenarios

scenario setting	Level of change					
	population size	GDP per capita	urbanization rate	industrial structure	energy intensity	energy structure
low-carbon	low	low	low	low	low	low
the benchmark	middle	middle	middle	middle	middle	middle
high energy consumption	high	high	high	high	high	high
the optimization of industrial structure	middle	middle	middle	low	middle	middle
technology energy-saving	middle	middle	middle	middle	low	low

Table 4. the fluctuation range of the main influencing factors

fluctuation range of variables	year	rate of change					
		population size	GDP per capita	urbanization rate	industrial structure	energy intensity	energy structure
low value	2021-2025	0.15%	5.00%	1.00%	-1.00%	-4.00%	5.00%
	2026-2030	0.00%	4.50%	0.50%	-0.75%	-2.00%	4.50%
	2031-2040	-0.15%	4.00%	0.30%	-0.35%	-1.00%	4.00%
median	2021-2025	0.20%	5.00%	1.50%	-0.75%	-3.50%	4.50%
	2026-2030	0.05%	4.00%	1.00%	-0.50%	-1.50%	4.00%
	2031-2040	-0.10%	3.00%	0.50%	-0.10%	-0.50%	3.50%
high value	2021-2025	0.25%	5.50%	2.00%	-0.50%	-3.00%	4.00%
	2026-2030	0.10%	4.50%	1.50%	-0.25%	-1.00%	3.50%
	2031-2040	-0.05%	3.50%	1.00%	-0.05%	-0.25%	3.00%

The change rate of each influencing factor is set at the median level in the benchmark scenario. Assuming that the variables grow at a moderate rate, and the specific setting of the change rate of each influencing factor refers to the development goals formulated in the 14th

Five-Year Plan to reflect the smooth operation of China's future economic development. Low-carbon scenarios and high-energy consumption scenarios are adjusted under benchmark scenarios. At the same time, the optimization scenario of industrial structure is to keep the industrial structure at a low level, and the change rate of other influencing factors is set to the median level, while the technology upgrading scenario is to set the energy intensity and energy structure at a low level, and the other influencing factors to maintain the median level. The change in the growth values of each variable in different scenarios is shown in Table 4.

4. Prediction and Analysis of China's Carbon Emission Peak

4.1. Prediction and Analysis of China's Carbon Emission Peak in Different Scenarios

According to the regression results of STIRPAT model, China's carbon emissions in 2018-2040 under different scenarios are calculated, as shown in Figure 1. It can be seen that there are differences in peak carbon dioxide emissions time and peak value in different scenarios. Under the benchmark scenario, China's carbon emissions will reach the peak in 2032, with the peak value of 17.417 billion tons. The peak time of the benchmark scenario is later than the target time of peak in 2030, which indicates that if the current policy trend is followed, China will not be able to achieve the peak target as scheduled.

The peak situation of low-carbon scenario and high-energy scenario is quite different. Under the low-carbon scenario, China's carbon emissions will reach the peak of 15.27 billion tons in 2028, while under the high-energy scenario, China's carbon emissions will not reach the peak before 2040. As far as the low-carbon scenario is concerned, because all factors affecting carbon emissions are low, the peak time of carbon emissions is earlier than that of the baseline scenario, and the peak value is 2.147 billion tons lower than that of the baseline scenario. The high-energy consumption scenario is just the opposite to the low-carbon scenario. Under the condition that all the influencing factors are high, the carbon emissions are increasing year by year, and have not reached the emission peak before 2040, which indicates that the extensive development model aiming at economic growth is far from achieving the peak target in 2030.
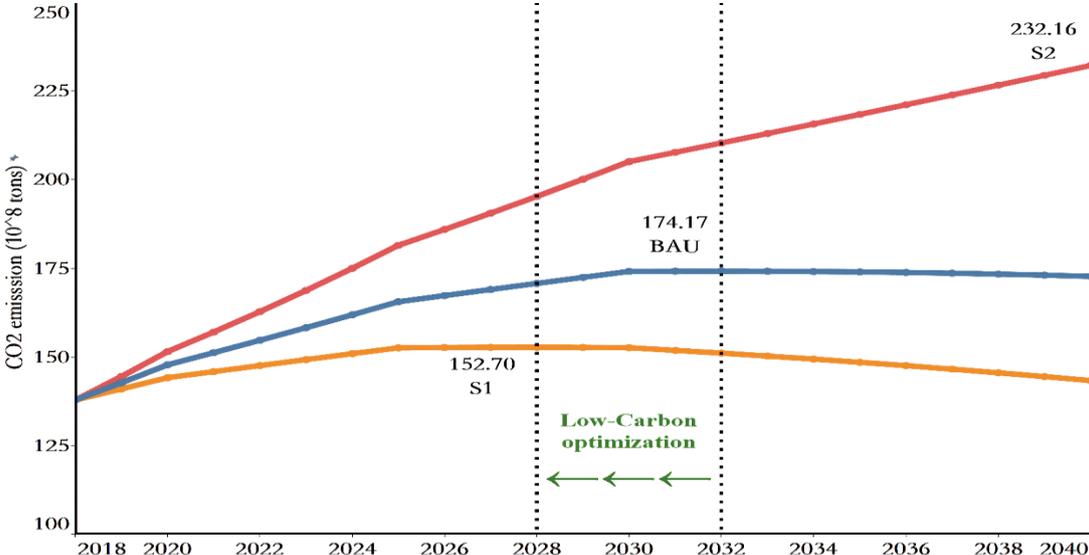
Figure 1. Trend forecast of China's carbon dioxide in the low carbon-benchmark-high energy consumption

Secondly, Figure 2 shows the prediction and analysis results of technical energy-saving scenarios and structural optimization scenarios. It can be seen that the peak years of the industrial structure optimization scenario and the technical energy saving scenario are the same, and the carbon emissions will reach the peak in 2030, with the peak values of 17.152 billion tons and 16.743 billion tons respectively. Compared with the baseline scenario, it is found that the industrial structure optimization scenario makes the peak time of China's carbon emissions advance by two years, which is in line with the target of 2030, and the peak value is reduced by 265 million tons compared with the peak value under the baseline scenario, which indicates that on the basis of the existing development plan, the traditional industries can be optimized and upgraded by curbing the blind development of industries with high energy consumption and high emissions, so that China's carbon emissions can reach the peak value in 2030 as expected. Compared with the baseline scenario, China's peak carbon dioxide emissions time under the technical energy-saving scenario is also two years ahead of schedule, reaching a peak value of 16.743 billion tons in 2030, which is 674 million tons lower than that under the baseline scenario. This shows that the increase of the proportion of non-fossil energy and the improvement of energy consumption efficiency play an important role in realizing China's peak carbon dioxide emissions path. At the same time, it is worth noting that although both the industrial structure optimization scenario and the technological energy-saving scenario will peak in 2030, there are differences in their peak values, and the technological energy-saving scenario is 409 million tons lower than the peak value of the industrial structure optimization scenario, which shows that the effect of technology on carbon emission reduction is greater than that of industrial structure adjustment.
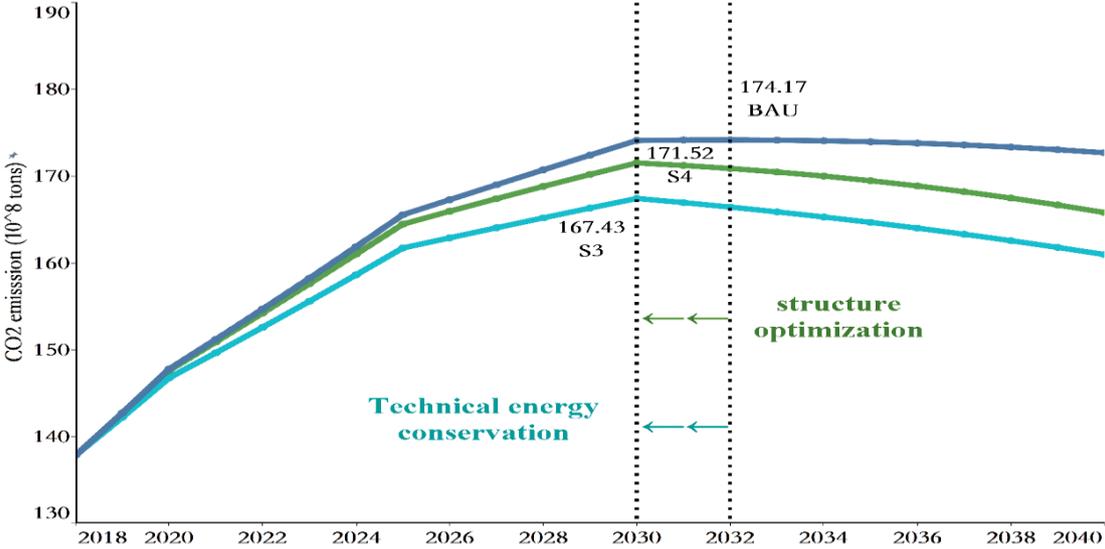
Figure 2. Trend prediction of carbon dioxide in China under different scenarios

4.2. Comparative Analysis of China's Carbon Emission Reduction Potential under Different Scenarios

By comparing the peak value in different scenarios with the baseline scenario, it can be found that the emission reduction potentials of low-carbon scenarios, industrial structure optimization scenarios and technology-saving scenarios are quite different. The low-carbon

scenario has the greatest emission reduction potential of 2.147 billion tons, and its emission reduction potential far exceeds that of other scenarios adjusted and optimized based on the baseline scenario, as shown in Table 5. It can be seen that the emission reduction potentials of the industrial structure optimization scenario and the technical energy-saving scenario are relatively small, which are 265 million tons and 674 million tons respectively, which indicates that the emission reduction effect brought by single or partial factor changes is not significant compared with the comprehensive adjustment of the change levels of various factors affecting China's carbon emissions, and the policies set for industrial structure and technological development may be ineffective, thus affecting the realization of China's peak carbon dioxide emissions goal in 2030.

Table 5. The peak year, peak value and emission reduction potential of China's carbon emissions under different scenarios

Scenario	Peak year	Peak/100 million tons	Emission reduction potential/hundred million tons
Low-carbon	2028	152.7	21.47
Benchmark	2032	174.17	/
High energy consumption	Didn't reach the peak before 2040	/	/
Industrial structure optimization	2030	171.52	2.65
Technical energy-saving	2030	167.43	6.74

5. Conclusions and Policy Implications

Based on STIRPAT model, this paper uses the data of energy consumption and economic development from 2000 to 2018 at the national level, and according to the government's recent development plan and the forecast of future development trend, sets up five different development scenarios to predict the peak time and peak value of China's overall carbon emissions. The results show that under the baseline scenario, China's carbon emissions will reach the peak in 2032, with the peak value of 17.417 billion tons, and the peak time will be later than 2030. Under the low-carbon scenario, China's carbon emissions will reach its peak in 2028, with the peak value of 15.27 billion tons. Under the scenario of high energy consumption, China's carbon emissions will not reach the peak before 2040; The peak years of the industrial structure optimization scenario and the technical energy-saving scenario are the same, and the carbon emissions will reach the peak in 2030, which is lower than that of the benchmark scenario, which is 17.152 billion tons and 16.743 billion tons respectively, and the technical energy-saving scenario is 409 million tons lower than that of the industrial structure optimization scenario.

In view of the current situation and trend analysis of China's carbon emissions, this paper puts forward the following policies to further serve China's 30-60 carbon targets, as follows:

First, optimize the industrial structure and develop a low-carbon economy. The government actively guides the optimization, upgrading and technological transformation of traditional industries to improve the energy utilization efficiency of traditional industries; Vigorously

cultivate sustainable industrial development and promote low-carbon industrial development. Secondly, vigorously promote green and clean energy and speed up the adjustment of energy structure. Advocate the use of clean energy, increase the proportion of renewable energy, reduce the dependence on fossil energy such as coal, encourage enterprises to develop and use clean energy, and subsidize polluting industries with low-carbon transformation, so as to optimize energy utilization structure and improve emission reduction efficiency. Finally, improve the implementation and efficiency of emission reduction policies. Government environmental departments should strengthen the inspection and supervision of environmental quality and strengthen the construction of law enforcement ability; Considering the economic development and environmental carrying capacity, the implementation efficiency of emission reduction policies in different situations will be continuously improved.

Conflict of interest: none

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Research on the Influence Mechanism of China's Natural Capital Investment on Economic Growth – Empirical Analysis Based on 30 Provincial Panel Data

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Abstract: This paper studies whether and how natural capital investment can become a new driving force for economic growth that promotes the construction of ecological civilization. The Cobb-Douglas production function model is extended, adding natural capital investment variables, and hypotheses: one is that natural capital investment directly promotes economic growth, and the other is that natural capital investment indirectly promotes economic growth through human capital channels. Finally, empirical regression is carried out on China's provincial panel data from 2006 to 2020 to test the direct and indirect impact mechanisms of natural capital investment on economic growth, as well as the existing regional differences. Natural capital investment not only directly promotes economic growth, but also promotes the accumulation of human capital, which in turn promotes economic growth indirectly. The forestry investment and ecological restoration and treatment investment in the eastern and central regions have a more obvious role in promoting economic growth, and the investment in industrial pollution control and urban environmental infrastructure construction investment in the western and northeastern regions have a more obvious role in promoting economic growth. Therefore, it is necessary to make overall design, rational planning, increase investment in natural capital, and inject new kinetic energy into economic growth.

Keywords: natural capital investment; economic growth; extended Cobb-Douglas production function; direct effect mechanism; indirect effect mechanism

JEL Classification: O33; O44

1. Introduction

The great success of China's economy over the past four decades has been built on the basis of massive consumption and waste of natural resources, destruction and sacrifice of the ecological environment. In 2020, the soil erosion area in my country is 2.6927 million km², accounting for 28.15% (The data comes from Bo (2021, June 8)) of the national land area. As of 2014, the national desertified land area was 2.6116 million km², accounting for 27.2% of the total land area; The total area of desertified land in the country is 1.7212 million square kilometers, accounting for 17.93% of the total land area (The data comes from Tu Zhifang, & Sun Tao (2016)). The new growth journey must take into account the depletion of natural capital, which is difficult to replace and prone to irreversible tipping points and collapse (Stern et al., 2020). The Chinese government pledged to the world on September 22, 2020 that carbon emissions will peak by 2030 and

carbon neutrality will be achieved by 2060 (Xinhua News Agency (2022, March 3)). This means that China's investment structure and national wealth will change, and more and more investment will flow into the field of natural capital.

Growth is driven by capital accumulation. As far as the impact of natural capital on economic growth is concerned, most scholars have analyzed theories or theoretical models, regarded natural capital as an input factor of economic output, and attached importance to the connection between natural capital and other capitals (Bi, 2004; Shi & Liu, 2004). Some scholars have conducted data analysis based on China's actual situation, and the results show that China's natural capital and economic growth are closely related (Hu & Wang, 2005; Zhao, 2012; Qi et al., 2015; Xue et al., 2016; Yang, 2017; Ma et al., 2017). However, there are few and limited studies on the impact of natural capital investment on economic growth. Pan (2019) systematically analyzed the mechanism of ecological, economic and social effects of agro-ecological capital investment. The research of Yu et al. (2020) shows that the double growth of GDP and natural capital can be achieved through natural capital investment. The above literature has deepened our understanding of the importance of natural capital, but most studies regard natural capital as a constraint rather than a driving factor, ignoring the multi-dimensional characterization of natural capital investment and ignoring the contribution of natural capital investment to economic growth.

The marginal contribution of this paper is that, first, it tries to answer whether natural capital investment has an impact on economic growth, and proposes the direct and indirect effects of natural capital investment on economic growth. Second, select the panel data of 30 provinces and cities from 2006 to 2020 for empirical analysis to verify that natural capital investment not only directly promotes economic growth, but also promotes the accumulation of human capital, which in turn promotes economic growth indirectly.

2. Methodology

When analyzing economic growth, Solow's economic growth model is generally used, and the production function is the Cobb-Douglas (C-D) production function. When discussing the impact of natural capital investment on economic growth, the impact of physical capital on economic growth should also be added. Therefore, we divide capital investment into fixed asset investment K and natural capital investment E, and introduce natural capital investment into the production function. The newly expanded economic growth model is shown in Formula 1 as follows:

$$Y_t = A(t)f(K_t, E_t, L_t) = A(t)K_t^{\beta}E_t^{\alpha}L_t^{\gamma} \tag{1}$$

After taking the logarithm of both sides of the formula, draw on the research idea of Yu (2015), use natural capital investment to replace the log value of total factor productivity, and other influencing factors are included in the random error term of the measurement equation, and the conduction variable X is used to calculate the factor of production. Simple substitution, to get:

$$lnY_t = f(lnK, lnE, lnX) \tag{2}$$

$$lnX = f(lnE_t) \tag{3}$$

According to Formula 2 and Formula 3, the hypothesis to be verified in the empirical part of this paper is proposed:

Hypothesis 1: Natural capital investment directly promotes economic growth.

Hypothesis 2: Natural capital investment brings human capital accumulation, and human capital can promote economic growth, so natural capital investment indirectly promotes economic growth through human capital channels.

Drawing on the ideas of Yan (2012), Acemoglu et al. (2014) and Ma (2017), the measurement equation is set as shown in Formula 4:

$$lnY_{it} = alnL_{it} + blnK_{it} + \alpha_1 lnFI_{it} + \alpha_2 lnEI_{it} + \alpha_3 lnWI_{it} + \alpha_4 lnCI_{it} + \mu_{it} \tag{4}$$

Among them, direct natural capital investment is measured by forestry investment (*FI*) and ecological restoration and treatment investment (*EI*), and indirect natural capital investment is measured by industrial pollution control investment (*WI*) and environmental infrastructure construction investment (*CI*). *i* represents the province, *t* represents the year, and μ represents the random disturbance term.

According to the measurement model established above, relevant data on economic growth, fixed asset investment, natural capital investment and human capital indicators are required. The characterization and specific meanings of each variable are as follows:

- Economic growth: Y. Economic growth is the explained variable, and the per capita gross domestic product (GDP) or its logarithm of each province, city and region is selected as the measure.

- Natural capital investment: E. As the core explanatory variable, natural capital investment is an important basis for empirical analysis. Here, natural capital investment is divided into direct investment and indirect investment. Based on data availability, it can be represented by the following data: First, forestry investment (FI) and ecological restoration and governance investment (EI), which aim to directly invest in natural capital and increase the Stocks improve quality, improve the stability and restoration of natural ecosystems, and create more ecosystem products and services. The second is investment in industrial pollution control (WI) and investment in environmental infrastructure construction (CI), which aim to slow down or reduce the waste of natural capital and reduce the negative externality of environmental pollution. Renewable energy investment should be one of the important indicators. Due to the lack of investment data for most provinces, cities and regions, it was not included as a measure.

- Forest coverage rate: forestcover. As the main body of the terrestrial ecosystem, forests not only provide human beings with forestry products such as timber, but also can effectively improve the ecological environment. The forest coverage rate here is represented by the ratio of forest saving area to each province, city or region.

- Human capital: L. There are two common ways to measure human capital: one is the proportion of education expenditures in government financial expenditures, and the other is the average years of education. Referring to the methods of Liu (2014), Yang et al.

(2016), and Ma (2017) to measure human capital, the average years of education are used to measure human capital. By summarizing, sorting, and calculating the data of the "China Statistical Yearbook", it is divided into five parts: illiterate, primary school, junior high school, high school, college and above. The years of education are 0, 6, 9, 12, and 16 years respectively. The calculation formula is as follows: Average years of education = (number of primary school graduates * 6 + number of junior high school graduates * 9 + number of high school graduates * 12 + number of college graduates and above * 16) is divided by (number of people aged six and above), you can get the human capital of each province and city for 15 years changes.

- Physical capital: K. my country's economic growth is highly dependent on fixed asset investment, and China's past economic growth was largely driven by fixed asset investment (Zhao, 2011). The empirical results are more realistic.

- In order to make the empirical results more accurate, the "urban" control variable of urbanization level is also added, which can affect economic growth to a certain extent and is expressed by the urbanization rate.

The empirical analysis uses the cross-sectional data of 30 provinces, cities and regions (excluding Tibet) in the country from 2006 to 2020. The data comes from the "China Statistical Yearbook" and "China Environmental Statistical Yearbook", which is operated on StataSE15.

3. Results and Discussion

3.1. The Direct Effect Mechanism Test of the Impact of Natural Capital Investment on Economic Growth

After passing the unit root test and cointegration test, the fixed effects model was selected. First, we examine the direct effect mechanism of natural capital investment on economic growth. The results are shown in Table 1. The data in the first column does not consider the impact of physical capital, human capital, openness, and urbanization rate on economic growth. In addition to the investment in ecological restoration and governance, forestry investment, environmental pollution control investment, urban infrastructure construction investment and forest coverage rate have all contributed to economic growth, and the statistics are significant at the 1% level. This may be due to insufficient investment in ecological restoration and governance. At present, the main source of investment in ecological restoration and governance is national financial funds, and the participation of social capital and multiple market players is not high. The natural capital stock represented by forest coverage can effectively promote economic growth, further demonstrating the importance of investing in natural capital to enhance the natural capital stock (Cai, 2008; Liu, 2018).

The second column of data adds the interaction term between forestry investment and forest coverage. Generally speaking, reasonable forestry investment can promote the improvement of the stock and quality of natural forest capital, and thus have a positive effect on economic growth. However, the empirical results are not so. Its interaction term has a significant hindering effect on economic growth, which is largely due to the lagging nature of forestry investment. Compared with economic growth, the growth of forest coverage is a

relatively slow process and requires long-term investment to achieve compensation for ecological benefits (Zhu, 2006).

The data in the third and fourth columns add fixed asset investment and human capital to the regression analysis, the effect of industrial pollution control investment on economic growth is no longer significant, and the regression coefficient of natural capital stock represented by forest coverage has dropped from 0.05 to 0.019, which indicates that fixed asset investment and human capital may have an inhibitory effect on it, which is in line with the assumption that the intervention of physical capital makes the inhibitory effect of natural capital on economic growth more obvious (Xue et al., 2016). At the same time, it also shows that fixed asset investment has a strong impetus to economic growth, and it is reasonable and scientific to use it as a control variable.

The fourth column adds all control variables to the regression equation. The absolute value of the natural capital investment coefficient is decreasing, but the forestry investment, urban environmental infrastructure construction investment, and industrial pollution control investment are at the level of 5%, 1%, and 10%, respectively. significantly. This is basically in line with hypothesis 1: natural capital investment has a direct role in promoting economic growth. Among them, forestry investment has a greater role in promoting. In 2019, there are 9 provinces with a total output value of forestry industry exceeding 400 billion yuan (The data comes from China Zhiyan Consulting (2021, February 2)). The development potential of the forestry industry is huge, and its ability to radiate the economy is also enhanced. The investment in ecological restoration and governance is still not significant, and the lack of investment funds due to the lack of market entities may be the reason for its insignificant economic growth benefits. The regression coefficient of industrial pollution investment is only significant at the 10% level, partly because the coverage of investment data is not accurate enough. On the other hand, it also shows that through investment in other natural capital, through technological innovation and progress, the production method should be transformed as soon as possible, and the production of industrial pollution should be reduced or even avoided. The coefficients of environmental infrastructure investment and other control variables are significant at the 1% confidence level. In the context of the urbanization process, accelerating investment in urban environmental infrastructure construction can not only prevent the economy from hindering the economy due to infrastructure, but also use its technological first-mover advantage to promote economic development in turn. Therefore, it is necessary to strengthen the management of investment in urban environmental infrastructure, and use innovative means to ensure economic benefits and investment efficiency (Niu & Zhao, 2010). In general, natural capital investment can directly create ecosystem products and services, influence and guide the construction and development of industries related to ecosystem products and services, reduce the cost of ecological environment governance, improve the investment structure, and play an important role in economic growth. positive push.

Finally, in order to consider the difference in the impact of direct and indirect natural capital investment on economic growth, in the sixth column, the interactive items of forestry investment and ecological restoration and governance investment, and the interactive items of industrial pollution control investment and urban environmental infrastructure

construction investment are respectively set. Both results are significant at the 1% level, which can tell us that there is a mutual promotion between natural capital investment, which is consistent with the supply and demand effects of natural capital investment. Through investment in natural capital, it can influence, guide and drive the development of many related industries, thereby strengthening the driving role of economic growth. This also suggests that we should strengthen natural capital investment in all aspects and play a positive role in promoting various types of natural capital investment.

Table 1. The direct contribution of natural capital investment to economic growth

VARIABLES	lnGDP	lnGDP	lnGDP	lnGDP	lnGDP	lnGDP
lnFI	0.228***	0.276***	0.071**	0.074**	0.059**	
	(4.76)	(5.45)	(1.97)	(2.27)	(2.00)	
lnEI	0.061	0.059	0.041	-0.001	-0.004	
	(1.30)	(1.27)	(1.18)	(-0.02)	(-0.13)	
lnCI	0.201***	0.200***	0.048***	0.043***	0.048***	
	(11.55)	(11.59)	(3.18)	(3.13)	(3.92)	
lnWI_Mg	0.047***	0.045***	0.007	0.014	0.017*	
	(3.13)	(3.05)	(0.61)	(1.41)	(1.92)	
Forestcover	0.028***	0.050***	0.019***	0.013***	0.009***	0.009***
	(12.56)	(6.14)	(10.94)	(7.47)	(5.08)	(5.23)
lnK			0.431***	0.375***	0.326***	0.353***
			(18.85)	(17.53)	(15.24)	(17.39)
L				0.245***	0.163***	0.169***
				(9.93)	(6.56)	(6.80)
urban					0.013***	0.013***
					(5.65)	(5.41)
Jh=lnFI*forestcover		-0.002***				
		(-2.74)				
Z1=lnFI*lnEI						0.002***
						(3.22)
Z2=lnCI*lnWI_Mg						0.002***
						(3.45)
Constant	10.701***	10.088***	8.001***	7.567***	8.829***	9.254***
	(48.81)	(32.32)	(37.12)	(38.07)	(36.42)	(34.18)
Observations	450	450	450	450	450	450
R-squared	0.899	0.901	0.946	0.956	0.965	0.964
Number of code	30	30	30	30	30	30
district FE	YES	YES	YES	YES	YES	YES
F test	0	0	0	0	0	0
r2_a	0.891	0.893	0.941	0.952	0.962	0.961
F	742.3	629.5	1,206	1,291	1,257	1,573

Note: t-statistics in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$

3.2. The Indirect Effect Mechanism Test of the Impact of Natural Capital Investment on Economic Growth

Before discussing the indirect effect mechanism of natural capital investment on economic growth, first familiarize yourself with a new concept, the mediating effect. The mediating effect, as the name implies, means that the explanatory variable X has an impact on the explained variable Y, the explanatory variable X has an impact on the mediating

variable Z, and finally the explanatory variable X has an impact on the explained variable Y through the mediating variable Z, that is, there is a mediating effect, and the transmission model is shown in Figure 1.
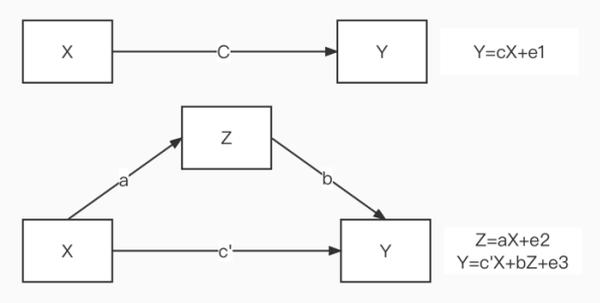
Figure 1. Mediation transfer model

From the previous empirical regression analysis results, it can be seen that natural capital investment has a significant impact on economic growth. It is now possible to consider whether human capital accumulation is a potential channel for influencing economic growth. Human capital is set as the mediating variable, the explained variable is lnGDP, and the explanatory variable is natural capital investment. Hypothesis 2 points out that investment in natural capital can promote the accumulation of human capital, and the improvement of human capital can promote economic growth, so natural capital investment can indirectly lead to economic growth through the channel of human capital. In addition to the significant impact of natural capital investment on economic growth, natural capital investment also has a significant role in promoting human capital accumulation, and ultimately achieves that investment promotes economic growth through the intermediary variable human capital. Before this empirical analysis, three fixed-effect models need to be used, which are simply expressed as:

Model 1: Economic growth$_{it}$ = α_0 + α_1 Natural capital investment$_{it}$ + α_2 Control variable$_{it}$ + e$_{it}$

Model 2: Human capital$_{it}$ = α_0 + α_1 Natural capital investment$_{it}$ + α_2 Control variable$_{it}$ + e$_{it}$

Model 3: economic growth$_{it}$ = α_0 + α_1 natural capital investment$_{it}$ + α_2 human capital + α_3 control variable$_{it}$ + e$_{it}$

Because both direct and indirect natural capital investment will have a certain impact on human capital accumulation, the interaction term of direct natural capital investment and indirect natural capital investment is set, and the regression results are shown in Table 2.

The results in the first column show that natural capital investment has a positive effect on economic growth. The coefficient of natural capital investment is significant at the level of 1%. The greater the investment, the more obvious the promotion effect on economic growth. The results in the second column show that natural capital investment also has a positive effect on human capital accumulation, and its coefficient is still significant at the 1% level. Increasing natural capital investment will accelerate human capital accumulation and produce spillovers. The results in the third column are significantly positive. Both natural capital investment and human capital accumulation are significant at the 1% level, which fully proves that natural capital investment can indirectly affect economic growth through the realization of human capital accumulation.

Table 2. The indirect contribution of natural capital investment to economic growth

VARIABLES	lnGDP	L	lnGDP
Z	0.011***	0.010***	0.008***
	(13.93)	(9.28)	(9.78)
L			0.366***
			(11.51)
lnK	0.206***	0.104***	0.168***
	(11.61)	(4.36)	(10.62)
Forestcover	0.028***	0.030***	0.017***
	(12.02)	(9.56)	(7.60)
Constant	12.442***	4.745***	10.706***
	(56.80)	(16.11)	(43.99)
Observations	450	450	450
R-squared	0.896	0.768	0.921
Number of code	30	30	30
district FE	YES	YES	YES
F test	0	0	0
r2_a	0.887	0.750	0.914
F	892.2	344.9	965.8

Note: t-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Human capital is an important factor affecting economic growth. Most researchers believe that the improvement of natural capital can effectively improve the ecological environment, improve the quality of the ecological environment, and then improve the production and living environment of human beings, improve the health level of the people, and then promote the increase of healthy human capital (Fogel, 2004; Wang, 2012; Xu, 2014). When people have good physical health, it will prolong people's labor time, improve labor efficiency, and get more remuneration. When people are in a pleasant environment, it can further stimulate their enthusiasm for work and life, and not only improve the ecology The sense of gain and happiness can stimulate consumer demand and promote economic growth. Having healthy human capital will also directly or indirectly increase investment in educational human capital. Whether people have good health status will directly affect the national education opportunities, efficiency, education level and labor supply. At this level, it will also affect economic growth.

3.3. Regional Differences in the Impact of Natural Capital Investment on Economic Growth

To explore regional differences in the impact of natural capital investment on economic growth, China is divided into eastern, central, western, and northeastern regions. Table 3 shows empirical results on the impact of natural capital investment on economic growth by region. Z1 represents the interaction item of forestry investment and ecological restoration and governance investment, which means direct natural capital investment. Z2 represents the interaction term of environmental pollution control investment and urban infrastructure construction investment, which represents indirect natural capital investment.

The first column of data is the empirical result of the eastern region. The direct natural capital investment coefficient is significant at the level of 1%, and the indirect natural capital investment effect is not obvious. The data in the second column is the empirical result of

Table 3. Regional differences in the impact of natural capital investment on economic growth

VARIABLES	Eastern region	Central region	Western region	Northeastern region
Z1	0.003***	0.004***	0.001	0.004
	(2.87)	(3.09)	(0.99)	(1.55)
Z2	-0.001	0.003**	0.002***	0.006***
	(-0.63)	(2.58)	(2.76)	(2.79)
Forestcover	-0.005	0.009**	0.010***	0.060***
	(-1.41)	(2.33)	(4.15)	(4.89)
lnK	0.446***	0.291***	0.373***	0.352***
	(8.65)	(7.66)	(11.60)	(4.66)
L	0.159***	0.123***	0.098***	0.085
	(3.48)	(2.76)	(2.79)	(0.58)
urban	0.007	0.012**	0.018***	-0.017
	(1.35)	(2.31)	(5.18)	(-1.14)
Constant	9.070***	10.352***	8.925***	8.590***
	(13.90)	(16.67)	(22.83)	(8.20)
Observations	150	90	165	45
R-squared	0.962	0.980	0.979	0.943
Number of code	10	6	11	3
district FE	YES	YES	YES	YES

Note: t-statistics in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$

the central region. The direct natural capital investment coefficient and the indirect natural capital investment coefficient are significant at the level of 1% and 5%, respectively. The third column and the fourth column are the empirical results of the western region and the northeastern region, respectively. The indirect natural capital investment coefficient of the two is significant at the level of 1%, and the direct natural capital investment effect is not obvious. Fixed asset investment is significant at the 1% level in the eastern, central, western and northeastern regions, showing the strong influence of fixed asset investment on economic growth. The coefficient of human capital in the eastern and central regions is significantly larger than that in the western region, and the human capital in the northeastern region has no significant impact on economic growth, which is also in line with the law of my country's economic development.

As far as the natural capital stock represented by the forest coverage rate is concerned, the natural capital stock in the central, western and northeastern regions has a more significant role in promoting economic growth, and the northeastern region is the strongest, the western region is the second, the central region is the smallest, and the eastern region is not. Significantly. This is related to the abundance of forests in the northeastern and western regions. However, it is precisely because of the relatively abundant natural capital that the northeastern and western regions lack investment in direct natural capital, the corresponding natural capital industry cannot develop rapidly, the foundation of the forestry industry is weak, and the benefits of forest resource development and utilization are not high. There is still a big gap between the output value per unit area and developed provinces, and ecosystem products and services are in urgent need of improvement. Compared with the central, western and northeastern regions, the

eastern region has less forest resources, and the stock of natural capital is limited. The investment in environmental pollution control and environmental infrastructure construction has no significant impact on economic growth. The increase of related industries and products has a greater impact, and it also reminds that the economic growth mode of the eastern region also needs to be transformed. It should not be at the expense of environmental pollution and ecological damage, but should move towards green development.

4. Conclusions

First, natural capital investment can be divided into direct investment and indirect investment. The former directly leads to an increase in the quantity and quality of natural capital and improves ecological stability and resilience (including forestry investment, ecological restoration and governance investment, etc.). Indirect investment can slow down the rapid consumption of natural capital and reduce the negative externalities of environmental pollution (including investment in renewable energy, investment in urban environmental infrastructure construction, and investment in environmental pollution control, etc.).

Second, construct the mechanism by which natural capital investment affects economic growth. The direct effect mechanism of the impact of natural capital investment on economic growth: natural capital investment will promote the formation and development of industries, products and services, and it will have economic benefits and directly create GDP. The indirect effect mechanism of the impact of natural capital investment on economic growth: natural capital investment will promote the accumulation of human capital, and human capital can effectively promote economic growth, which is an indirect driving effect.

Thirdly, to establish an extended C-D production function, a fixed-effect model is used for empirical analysis, and the results show that natural capital investment has a significant role in promoting economic growth. The coefficients of the mediation effect are significantly positive, indicating that natural capital investment will also indirectly promote economic growth through the channel of human capital. The empirical results are consistent with theoretical research.

In order to achieve sustainable economic growth, it is necessary to deeply understand natural capital investment and establish a correct concept of natural capital investment; increase natural capital investment channels, establish and improve natural capital allocation mechanism; increase natural capital investment, and focus on promoting talents to boost industrial development; Only in the end can increase the stock of natural capital, improve the quality of natural capital, increase the quality of ecosystem products and services, promote the establishment and development of related natural capital industries, and then promote the optimization and upgrading of investment structure and industrial structure, and inject new impetus into long-term economic growth.

Conflict of interest: none

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Impact of Digital Economy on the Transformation and Upgrading of Industrial Structure

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Abstract: Does digital economy affect the pace and nature of industrial structure and if so, by how much? We discuss the linear impact, nonlinear characteristics and constraint mechanisms of the digital economy on industrial structure. We apply this to inter-provincial panel data from China and find that there is a remarkably promotion of digital economy on the advancement of industrial structure. Further, a heterogeneity analysis shows a sharp enhancement in the upgrading of industrial structure response to digital economy for the western region compared with the east and the central region. We then quantitatively test the threshold effect and find that there is an ascending trend in the upgrading of industrial structure just to the right of the digital economy threshold, and a positive marginal effect between the two. Finally, we allow for changes in the threshold variables and conclude that trade openness has a prominent marginal incremental effect on the rationalized and advanced industrial structure; when the proportion of fixed investment in real estate is the threshold variable, the digital economy only presents a marginal incremental effect on the rationalization of the industrial structure; when Internet development, human capital investment, and R&D input intensity are used as threshold variables, the digital economy noteworthily promotes advanced industrial structure.

Keywords: digital economy; rationalization of industrial structure; industrial structure upgrading; threshold effect

JEL Classification: O11; O14; E00

1. Introduction

The 19th National Congress of the Communist Party of China pointed out that it is necessary to accelerate the construction of a cyberpower, digital China, and a smart society, and vigorously promote the deep integration of the Internet, big data, artificial intelligence and the real economy. The digital economy represents a series of economic activities based on digital technology, with digital platforms as the main medium, and digital empowerment infrastructure as an essential support (Xu & Zhang, 2020), including digital core activities and digital application activities (Wu & Wang, 2021). The digital economy promotes the integrated development of the agricultural industry through kinetic energy conversion and technology spillovers (Chen, 2021); by promoting value creation (Jiao, 2020), blurring industrial boundaries, reducing transaction costs, improving the demand side (Li et al., 2020), and raising the position of the global value chain (He, 2020) and other aspects to drive the

transformation and upgrading of the manufacturing industry. It can accelerate the transformation and upgrading of the service industry and promote the progress of cross-border integration of the service industry (Cao & Li, 2020); continuously improve the high-quality and high-level development and development of the service industry (Ye, 2021), etc.

Scholars at home and abroad have carried out a lot of research. Appropriate industrial policies can facilitate the efficiency of industrial innovation (Peters et al., 2012), thereby further the transformation and upgrading of the industrial structure (Han et al., 2017). Trade liberalization (Amighini & Sanfilippo, 2014), large-scale high-speed rail construction (Luo et al., 2020), informatization (Ji & Sun, 2019) and Internet technology advancement (Xu & Zhou, 2019), foreign investment (Xiao et al., 2020), land finance and housing prices (Wang & Wu, 2019) and other factors are all conducive to upgrading the industrial structure. The relationship between financial scale (Wang et al., 2020) and financial openness (Bao, 2020) and the level of industrial structure is an inverted "U"-shaped nonlinear relationship. The national-level industrial transfer demonstration zone has inhibited the transformation and upgrading of the industrial structure (Chen & Zhou, 2020).

As a more advanced and sustainable economic form, digital economy is an important driving force to promote industrial restructuring and achieve sustainable and high-quality economic development. Accordingly, this paper will build a comprehensive index system of digital economy development based on China's provincial panel data and analyze the impact of digital economy on industrial structure transformation and upgrading by using panel regression model.

2. Research Assumptions

Generally speaking, only when the digital economy enhances the optimization of the industrial structure does it mean that the digital economy has played a vital role in boosting the transformation and upgrading of the industrial structure. With the rapid development of digital technology, various industries have also undergone differentiation, reorganization and integration due to its influence. New industries are being formed, and the speed of industrial transformation is accelerating. On the one hand, the digital economy has transformed traditional industries; on the other hand, the digital economy has promoted the formation and development of new industries. This brings about the adjustment of the proportion of the three industries in the national economy and the improvement of labor productivity, which in turn increases the proportion of the output value of the industries with high labor productivity and the level of industrial structure sophistication.

2.1. The Direct Impact of the Digital Economy on the Transformation and Upgrading of the Industrial Structure

The development of the digital economy stimulates the rational allocation of resources. At the beginning of the rise of the digital industry, China has put forward relatively clear industrial development goals and guidelines, thus avoiding some blind investment behaviors to a certain extent, which is favorable for the realization of the rationalizing the industrial structure. The state's supportive policies for the digital economy can also serve to make up

for the incompleteness of market information, raise the efficiency of resource utilization, and strengthen the degree of inter-industry correlation, which is propitious to the coordinated development of industries (Zuo et al., 2020). Chen and Yang (2021) believe that the digital economy is a new actuator for economic transformation, which can push forward the transfer of labor-intensive and heavy industry-based industrial structures to high-tech and environment-friendly industrial structures. This paper proposes that:

Hypothesis 1. The digital economy can enhance the industrial structure, propel the rationalization of the industrial structure, and then realize the transformation and upgrading of the industrial structure.

2.2. The Nonlinear Influence Mechanism of Digital Economy on Industrial Structure Transformation and Upgrading

Under the network externality, the information network benefit is related to the square term of the number of users, which makes the network value show the phenomenon of increasing marginal effect. With the deepening of the integration of the digital economy and traditional industries, the upfront fixed costs of enterprises have further increased, including the cost of subsidizing activities to attract new customers. Under the action of the Metcalfe's law, the marginal revenue brought by the expansion of enterprise user scale shows an increasing trend, thereby reducing the average cost of the enterprise and gradually forming economies of scale. This effect will become more pronounced with the development of the digital economy. Based on this, this paper proposes:

Hypothesis 2. The digital economy has an aggressive marginal effect on the sophistication of the industrial structure.

2.3. The Nonlinear Constraint Mechanism of the Digital Economy on the Upgrading of the Industrial Structure

In the digital economy era, the spillover effect of the digital economy on the industrial structure will be constrained by external factors such as trade, economy, and technology. The expansion of regional openness to the outside world can boost the knowledge spillover brought by the digital economy, which is active for enterprises to absorb experience and advanced technologies, but the introduction of foreign technologies, products, and resources will occupy the domestic market and weaken the spillover dividends of the digital economy. Another issue that needs attention is that although progressive manufacturing is a critical part of economic development, it may impede the transformation of the economy to service-oriented, and is detrimental to the role of the digital economy in industrial upgrading. In addition, R&D investment can furnish economic development with financial guarantee and figure out the problem of deficient innovation funds for enterprises; however, the increase in R&D investment will correspondingly crowd out digital technology capital, resulting in ungenerous financial support for the digital economy in the process of power the transformation of the industrial structure. Based on the above analysis, this paper proposes the following assumptions:

Hypothesis 3. The impact of the digital economy on the transformation and upgrading of the industrial structure will be subjected to the external environment.

3. Research Design

3.1. Model Settings

Based on the above theoretical analysis, the following model is established:

$$LN\_STU_{it} = \alpha_0 + \alpha_1 LN\_DIGECO_{it} + \alpha_2 LN\_CONTROL_{it} + X_t + X_i + \varepsilon_{it} \tag{1}$$

The explained variable LN_STU_{it} in model (1) represents the transformation and upgrading level of industrial structure, which is measured by the rationalization level of industrial structure (LN_TL_{it}) and the upgrading level of industrial structure (LN_TS_{it}) ,and the core explanatory variables LN_DIGECO_{it} represent the development level of the digital economy in the province i in the period t; $LN\_CONTROL_{it}$ is the set of other control variables affecting industrial structure x_t, x_i are the time and region dummy variables, respectively, which are used to reflect the time fixed effect and the regional fixed effect; ε_{it} are random disturbance terms. Model (1) are the effects of explanatory variables on the conditional expectations of the explained variables, and are susceptible to extreme influences. In order to more comprehensively reflect the conditional distribution of the explained variables, the quantile regression model (2) is further constructed to capture the influence of the explained variables in the extreme value.

$$LN\_STU_{it}(\tau) = \beta_0(\tau) + \beta_1(\tau)LN\_DIGECO_{it} + \beta_2(\tau)LN\_CONTROL_{it} + X_t + X_i + \varepsilon_{it} \tag{2}$$

Among them: τ (0<τ<1) represents the different quantiles of the conditional distribution, which are 0.1, 0.25, 0.5, 0.75, 0.90; the core coefficient reveals the marginal impact of the digital economy on the industrial structure of different quantiles.

3.2. Variable Design

Explanatory variables: measurement of the digital economy

This paper draws on the digital economy index system, which is based on the connotation of digital economy, focuses on the conditions, applications and environment of digital economy, and reflects the development level of digital economy in an all-round way (Wang, et al. 2021). The overall digital economy development level indicator system consists of 4 target layers, 9 subdivision indicators, and 30 variables. In the benchmark regression part, this paper uses the entropy method to calculate the digital economy development level as the explained variable, and it is estimated by AHP in the robustness check section.

Explained variable: level of industrial structure upgrading

The explained variable of this paper is the level of industrial structure upgrading. Measured by rationalization of industrial structure and advanced industrial structure.

First of all, the rationalization of industrial structure reflects the degree of coordinated development of various industrial sectors. This paper uses the Theil index (TL) to measure the level of rationalization of industrial structure according to (Gan et al., 2011). The specific

calculation formula is: $TL = \sum_{i=1}^{n} \frac{Y_i}{Y} ln(\frac{Y_i}{L_i}/\frac{Y}{L})$,which Y represents output value and L represents employment, i represents the industry, and n represents the number of industry sectors. The Theil Index (TL) is an inverse index. The closer its value is to 0, the closer the current industrial structure is to an equilibrium and more reasonable state. The degree of deviation of industrial structure refers to the degree of difference between the proportion of added value of each industry and the corresponding proportion of labor force. In this paper, the degree of deviation of industrial structure (E) is selected to measure the rationalization level of industrial structure as a replacement indicator for robustness testing. The specific calculation formula is: $E = \sum_{i=1}^{n} \left| \frac{Y_i/L_i}{Y/L} - 1 \right| = \sum_{i=1}^{n} \left| \frac{Y_i/Y_i}{L/L} - 1 \right|$, The larger the E value, the more the economy deviates from the equilibrium state, and the more unreasonable the industrial structure is.

Secondly, considering that the upgrading of industrial structure is dominated by modern service industry, this paper chooses the GDP ratio of tertiary industry and secondary industry to measure the advanced level of industrial structure (TS). The robustness test is carried out according to "1×the proportion of primary industry +2×the proportion of secondary industry +3×the proportion of tertiary industry". The higher the value is, the higher the level of industrial structure is.

Control Variable

The main control variables selected in this paper are: the level of economic development (pgdp). Economic development is an important driving force for the transformation and upgrading of the industrial structure. This paper uses the per capita GDP to measure; Marketization level(mark), which is measured by the ratio of non-state-owned enterprise employees to total employment; Social consumption(soc). The continuous change of consumer demand and the diversification of consumption structure can promote the adjustment of industrial structure. This article uses the proportion of social retail goods consumption to GDP to represent social consumption; Foreign investment(fdi). Foreign direct investment can bring new technology and management experience, which is conducive to improving the level of industrial development. However, if foreign businessmen tend to invest in the secondary industry, it may exacerbate the imbalance of industrial structure. This study uses foreign direct investment to represent foreign business invest.

3.3. Data Sources

This article uses data related to the transformation and upgrading of the digital economy and industrial structure in 30 provinces in China from 2013 to 2018. The data comes from the official websites of the National Bureau of Statistics and the provincial statistical bureaus, China Statistical Yearbook, China Tertiary Industry Statistical Yearbook, China Information Yearbook, China Information Industry Yearbook, China Academy of Information and Communications Technology, and industry and informatization-related research reports and published data, Statistical yearbooks of various provinces over the years, and China's digital

economy development reports over the years. Due to data availability issues, Hong Kong, Macau, Taiwan and Tibet are not included.

4. Empirical Analysis

4.1. Benchmark Regression

The panel regression of model (1) was carried out through stata16.0 to examine the specific impact of the digital economy on the transformation and upgrading of the industrial structure. When the panel regression was performed by adding time effects, it was found that the joint statistic F for the time effect regression was very insignificant. Therefore, a panel model with individual effects was selected to continue the regression. In order to increase the rigor of the model and improve the credibility of the model, other control variables for the transformation and upgrading of the industrial structure are gradually added for regression.

Table 1. Benchmark regression results

VARIABLE	LN_TL			LN_TS		
	(1) OLS	(2) FE	(3) GMM	(4) OLS	(5) FE	(6) GMM
LN_GIGECO	-2.294***	-0.350***	-0.0475**	1.793***	0.595***	0.215***
	(0.624)	(0.106)	(0.012)	(0.265)	(0.145)	(0.0686)
L. LN_TS			0.828***			
			(0.0320)			
L. LN_TL						1.055***
						(0.0371)
AR (1)			-2.0176			-2.6629
			[0.0436]			[0.0077]
AR (2)			-0.66572			-1.8763
			[0.5056]			[0.0606]
_CONS	3.295***	2.880***	0.547*	0.848***	0.619**	0.0159
	(0.150)	(0.0877)	(0.294)	(0.190)	(0.234)	(0.107)
CONTROL VARIABLES	YES	YES	YES	YES	YES	YES
INDIVIDUAL EFFECT	NO	YES	NO	NO	YES	NO
N	180	180	150	180	180	150
R²	0.353	0.149		0.795	0.733	

Note: (1) *, **, *** indicate significance at the statistical level of 1%, 5%, and 10%, respectively; (2) the robust standard errors are in parentheses; (3) P-values are in square brackets; (4) Due to space limitations, this paper does not report the regression results of relevant control variables. The same below.

It can be seen from Table 1 that whether or not the OLS, fixed-effects model or GMM model is used, the digital economy as an explanatory variable has prominently propel the level of rationalization and upgrading of the industrial structure, and the level of industrial structure in the past will affect the current period.

4.2. Quantile Regression Results

The panel fixed effect model reflects the impact of the digital economy in the mean range. In order to describe the characteristics of extreme value regions and reduce the impact of extreme values, and to fully reflect the role of the digital economy on the transformation and upgrading of the industrial structure, the panel quantile regression method was selected as showed in model (2) to estimate the effect at different quantiles (Table 2). Columns (1) to (5)

in Table 2 represent the effect of the digital economy at the 10%, 25%, 50%, 75%, and 90% quantiles when controlling for individual effects and other control variables. The quantile regression results show that the fitting coefficients of the rationalization and advanced level of the industrial structure vary between [-5.041, -0.415], [0.917, 2.476], respectively, indicating that the digital economy has an impact on the rationalization and advanced level of the industrial structure. The change level has a significant effect at different quantiles. Although it shows an irregular "N" development tendency, the overall shows an upward trend.

Table 2. Quantile regression results

VARIABLE	QR_10	QR_25	QR_50	QR_75	QR_90
	(1)	(2)	(3)	(4)	(5)
DIGECO_TL	-0.415***	-0.780***	-0.607***	-1.055***	-5.041*
	(0.00749)	(0.00311)	(0.118)	(0.0549)	(2.831)
DIGECO_TS	1.205***	0.917***	1.806***	2.476***	2.123***
	(0.225)	(0.164)	(0.498)	(0.0686)	(0.121)
N	180	180	180	180	180

4.3. Endogenous Resolution

Endogenous problems in the model will affect the model estimation results. To address this issue, we chose to retest using the panel instrumental variables method. The number of fixed telephones per 10,000 people in 1984 (Huang, et al. 2019) and the digital economy lag by one period are used as instrumental variables. As can be seen from the fitting results of the first stage in Table 3, the fitting coefficients of the number of fixed telephones per 10,000 people and the first-order lag of the digital economy are all significantly positive, and they have passed the weak instrumental variable test, the over-identification test and the unidentifiable test. It testifies that the number of fixed telephones per 10,000 people and the first-order lag of the digital economy are desirable instrumental variables that meet both the correlation and exogenous requirements. According to the fitting results of the second stage,

Table 3. Endogenous test results

VARIABLE	LN_TL		LN_TS	
	FIRST STAGE	SECOND STAGE	FIRST STAGE	SECOND STAGE
	(1)	(2)	(3)	(4)
DIGECO		-0.5137**		1.296**
		(0.1461)		(0.569)
FIXED TELEPHONES PER 10,000 PEOPLE	0.00001***		0.0000*	
	(2.75e-06)		(6.94e-06)	
L. DIGECO	2.91e-06**		1.4801***	
	(1.40e-06)		(0.1879)	
Anderson canon. corr. LM statistic	49.779		51.611	
	[0.0000]		[0.0000]	
Cragg-Donald Wald F statistic	36.259		42.261	
Sargan statistic	0.000		0.498	
	[0.9917]		[0.4802]	
CONTROL VARIABLES	YES	YES	YES	YES
INDIVIDUAL EFFECT	YES	YES	YES	YES
N	180	180	180	180
R²	0.4901	0.1096	0.6571	0.6771

after controlling the individual effect and other control variables, the fitting coefficients of the digital economy to the rationalization and advanced level of the industrial structure are -0.5137 and 1.296, respectively. This reveals that after using landlines per 10,000 people and the digital economy lag by one period as instrumental variables, the furthered effect of the digital economy on the industrial structure is robust.

4.4. Robustness Test

The digital economy and industrial structure are affected by many factors. In order to ensure the reliability of the analysis results, further robustness tests are required. Columns (2) and (4) in Table 4 are the regression results of the rationalization and upgrading of the replacement industrial structure, respectively, and columns (1) and (3) are the regression results of the digital economy re-estimated by the AHP, signifying that whether replacement of indicators and replacement of estimation methods, the digital economy still facilitates the rationalization and advanced level of industrial structure, manifesting that the core conclusion of this paper is stable.

Table 4. Robustness test results

VARIABLE	LN_TL		LN_TS	
	REPLACE OF DIGECO	REPLACE OF LN_TL	REPLACE OF DIGECO	REPLACE OF LN_TS
	(1)	(2)	(3)	(4)
DIGECO2	-0.0683**		0.163***	
	(0.0207)		(0.0232)	
DIGECO		-0.0445**		2.182***
		(0.0216)		(0.439)
_CONS	2.8282***	0.462***	1.730***	1.382***
	(0.0904)	(0.0604)	(0.113)	(0.144)
N	180	180	180	180
R²	0.2105	0.439	0.712	0.656

5. Further Analysis

5.1. Heterogeneity Analysis

The industrial structure is subject to the influence of regional resource endowment, regional infrastructure and regional economic development level. Based on this, the impact of the digital economy on the transformation and upgrading of different regional industrial structures is further investigated. It can be seen from Table 5 that the digital economy has played a conspicuous role in assisting the rationalization and advanced level of the industrial structure in the eastern, central and western regions, declaring that the digital economy has a main function in promoting the transformation and upgrading of the industrial structure, and the impact shows a trend of central > western > eastern. One explanation is that with the continuous development of the economy, the industrial structure of the eastern region has a higher tendency of "service-oriented", that is, the industrial structure of the eastern region is more reasonable than that of the central and western regions, which are dominated by primary and secondary industries. Compared with the western region, the industrial development foundation of the central region is better, which can provide better element

support for the effect of the digital economy. Therefore, the effect of industrial transformation and upgrading in the central region is better than that in the western region. From the columns (3) and (7) in Table 5, it is clear that the digital economy has a boosting effect on the rationalization of the industrial structure in the northeast, but the result of the advanced industrial structure is indistinctive. The possible reason is that there is a clear gradient gap between the northeast region and the eastern region, the economic is suboptimal, the population continues to flow out. In addition, the industry is concentrated in heavy industry, resulting in an unbalanced economic structure and insufficient development of emerging industries such as electronic information and communication. At the same time, the connection between upstream and downstream industrial chains is not perfect. Therefore, digital technologies such as informatization, digitization, and intelligence can help to rationalize the structure of the three major industries, but whether the industrial structure has a service-oriented trend has not yet shown an impact at this stage.

Table 5. Heterogeneity test

VARIABLE	LN_TL				LN_TS			
	EAST	CENTRAL	NORTH EAST	WEST	EAST	CENTRAL	NORTH EAST	WEST
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DIGECO	-0.0325***	-0.0763***	-0.229*	-0.0567**	0.630***	0.825**	2.362	0.588**
	(0.0075)	(0.0101)	(0.0722)	(0.0215)	(0.134)	(0.245)	(2.454)	(0.228)
_CONS	0.273	0.530***	-0.342	0.228***	2.131***	0.453	1.687**	0.979***
	(0.167)	(0.0433)	(0.171)	(0.0553)	(0.249)	(0.316)	(0.228)	(0.153)
N	60	36	18	66	60	36	18	66
R²	0.686	0.889	0.962	0.599	0.869	0.737	0.800	0.643

5.2. Threshold Effect Test

In order to further analyze the nonlinear dynamic characteristics of the digital economy on the transformation and upgrading of the industrial structure, according to the panel threshold model of Hansen (1999), the nonlinear impact of the digital economy on the transformation and upgrading of the industrial structure is investigated. Build the model as follows:

$$LN_I STU_{it} = \gamma_1 LN_D IGECO_{it} \cdot I(LN_D IGECO_{it} \leq \theta_1) + \gamma_2 LN_D IGECO_{it} \cdot I(\theta_2 \geq LN_D IGECO_{it} > \theta_1) + \cdots + \gamma_{n+1} LN_D IGECO_{it} \cdot I(LN_D IGECO_{it} \leq \theta_n) + \delta_1 LN_C ONTROL_{it} + X_t + X_i + \varepsilon_{it} \quad （3）$$

In model (3), $\theta_1 \sim \theta_n$ are n threshold values. I（*）is an indicator function, which takes the value1 when the conditions in the parentheses are satisfied, and 0 otherwise. In addition, considering the constraint mechanism that affects the digital economy on the transformation and upgrading of the industrial structure, the following model is constructed:

$$LN\_ISTU_{it} = \gamma_1 LN\_DIGECO_{it} \cdot I(T_{it} \leq \theta_1) + \gamma_2 LN\_DIGECO_{it} \cdot I(\theta_2 \geq T_{it} > \theta_1) + \cdots + \gamma_{n+1} LN\_DIGECO_{it} \cdot I(T_{it} \leq \theta_n) + \delta_1 LN\_CONTROL_{it} + X_t + X_i + \varepsilon_{it} \quad （4）$$

In model (4), T_{it} represents the threshold variable. There are five threshold variables in this paper: 1) Internet development. Internet Broadband Access Port (IBAP) is a way to

communicate with the outside world through a computer. This paper chooses it as a measurement variable for Internet development. 2) Economic operation. As the main source of local fiscal revenue, real estate fixed investment is not only a fixed asset investment but also involves people's livelihood, and can be a good measure of local economic operation. Therefore, the proportion of real estate fixed asset investment in GDP (IREFA) is selected to measure the degree of local economic operation. 3) Trade liberalization. This paper chooses the proportion of total imports and exports to GDP (OPEN) to measure trade openness. (4) Technological innovation. Select R&D input (RD) to measure the level of technological innovation. 4) Human capital. College students serve as a talent pool, supplying talents from all walks of life to the society. This paper chooses the proportion of graduates (HC) to measure the level of human capital.

According to the results in Table 6, a reasonable explanation is that when the digital development reaches a certain value, rationalization of the industrial structure exceeds a certain value, so the role played by the digital economy is gradually decreasing; however, the tendency of industrial servitization is still expanding, so the influence of the digital economy on the advanced industry displays a marginal increasing effect. In summary, the impact of the digital economy on the industrial structure is non-linear and forward shock, but it has a marginal decreasing effect on the rationalization and a marginal increasing effect on the advanced industrial structure.

Under the heterogeneous restriction of Internet development, economic operation, trade opening, technological innovation, human capital and other factors, the digital economy also has nonlinear characteristics for the upgrading of China's industrial structure. When Internet development, human capital investment, and R&D investment are used as threshold variables, and with the reinforcement of the above variables, the digital economy presents a marginal declining effect on the rationalization of the industrial structure, and a marginal

Table 6. Test of threshold effect of digital economy on industrial structure

VARIABLE		DIGECO	IBAP	HC	IREFA	OPEN	RD
		（1）	（2）	（3）	（4）	（5）	（6）
Rationalization of industrial structure	DIGECO_0	-0.558***	-0.182***	-7.949***	-0.859**	-1.559***	-4.558***
		(0.203)	(0.0347)	(1.164)	(0.434)	(0.499)	(0.802)
	DIGECO_1	-0.274**	-0.0569*	-2.061***	-4.337***	-4.273***	-1.238***
		-0.558***	-0.182***	(0.412)	(1.002)	(0.942)	(0.440)
	THRESHOLD	0.3444	2760.1	47.046	0.0735	0.1683	271
	P-VALUE	[0.0640]	[0.0000]	0.032	0.064	0.018	0.0260
Advanced industrial structure	DIGECO_0	-0.571**	0.184	0.325**	3.259***	-0.0980**	-0.117***
		(0.275)	(0.118)	(0.165)	(0.782)	(0.0435)	(0.0445)
	DIGECO_1	0.477***	0.569***	1.021***	1.806***	0.110***	0.0989***
		(0.107)	(0.104)	(0.128)	(0.265)	(0.0183)	(0.0122)
	THRESHOLD	0.591	1580.5	26.8151	0.2067	0.7968	0.0045
	P-VALUE	[0.0260]	[0.0180]	0.0920	0.0250	0.0600	0.1840

ascendant effect on the advanced industrial structure; when trade openness is used as the threshold variable, the digital economy has a marginal expanding effect on the rationalization and upgrading of the industrial structure; when the proportion of fixed investment in real

estate is used as the threshold variable, the digital economy has a marginal increasing effect on industrial rationalization, and a diminishing impact on the advancement of industrial structure.

6. Conclusions

Based on the theory that the digital economy actuates the transformation and upgrading of China's industrial structure, this paper comprehensively discusses the linear impact, nonlinear characteristics and constraint mechanisms of the digital economy impelling the transformation and upgrading of China's industrial structure by using the inter-provincial panel data from 2013 to 2018. The following main conclusions are drawn: First, the digital economy can potently promote the sophistication of China's industrial structure, and there is regional heterogeneity. The digital economy can conspicuously motivate the rationalization and upgrading of the industrial structure in the eastern, central and western regions, and the effect is the most impressive for the western region. For the Northeast, it only affects the rationalization of the industrial structure, and the effect of the advanced industrial structure is inapparent. Second, the digital economy has a nonlinear dynamic impact on the transformation and upgrading of the industrial structure, and with the improvement of the level of the digital economy, there is a marginal decreasing effect on the rationalization of the industrial structure, and a marginal increasing effect on the advanced industrial structure. Third, the impact of the digital economy on the upgrading of the industrial structure will be constrained by Internet development, economic operation, trade opening, technological innovation, and human capital. When Internet development, human capital investment, and R&D investment are used as the threshold variables, the digital economy shows the law of diminishing marginal effects for the rationalization of industrial structure, and the law of increasing marginal effects for the advanced industrial structure; when trade opening is the threshold variable, the digital economy reveals the law of increasing marginal effect for both the rationalization and upgrading of the industrial structure; when the proportion of fixed investment in real estate is used as the threshold variable, the digital economy demonstrates the law of increasing marginal effect for industrial rationalization, and the law of decreasing marginal effect for the advanced industrial structure. Based on the above conclusions, we should continue to implement the national Big data strategy, consolidate the digital technology application for the transformation and upgrading of industrial structure in the dividends of advantage, increase the economic impact on the transformation and upgrading of industrial structure of the digital differential effect, meanwhile, other factors should be fully aware of the external effect on digital economy in the transformation and upgrading of industrial structure.

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External Employer Branding in the IT Sector in Poland: Employee Perspective on Employer Attractiveness

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Abstract: This article concerns employer branding in the IT sector in Poland and focuses on EVP elements as well as employer attributes. The paper aims to investigate employer attractiveness in relation to contemporary factors like employees' expectations, the COVID-19 pandemic, sex-based views and new generations in the labor market. The hypotheses are verified with the use of ANOVA, student's t-test and non-parametrical statistical tests. The results of empirical research (author's questionnaire, CAWI method) confirm that there is a difference between men/women' as well as Generation Z/older generations' view on the importance of individual EVP elements. The research also proves that in the IT sector in Poland, the COVID-19 outbreak resulted in a larger employee focus on certain EVP elements and employer attributes. The findings may be applicable for IT companies in the Polish IT market which aim to build a unique and attractive employer brand.

1. Introduction

The demand for employees in the IT sector in Poland has remained high for the last several years. In contrast to the general labor market situation in Poland, where the outbreak of the COVID-19 pandemic resulted in a higher level of unemployment (Fraczyk, 2021), the demand for IT professionals increased (Antal, 2020). The demand for employees boomed due to the rapidly growing demand for IT services. Companies across all economic sectors impacted by the coronavirus pandemic required assistance from IT companies in digitalization, e-commerce, optimization of web pages, communication channels, remote work, telecommuting etc. Therefore, the technology specialists from infrastructure, cybersecurity, cloud solutions, customer support and consulting areas of expertise are highly sought-after (Grzeszczyk, 2020). On the other hand, the in-demand employees, whose technical qualifications, soft skills and personality traits fulfill the employers' requirements, also set certain expectations for the potential and current employers (Paluch, 2020).

In order to achieve the organization's goal by building a competitive advantage based on human resources, the employers need to attract the best candidates. Taking into consideration the employees' expectations, this task requires a deliberate, well-planned employer branding strategy and processes (Kampioni-Zawadka, 2018). Although some of the employees' expectations towards (potential) employers have already been researched as a key factor

influencing effective external employer branding, it seems that so far a comprehensive research determining specific elements that have an impact on employer attractiveness in the IT sector in Poland has not been carried out. Considering the identified research gap, this paper aims to investigate employer branding in the IT sector in Poland in relation to contemporary factors like employee expectations, the COVID-19 pandemic and new generations in the labor market. Thereby, the findings of this paper can be beneficial for organizations seeking a competitive edge through their personnel.

1.1. Employer Branding Definition

According to one of the well-known definitions, employer branding is "the process of building an identifiable and unique employer identity" and the employer brand is "a concept of the firm that differentiates it from its competitors" (Backhaus & Tikoo, 2004, p. 502). Lloyd defined employer branding as "the sum of a company's efforts to communicate to existing and prospective staff that it is a desirable place to work" (Lloyd, 2002, p. 65). Some of the researchers characterize employer branding in terms of a strategy rather than a process: "a targeted, long-term strategy to manage the awareness and perceptions of employees, potential employees, and related stakeholders with regards to a particular firm" (Sullivan, 2004). Regardless of the differences between the approaches, from the beginning the common understanding is that employer branding incorporates the disciplines of human resources and management in one conceptual frame (Ambler & Barrow, 1996) to provide benefits at the employer's level (employee loyalty, employee development, recruitment process, employee engagement) as well as the organizational level (corporate brand, organizational culture) (Melde & Benz, 2014). Recent studies prove that employer branding positively relates to job satisfaction (Bharadwaj et al., 2021), employee involvement and commitment (Botella-Carrubi et al., 2021), internal communication satisfaction (Tkalac Verčič, 2021).

1.2. Employer Branding Process and Models

The researchers distinguish three main steps of the employer branding process:

- Creating Employer Value Proposition (EVP), which represents the organization's offer for its employees and provides the central message of the employer brand (Eisenberg et al., 2001). Creating EVP is a starting point for all measures taken by the organization to improve the employer brand image (Melde & Benz, 2014).
- External marketing of the employer brand, which attracts the best employees by shaping an image of an employer of choice (Backhaus & Tikoo, 2004). Lately, an additional role of external marketing of the employer brand has been emphasized, namely the employer brand should also support the brand of the company's products and services. This means that the employer brand must align with the corporate brand (Zajac-Paldyna, 2020).
- Internal marketing, which contributes to employee intention to stay and creation of a unique workforce that is hard to imitate or duplicate by the competitors (Backhaus & Tikoo, 2004).

A systematic literature review (Dabrowska, 2014) shows that the employer branding models created by researchers can be divided into three main categories:

- Outside-in (employer branding) frameworks, focused on external factors in building employer's brand and image, e.g. Backhaus and Tikoo (2004) or Martin (2008).
- Inside-out (employee branding) frameworks, focused on internal factors in building employer's brand and employer of choice, e.g. Miles and Mangold (2004), Wilden et al. (2010).
- Corporate brand frameworks, treating employer brand and corporate brand as inseparably linked, e.g. Vision-Culture-Image (VCI) model by Hatch and Schultz (2008), Aggerholm et al. (2011).

However, in the practice of effective employer branding it is crucial to focus simultaneously on all the mentioned aspects (external, internal, corporate) by building one cohesive brand image in order to attract the best candidates and shape the intention to stay of current employees (Rzewuska et al., 2013).

1.3. Factors Influencing Employer's Atractiveness

Employer Value Proposition (EVP) created in the first step of the employer branding process should be real, achievable, stable, unique and attractive (Zajac-Paldyna, 2020). Such EVP is data-driven, based on legal and ethical requirements, competitors in sector, market trends as well as candidates' expectations (Dabrowska, 2014). The candidate's expectations, along with current employees' expectations, determine the employer attractiveness. Based on data collected from various sources, Charak and Zaware confirm five groups of EVP factors: rewards, career, institutional, work, and people (Charak & Zaware, 2020). As proposed by Sengupta and colleagues in their value proposition model for external employer branding in India (Sengupta et al., 2015), the values building employer attractiveness belong to five groups:

- Image and fundamental values like competitive pay and facilities, scope of balancing work and personal lives, the nature of job advertisement given by the company, moral practices of managers, working environment – relationship with peers and supervisor, scope of diversified learning, company brand, duty hours;
- Job structure values like information about continual training and development, job security—permanent or temporary, challenging and interesting job details;
- Work culture values – attrition rate, duration of assignment in case of project-based job. quick growth, office infrastructure;
- Reference values like referred by employee of the organization – present or past, referred by somebody whom you trust, location of the posting;
- Pride values like recognition or reward policy, position (Sengupta et al., 2015).

Despite cultural differences, a similar set of values seems to be applicable for Polish IT specialists. Due to a research carried out by Bulldog Job company under the auspices of the Ministry of Development and the Polish IT Association shortly before the COVID-19

pandemic outbreak, Polish IT specialists highly value: development possibilities (38% of subjects), competitive salary (24%), colleagues and managers (21%) and a quiet, steady job (16%). They are motivated to stay with the same employer for a longer time mostly by work atmosphere (more than 50%), competitive salary and flexible working hours (ca. 40%), possibility of technical development (28%), initiative and friends (ca. 20%), remote work (16%), new technologies, permanent contract and promotion possibility (ca. 10%) (BulldogJob, 2020). Due to the report, the main factor that could have an impact on job change is better salary (87% of subjects), but also possibility of technical development (42%), new technologies, remote work, promotion possibility, work atmosphere, flexible working hours and other (less than 25%). To decide whether to apply for a concrete position, more than 90% of respondents would like to get to know the potential employer's company from the inside and salary range. Moreover, they would like to know the technologies (49%), office location (36%), form of employment (34%), detailed information of the project (32%), description of required experience (32%), benefits, information about co-workers, office facilities or employer status as an industry leader (4%) (BulldogJob, 2020).

As shown in several studies, the factors influencing employer attractiveness can also be prioritized differently depending on generation or sex (Reis & Beatriz , 2016; Randstad, 2020). Due to Randstad's report, in Poland women and men attach the same or similar importance to payroll and benefits, job stability, clear promotion rules, work-life balance, office location, employer brand, high product quality, gender diversity, CSR and competent management. The differences are visible in areas of enjoyable work atmosphere, trainings and flexible working hours (men are less interested in this point) as well as a strong financial situation of the company, an interesting job and the newest technologies (men are more interested in this requirement) (Randstad, 2020).

Taking into consideration the results of pervious research and the COVID-19 outbreak (which resulted in faster digitalization, popularization of remote work, growing phenomenon of job insecurity), a question arises, which factors are currently most valued by employees in the IT sector in Poland, if the discrepancies between the sexes' points of view are apparent and how the coronavirus pandemic outbreak has changed candidates' preferences towards values offered by employers.

In the context of the literature review, the following hypotheses can be formulated:

Hypothesis No. 1:

H0. In the IT sector in Poland, the average rating of various EVP elements and employer attributes does not differ depending on sex.

H1. In the IT sector in Poland, the average rating of various EVP elements and employer attributes differs depending on sex.

Hypothesis No. 2:

H0. In the IT sector in Poland, the average rating of various EVP elements and employer attributes is the same for the representatives of different generations.

H2. In the IT sector in Poland, the average rating of various EVP elements and employer attributes differs for the representatives of different generations.

Hypothesis No. 3:

H0. In the IT sector in Poland, the COVID-19 pandemic has not resulted in higher interest in the EVP elements which guarantee job stability, remote work possibility, competitive salary, permanent contract, medical care, sports package/card, wide selection of training opportunities and flexible working hours.

H3. In the IT sector in Poland, the COVID-19 pandemic has resulted in higher interest in the EVP elements which guarantee job stability, remote work possibility, competitive salary, permanent contract, medical care, sports package/card, wide selection of training opportunities and flexible working hours.

2. Methodology

Quantitative research was conducted with the CAWI method. A research tool chosen for the research was a questionnaire prepared by the researcher in the Google Forms tool. The questionnaire content was verified by the author's supervisor and EB specialists in one of the IT corporations in Wroclaw. A pilot survey was conducted among five employees from various organizations, who did not take part in further stages. After eliminating ambiguities reported by the subjects of the pilot survey, the main survey was conducted on the 16th of March – 10th of April 2021 among the IT organizations' employees in Wroclaw, Lodz and Warsaw (targeted sample of companies). The return rate of the questionnaire is not possible to assess, because the final number of employees who received the survey is unknown.

The questionnaire consisted of three parts:(1) demographics (sex, age, seniority, job position, organization size), (2) employer branding and EVP, where the subjects decided how important when choosing an employer are the given EVP elements and employer attributes

Table 1. Research sample characteristics

Characteristics	Value	n	%
Sex	Female	42	36.5
	Male	73	63.5
Age (yrs.)	< 25	26	22.6
	26-30	32	27.8
	31-35	24	20.9
	35-40	23	20.0
	> 40	10	8.7
Tenure (yrs.)	0-3	32	27.8
	4-6	31	27.0
	7-10	18	15.7
	10-15	22	19.1
	> 15	12	10.4
Organization size	Micro	1	0.9
	Small	13	11.3
	Medium	2	0.9
	Big	99	86.1
Position	Developer / software engineer	56	48.7
	Application consultant / IT Support	20	17.4
	Manager / leader	17	14.8
	Software tester	14	12.2
	Other	8	7.0
Knowledge of EB	Yes	91	79.1
	No	24	20.9

as well as (3) employer branding in relation to COVID-19, where the subjects decided to what extent the given EVP elements are more important than before the COVID-19 outbreak. In both parts, the 5-point Likert scale was used, and the factors were limited without possibility to add additional, non-listed options. All variables were measured with single-item scales.

The research sample covers the employees working in IT organizations in Poland. There were 115 valid responses, but the sample cannot be considered as representative. Although efforts were made to ensure that the sample is sufficiently diversified considering the characteristics of subjects, more than 86% of subjects are employed in a big organization (more than 250 employees). Other sample characteristics are presented in Table 1.

3. Results

In the first step, the collected data has been analyzed using descriptive statistics. The basic analysis showed which EVP elements and attributes are the most important in the opinion of the subjects. The statistical analysis was conducted using IBM SPSS Statistics.

3.1. EVP Elements and Employer Attributes

The analysis of the answers on EVP elements shows that the first five factors rated as "(very) important" are: development and salary (97%), interesting tasks (95%), employment stability (94%) and flexible working hours (89%). The detailed results are shown in Table 2.

Table 2. EVP elements – descriptive statistics

No.	Factor	Average grade (scale 1-5)	σ
1	Development	4.60	0.57
2	Employment stability	4.57	0.64
3	Salary	4.56	0.58
4	Interesting tasks	4.51	0.65
5	Flexible working hours	4.47	0.79
6	Casual atmosphere	4.23	0.81
7	Office facilities	4.14	0.76
8	Employer reputation (current employees)	4.13	0.84
9	New technologies	4.10	0.88
10	Salary range listed in job offer	4.09	0.79
11	Remote work	4.09	1.09
12	Clear promotion rules	3.99	0.87
13	Office location	3.88	0.97
14	Person-organization fit	3.79	1.03
15	Rapid promotion possibility	3.63	0.92
16	Benefits	3.55	0.98
17	Employer reputation (on Internet)	3.03	0.96
18	Organization size	2.87	1.00
19	Employer reputation (friends from other companies)	2.75	1.02
20	Company events	2.61	1.08

Due to the participants, the most important employer attributes are: professionalism ("very important" or "important" for 86% of subjects), ensuring work-life balance (84%),

company stability (77%), supporting teamwork (65%), social responsibility (53%), industry leadership (51%) and family friendliness (48%). Less important attributes are supporting diversity and individuality (44% and 32%) as well as best employer awards (22%).

Table 3. EVP elements and employer attributes – average grade in groups and Mann-Whitney U test

No.	Factor	M (women) n=42	M (men) n=73	ΔM	Mann-Whitney U test			
					Mean rank (women)	Mean rank (men)	U	p
1	Salary	4.55	4.56	0.01				
2	Employer reputation (current employees)	4.21	4.08	0.13				
3	Employer reputation (friends from other companies)	2.67	2.79	0.12				
4	Employer reputation (on Internet)	3.00	3.04	0.04				
5	Salary range listed in job offer	4.12	4.07	0.05				
6	Person-organization fit	3.98	3.68	0.30	64.93	54.01	1242.0	0.077
7	Benefits	3.76	3.42	0.34	63.76	54.68	1291.0	0.133
8	Company events	2.76	2.52	0.24				
9	Organization size	3.05	2.77	0.28	63.64	54.75	1296.0	0.148
10	Clear promotion rules	4.26	3.84	0.42	68.12	52.18	1108.0	0.007
11	Interesting tasks	4.67	4.42	0.25	66.56	52.08	1173.5	0.016
12	Development	4.69	4.55	0.14				
13	Remote work	4.17	4.04	0.13				
14	Rapid promotion possibility	3.60	3.66	0.06				
15	Flexible working hours	4.57	4.41	0.16				
16	Casual atmosphere	4.26	4.22	0.04				
17	New technologies	3.95	4.19	0.24				
18	Office facilities	4.24	4.08	0.16				
19	Employment stability	4.62	4.55	0.07				
20	Office location	3.76	3.95	0.19				
21	Company stability	4.10	3.84	0.26	64.90	54.03	1243.0	0.071
22	Family friendliness	3.57	2.82	0.75	68.39	52.02	1096.5	0.009
23	Social responsibility	3.43	3.30	0.13				
24	Supporting individuality	3.21	2.89	0.32	64.70	54.14	1251.5	0.089
25	Supporting teamwork	3.76	3.77	0.01				
26	Best employer awards	3.00	2.37	0.63	69.18	51.57	1063.5	0.005
27	Ensuring work-life balance	4.26	4.22	0.04				
28	Supporting diversity	3.43	2.92	0.51	65.29	53.81	1227.0	0.069
29	Professionalism	4.36	4.22	0.14				
30	Industry leadership	3.71	3.22	0.49	67.02	52.81	1154.0	0.022

3.2. EVP Elements and Employer Attributes – Sex Differences

The hypothesis H1. "In the IT sector in Poland, the average rating of various EVP elements and employer attributes differs depending on sex" has been verified for those of the factors mentioned above, which are rated differently by men and women (i.e. only when the difference in rating exceeds 0.24). Due to the fact that the sample size for both groups is not equal (women – 42 answers, men – 73 answers) and the collected data tested with the Shapiro-Wilk test does not have a normal distribution ($p < 0.05$), the hypothesis was checked with the Mann-Whitney U test. The test results are presented in Table 3 above.

Based on the test results, the hypothesis H1 can be accepted in detailed form: in the IT sector in Poland, the average rating of importance of clear promotion rules, interesting tasks, family friendliness, best employer awards and industry leader status is statistically higher in the group of women.

3.3. Generational Differences

The hypothesis **H2.** "In the IT sector in Poland, the average rating of various EVP elements and employer attributes differs for the representatives of different generations" has been tested for three groups of generations in the labor market: (1) Z – digital natives, (2) Y – millennials and (3) – X and baby boomers, with the One-way Analysis of Variance (ANOVA) after checking the theoretical assumptions of ANOVA (Bedyńska & Cypryańska, 2013):

- The dependent variable must be a continuous (interval or ratio) level of measurement – this assumption is fulfilled due to measuring EVP elements and employer attributes with the Likert scale.
- No significant difference among the groups – to meet this assumption, from the whole sample (26 digital natives, 56 millennials, 33 X and baby boomers), only some answers have been randomly drawn (26 digital natives, 30 millennials, 30 X and baby boomers). The $\chi2$ for the chosen answers shows no significant difference among the groups.
- Assumption of normality – due to the Shapiro-Wilk test results, this assumption is not fulfilled. However, considering the sample size, the analysis can be further carried out as in this case ANOVA should be robust against violations of assumptions of normality.
- Homogeneity of variance – Levene's test showed that this assumption is violated ($p < 0.05$) for the following variables: salary range listed in job offer, clear promotion rules, interesting tasks, development, rapid promotion possibility, casual atmosphere, employment stability, company stability and family friendliness. For those factors additionally Brown-Forsythe and Welch tests have been performed. For all other factors, ANOVA analysis is sufficient.

Statistically significant differences were noted for clear promotion rules, rapid promotion possibility, family friendliness, new technologies, supporting individuality, and professionalism ($p < 0.05$). Descriptive statistics for those factors are shown in Table 4.

Table 4. Descriptive statistics of variables with statistically significant differences for generations

No.	Factor	Statistics					95% confidence interval		Rating (scale 1-5)	
		Gen.	n	M	σ	SE	Lower limit	Upper limit	Min.	Max.
1	Clear promotion rules	Z	26	4.31	0.68	0.13	4.03	4.58	3	5
		Y	30	3.47	1.04	0.19	3.08	3.86	1	5
		X	30	4.03	0.81	0.15	3.73	4.34	2	5
		All	86	3.92	0.92	0.10	3.72	4.12	1	5
2	Rapid promotion possibility	Z	26	4.04	0.66	0.13	3.77	4.31	3	5
		Y	30	3.40	1.04	0.19	3.01	3.79	1	5
		X	30	3.50	0.97	0.18	3.14	3.86	1	5
		All	86	3.63	0.95	0.10	3.43	3.83	1	5
3	Family friendliness	Z	26	2.27	1.25	0.25	1.76	2.77	1	5
		Y	30	3.20	1.67	0.30	2.58	3.82	1	5
		X	30	3.50	1.38	0.25	2.98	4.02	1	5
		All	86	3.02	1.53	0.16	2.70	3.35	1	5
4	New technologies	Z	26	4.42	0.70	0.14	4.14	4.71	3	5
		Y	30	4.20	0.96	0.18	3.84	4.56	1	5
		X	30	3.73	1.01	0.19	3.35	4.11	1	5
		All	86	4.10	0.95	0.10	3.90	4.31	1	5
5	Supporting individuality	Z	26	2.58	1.03	0.20	2.16	2.99	1	5
		Y	30	2.87	1.11	0.20	2.45	3.28	1	5
		X	30	3.37	1.10	0.20	2.96	3.78	1	5
		All	86	2.95	1.12	0.12	2.71	3.19	1	5
6	Professionalism	Z	26	4.54	0.71	0.14	4.25	4.82	3	5
		Y	30	4.00	0.91	0.17	3.66	4.34	1	5
		X	30	4.30	0.65	0.12	4.06	4.54	3	5
		All	86	4.27	0.79	0.09	4.10	4.44	1	5

Post Hoc Tamhane's and C Dunett's tests showed:
- statically significant differences ($p < 0{,}01$) between Generations Z (M = 4.31; SE = 0.68) and Y (M = 3.47; SE = 1.04) for clear promotion rules,
- statically significant differences ($p < 0{,}05$) between Generations Z (M = 4.04; SE = 0.66) and Y (M = 3.40; SE = 1.04) for rapid promotion possibilities,
- statically significant differences ($p < 0.05$) between Generations Z (M = 2.27; SE = 1.25) and X (M = 3.50; SE = 1.38) for family friendliness.

Post hoc Student–Newman–Keuls and Bonferroni tests showed:
- statically significant differences ($p < 0{,}05$) between Generations Z (M = 4.42; SE = 0.70) and X (M = 3.73; SE = 1.01) for new technologies,
- statically significant differences ($p < 0{,}05$) between Generations Z (M = 2.58; SE = 1.03) and X (M = 3.37; SE = 1,10) for supporting individuality,
- statically significant differences ($p < 0{,}05$) between Generations Z (M = 4.54; SD = 0.71) and Y (M = 4.00; SD = 0.91) for professionalism.

Based on the above analysis, the hypothesis H2 can be accepted in the detailed form: In the IT sector in Poland, the average rating of various EVP elements and employer attributes among the representatives of Generation Z is:

- for clear promotion rules, rapid promotion possibility and employer professionalism: higher than among the representatives of Generation Y,
- for new technologies: higher than among the representatives of Generation X and baby boomers,
- for family friendliness of the employer and supporting individuality: lower than among the representatives of Generation X and baby boomers.

3.4. COVID-19 Pandemic

In the questionnaire, the subjects were also asked to what extent the given EVP elements are more important than before the COVID-19 outbreak on the 5-point Likert scale (1 – to a very small extent; 2 – to a small extent, 3 – to a moderate extent, 4 – to a large extent, 5 – to a very large extent). The data was tested with the student's t-test to find the factors whose importance is statistically significantly higher than before the COVID-19 outbreak. Table 5 shows mean values of individual factors and the detailed t-test results.

Table 5. Student's t-test for the factors after COVID-19 outbreak (N=115)

No.	Factor	M	Student's t-test df = 114, tested value = 3					Student's t-test df = 114, tested value = 4				
			t	p	ΔM	95% CI		t	p	ΔM	95% CI	
						LL	UL				LL	UL
1	Job stability	4.08	9.727	0.000	1.078	0.86	10.00	0.726	0.469	0.078	-0.14	0.29
2	Perm. contract	3.77	5.292	0.000	0.765	0.51	6.01	1.843	0.068	0.235	-0.49	0.02
3	Salary	4.01	7.990	0.000	1.009	0.80	9.73	0.084	0.933	0.009	-0.20	0.21
4	Medical care	3.63	7.446	0.000	0.635	0.40	5.29	3.044	0.003	0.365	-0.60	-0.13
5	Sports card	2.10	12.78	0.000	0.904	1.13	-7.99	16.83	0.000	1.904	-2.13	-1.68
6	Flexible hours	3.91	2.259	0.000	0.913	0.67	7.45	0.709	0.480	0.087	-0.33	0.16
7	Remote work	4.39	9.727	0.000	1.391	1.18	12.78	3.594	0.000	0.391	0.18	0.61
8	Training	3.27	5.292	0.026	0.270	0.03	2.26	6.122	0.000	0.730	-0.97	-0.49

The analysis showed that the hypothesis H3. can be accepted as follows: In the IT sector in Poland, the COVID-19 pandemic has resulted in higher interest in the EVP elements which guarantee remote work possibility, job stability, permanent contract, competitive salary and flexible working hours.

4. Discussion

The research results report statistically significant differences in higher importance of selected EVP elements for women. In those terms, the findings also show statistically significant differences between Generation Z and Y as well as between Generation Z and generations older than Y. A comparison between current and previous empirical studies on EVP elements shows some differences in results (e.g. in this study sample, women are more interested in clear promotion rules than men, whereas previous studies show that there are not any significant differences between sexes). However, the findings of this study generally remain in line with theoretical approach presented in the literature, which underlines the need of creating an individual, targeted EVP based on adjusting a set of values building employer attractiveness (Dąbrowska 2014; Sengupta et al., 2015; Zajac-Paldyna, 2020). The

research results confirm also the results of an empirical study conducted in the Polish IT market shortly before the COVID-19 pandemic outbreak (BulldogJob, 2020) in terms of the most valued EVP elements among all groups: job stability, competitive salary, development possibility, flexible working hours. Moreover, according to the current study results, the COVID-19 pandemic outbreak strengthened the importance of the top-valued elements that guarantee job stability and employees' comfort in the new, pandemic reality.

4.1. Limitations

The main identified limitation of this study is the non-representative sample in the context of the organization's size, which can serve as a basis for further studies. Moreover, in all data series a skewness of distribution can be observed. This shows that the subjects rated almost all factors optimistically (above average) and may mean that the questions should be formulated differently. Due to the high grading of the questions by the participants, it is also very difficult to compare the results of the study with the previous research.

4.2. Study Implications

Regardless of the identified limitations, the conducted research has some practical and theoretical implications. Although the study shows that certain differences between sex and generational groups can be proven, it does not indicate possible reasons for those differences. In further studies, a detailed analysis could determine which factors showing statistical differences can have the most significant practical meaning in creating a targeted EVP. Another theoretical implication of this study is that the employers' views on EVP values cannot be considered as constant, which means that after some time, further analysis may be conducted to prove if the COVID-19 pandemic influence on employer expectations abates.

5. Conclusions

The research gap was filled by the literature review and the empirical study, which allowed to fulfill the aim of the paper, i.e. to investigate employer attractiveness in relation to the COVID-19 outbreak or target group characteristics (sex, generation). The research shows high expectations of specialists in the Polish IT market. Therefore, the study proves that in practice the EVP must be shaped cautiously and flexibly, considering not only the best and most well-known employer branding practices, but also employer expectations in the constantly changing world. A good start for creating such an individual EVP in the Polish IT sector can be the factors identified in this paper as important for certain target groups.

Conflict of interest: none

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Whether the Social Insurance Law Affects Scientific and Technological Innovation: Evidence Based on China's Inter Provincial Panel Data

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Abstract: Using the panel data of 30 provinces in China from 2008 to 2013, this paper makes an empirical analysis on the relationship between the promulgation and implementation of the social insurance law and the R&D investment intensity of Industrial Enterprises above Designated Size by using the double difference method. The results show that there is a positive correlation between the income of social insurance fund and the R&D investment intensity of Industrial Enterprises above designated size. This result is significant in the central region, but not significant in the eastern and western regions, indicating the difference of regional innovation. After replacing the explanatory variable with R&D investment of Industrial Enterprises above Designated Size, the result is still significant. This shows that the promulgation and implementation of the social insurance law in 2011 has stimulated the R&D investment behavior of Industrial Enterprises above designated size. The evidence provided based on the above research is helpful to understand the impact of the promulgation and implementation of the social insurance law on Scientific and technological innovation.

Keywords: social insurance law; income from social insurance fund; investment intensity of scientific and technological innovation; regional differences

JEL Classification: E65; H55; O32

1. Introduction

Since the 13th Five-Year plan, China has changed its development mode, implemented the innovation driven development strategy, and created an institutional mechanism to encourage innovation. In 2019, China's total investment in Scientific and technological innovation (R&D) was 2,214.36 billion yuan, an increase of 246.57 billion yuan or 12.5% over the previous year. The R&D investment intensity (ratio to GDP) was 2.23%, an increase of 0.09 percentage points over the previous year. Since 2013, China's total R&D expenditure has always ranked second in the world, and the gap with the United States has gradually narrowed. The investment intensity of R&D funds has increased steadily, which is close to the average level of 15 EU countries. Although China's investment in Scientific and technological innovation has achieved great success in quantity, its quality development is relatively backward. China is still at the middle and low end of the world industrial chain and is moving towards the middle and high end.

On July 1, 2011, China officially implemented the social insurance law, which marks that China's social insurance system has entered a new stage of standardized development with legislative guarantee. After the promulgation and implementation of the social insurance law, the income of social security fund increased rapidly, from 2,575.766 billion yuan in 2011 to 8,084.409 billion yuan in 2019, and the national social insurance fund expenditure increased from 1,887.713 billion yuan in 2011 to 7,498.923 billion yuan in 2019. The number of social insurance participants also increased significantly. The number of industrial injury insurance participants increased from 17,696 million in 2011 to 255 million in 2020, and the number of unemployment insurance participants increased from 143 million in 2011 to 205 million in 2020. The promulgation and implementation of the social insurance law is undoubtedly good news for workers, but problems also follow. Will this have an impact on innovation?

Using the panel data of provinces in mainland China from 2008 to 2014, this paper selects the social insurance expense income as the social insurance expense index, and takes the R&D investment and innovation expense investment intensity as the index to measure Scientific and technological innovation. On this basis, this paper makes an empirical analysis on the relationship between the promulgation and implementation of China's social insurance law and Scientific and technological innovation.

The rest of this paper is arranged as follows: the second part is literature review, the third part is data source, model construction, research variable selection and its corresponding statistical description, the fourth part is the results of empirical test, and the fifth part is the conclusion of this paper.

2. Literature Review

The existing literature mostly focuses on the impact of social security on economic growth, and there is little research on the relationship between social security and innovation. According to previous studies, we can know that in a company, with the increase of employee welfare, although the total cost of the company will rise, the number of patents applied by the company will increase, and the proportion of invention patents with the highest gold content in the total number of patent applications will also increase. That is to say, the increase of employee welfare not only promotes the increase of the number of enterprise innovation, At the same time, it also improves the quality of enterprise innovation (Wei et al., 2020). Sometimes, the strict social insurance contribution system will inhibit the innovation behavior of a single enterprise, resulting in the reduction of innovation input and innovation output. In order to maintain technological advantages, enterprises will join forces to carry out cooperative innovation and improve innovation efficiency on the whole (Shen et al., 2020). In the national and social context, contrary to the general view that welfare expenditure will weaken the innovation potential, the increase of social welfare can affect people's psychology by weaving a safety net, which can promote the innovation vitality of a country and contribute to the long-term growth of the country's economy (Koo & Joo, 2019). Welfare expenditure directly affects economic growth and fluctuation in the long run. At the same time, the increase of welfare expenditure promotes the economic performance of the state by stimulating the innovation ability of the state, especially in the states that pay attention to the

development of knowledge economy (Shen, 2019). In the agricultural sector of Denmark, the increase of social welfare expenditure will stimulate innovation and increase the overall social welfare (Akkaya et al., 2020). In China, after the full implementation of the new rural cooperative medical system, the probability of rural residents entering the hospital for formal treatment after illness has increased. When the hospitalization rate of rural residents suffering from related diseases increases by 10%, the number of drug patent applications increases by 12.4%, and the patent quality also increases slightly (Zhang & Nie, 2021). Not all scholars believe that a strict social insurance system will promote innovation. Compared with regions with lower endowment insurance payment rate, regions with higher endowment insurance payment rate have lower innovation intensity and investment (He & LV, 2019).

After the implementation of the social insurance law, it will stimulate innovation through two effects: producer effect and consumer effect. From the perspective of producer effect, after the implementation of the social insurance law, under a stricter legal system, enterprises have to pay social insurance for more employees, and the cost of enterprises will increase, which means that the financial burden of enterprises is heavier (Wei & Xia, 2020). In order to reduce labor costs, enterprises may choose to use capital factors instead of labor factors. Because compared with the rising labor cost, capital factors become more competitive, which will improve the overall productivity of enterprises (Huang & Li, 2013), which is reflected in the improvement of total factor productivity (Cheng & Wang, 2016). As a large manufacturing province, Zhejiang Province has many enterprises. In order to keep the competitive advantage, Zhejiang Province has made a lot of efforts. Finally, it is found that the structural adjustment of labor cost will have a significant impact on enterprise production efficiency, and productivity can be improved by increasing welfare and education expenditure (Sun et al., 2013). According to the research of many scholars, productivity growth is generally innovation driven, which means the emergence of innovation behavior (Liu & Wu, 2009). Under the pressure of rising labor costs, enterprises can also innovate production technology by increasing R&D investment (Lin, 2013). The endogenous growth theory supports the view that higher labor costs will force enterprises to innovate. From the perspective of consumer effect, the lack of necessary social security leads to the weak upgrading of consumption structure and restricts the transformation and upgrading of industrial structure (Wang, 2009). According to the lasting income theory and life cycle theory, consumers determine their consumption behavior according to the current income and expected future income; At the same time, people's consumption should not only consider current consumption, but also consider future consumption. Therefore, a sound social security system is very important to people's consumption behavior and consumption expectation (Liu, 2008). The improvement of social security level can increase the income expectation of residents, relieve people's worries, especially low-income people, and make them dare to spend immediately (Fan et al., 2017). The state has a large amount of funds for social security expenditure and a high level of social security, which means that the real income of workers increases. Under the influence of income utility, it will stimulate people to consume (Wang, 2000). This phenomenon not only occurs in China. Under the assumption of relaxing the rational economic man, using the analytical framework of behavioral economics to analyze the consumption cultural differences between

the East and the west, it will be found that the social security expenditure is positively correlated with the consumption rate in both eastern and Western countries (Ye & Li, 2012). When the social insurance law is implemented, consumers' consumption will increase, which means that consumers need more and better products, which will stimulate enterprises to innovate (Xiao, 2003).

Based on previous studies, this paper takes the implementation of the social insurance law in 2011 as the starting point, with the help of the relationship between social security and innovation behavior in different provinces and at different times after the implementation of the social insurance law, quantitatively studies the stimulating effect of the improvement of social security level on Innovation behavior.

3. Methodology

3.1. Data Resources

This paper uses the panel data of 30 provinces in China from 2008 to 2013 (excluding Tibet Autonomous Region, Hong Kong, Macao Special Administrative Region and Taiwan Province), mainly including the R&D investment intensity of Industrial Enterprises above Designated Size, the income of social insurance fund and the number of insured persons. The data are from the websites of the National Bureau of statistics and the Provincial Bureau of statistics. The social insurance fund income and the number of insured persons mainly include the data of five types of insurance, namely, endowment insurance, medical insurance, maternity insurance, industrial injury insurance and unemployment insurance. Among them, the fund income and the number of insured persons of endowment insurance and medical insurance are more, and their position in social insurance is more important. Using the research of Zhou and Tang (2016) in the measurement and influencing factor analysis of China's inter provincial innovation driven development capacity, this paper takes the industrial structure, government expenditure intensity, human capital, foreign direct investment, non-marketization degree and highway mileage as the relevant influencing factors.

3.2. Figures, Tables and Schemes

When China promulgated the social insurance law, China's labor costs were rising and innovation activities were increasing. The impact of the social insurance law on different provinces is different. Social insurance income is a continuous variable. If provinces are divided into two groups according to a certain threshold, it is difficult to capture the impact of subtle changes in social insurance income on innovation. Therefore, this paper uses Giroud and Mueller's ideas to construct a double difference (did) model of continuous variables. In order to solve the endogenous problem and identify the policy causal effect of social insurance law on innovation behavior. The following models can be established:

$$Innovation_{it} = a_1 + a_2law_t + a_3Sci_{it} + a_i*law_t*Sci_{it} + a_5x_{it} + z_{it} \tag{1}$$

In formula 1, i represents the province, t represents the year, $innovation_{it}$ represents the innovation behavior of i province in year t, law_t is the time dummy variable, representing the

implementation of the social insurance law. Assigned 0 before 2011 and 1 after 2011. a_4 is the regression coefficient, which captures the impact of the increase of social insurance income on the innovation behavior of the province after the implementation of the social insurance law. Under normal circumstances, the formal implementation of the social insurance law means stricter law enforcement standards, and the income of the social insurance fund will increase. Therefore, we control the interaction term of the dummy variable between the social insurance fund income and whether the social insurance law is implemented to measure its causal effect.

Xit is other control variables affecting innovation behavior. According to previous studies, we know that the factors affecting a region's innovation behavior include higher education resources, infrastructure, industrial structure, the degree of opening to the outside world, the intensity of fiscal expenditure and the degree of non-marketization. Among them, human capital is determined by dividing the number of graduates of colleges and universities over the years by the total population (hc). The infrastructure uses highway mileage (hw), the industrial structure uses the ratio of the added value of the tertiary industry to GDP (is), the degree of opening to the outside world uses foreign direct investment (fdi), and the intensity of financial expenditure is determined by the proportion of provincial financial expenditure in GDP (ife). The degree of non-marketization is expressed by the proportion of the sales revenue of state-owned enterprises in the total sales revenue of a province (nw).

3.3. Descriptive Statistics

The descriptive statistical results of variables are shown in Table 1.

Table 1. Descriptive statistical analysis of variables

Variables	Obs	Mean	Std.Dev
Law*lnSci	180	7.89	7.92
Law	180	0.50	0.50
lnSci	180	15.49	0.84
Is	180	0.41	0.09
Ife	180	0.22	0.09
hc	180	13.30	7.02
hw	180	0.004	0.002
lnfdi	180	10.59	1.37
nm	180	0.38	0.18

4. Discussion

4.1. Benchmark Regression Results

In this paper, the data of 30 provinces from 2008 to 2013 are used for double differential regression. The logarithm of R&D investment in each province is used as the explanatory variable, the logarithm of social insurance income in each province is used as the explanatory variable, and other relevant control variables are added for regression. The results are shown in Table 2.

Table 2. Decision on R&D investment intensity of industrial enterprises above designated size

	(1)	(2)
Variables	(R&D)/GDP	(R&D)/GDP
Law*lnSci	0.0009*** （5.02）	0.0013*** (5.42)
Constant	0.028 （1.48）	0.0083 (-0.97)
Control variable	NO	YES
Province fixed effect	YES	YES
Year fixed effect	YES	YES
Observations	180	180
R-squared	0.9815	0.9828

[1] Standard errors in parentheses; [2] *, * *, * * * are significant at the level of 10%, 5% and 1% respectively.

In the first column, without adding control variables, we can find that the regression coefficient of the interaction term of law*SCI is significantly positive by controlling the control effect of the year and the fixed effect of the province, which shows that the implementation of the social insurance law has significantly improved the innovation behavior of the province. In the second column, when all variables affecting the characteristics of provinces are added, the coefficient of the interaction term is still significantly positive, and the regression coefficient is greater than the cross-term coefficient without any control variables. The regression results in Table 1 show that the promulgation and implementation of the social insurance law did not inhibit innovation behavior, but stimulated innovation behavior. After adding relevant influencing factors, this result is still significant.

Table 3. Decision on R&D investment intensity of Industrial Enterprises above Designated Size in sub regions

	Eastern Region	Central region	Western Region
Variables	(R&D)/GDP	(R&D)/GDP	(R&D)/GDP
Law*lnSci	0.0004 (0.98）	0.0021*** (4.82)	0.0003 (0.99)
Constant	0.0125 (0.45)	-0.0064 (-0.27)	0.0246 (1.97)
Control variable	YES	YES	YES
Province fixed effect	YES	YES	YES
Year fixed effect	YES	YES	YES
Observations	180	180	180
R-squared	0.9909	0.9884	0.9775

[1] Standard errors in parentheses; [2] *, * *, * * * are significant at the level of 10%, 5% and 1% respectively.

Based on the specific analysis of the actual situation of each province, we can know that due to the influence of factors such as economic development level, culture and geographical location, the enforcement of social insurance law is different. Therefore, the stimulating effect of the implementation of social insurance law on innovation behavior is heterogeneous due to the different regions of each province. According to the zoning plan of the national

development and Reform Commission, we divide 30 provinces into three regions. The eastern provinces include Beijing, Tianjin, Hebei, Liaoning, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong, Guangxi and Hainan, and the central provinces include Inner Mongolia, Shanxi, Henan, Anhui, Jiangxi, Hunan, Heilongjiang, Jilin and Hubei, Western provinces include Shaanxi, Ningxia, Gansu, Sichuan, Xinjiang, Chongqing, Guizhou, Yunnan and Qinghai. According to the regression results in table 3, the promulgation and implementation of the social insurance law has a significant positive effect on the R&D investment of Industrial Enterprises above Designated Size in the central region, but it is not significant in the eastern and western regions. This may be because the Eastern Region strictly abided by the relevant social insurance legal system before the promulgation of the social insurance law, and the proportion of workers working in the eastern region is higher than that in the central and western regions. Therefore, the promulgation and implementation of the social insurance law did not have a great impact on their insured number and insured income. Due to the backward economy in the western region, the local government will greatly discount the law enforcement for economic consideration after the promulgation of the social insurance law, so the promulgation and implementation of the social insurance law will not have a great impact on the western region. The level of economic development and law enforcement in the central region are between the western region and the eastern region. After the promulgation of the social insurance law, the number of insured persons and insured income will increase greatly. Therefore, the promulgation and implementation of the social insurance law has the greatest impact on the central region.

In fact, it is not difficult to understand why the implementation of the social insurance law has an impact on the R&D investment of Industrial Enterprises above designated size. After the promulgation and implementation of the social insurance law, the strictness and intensity of law enforcement will be improved when there are laws to follow. The total amount of social insurance paid by enterprises for employees will rise, which essentially increases the cost of enterprises. Although enterprises will come up with other ways to avoid the impact of social insurance law, such as increasing the proportion of employees dispatched, these methods will address the symptoms rather than the root causes. In order to fundamentally solve this problem, it is necessary to reduce enterprise costs, improve enterprise productivity and increase innovation investment. With the increase of innovation investment, the use of new technology and the improvement of labor productivity, enterprises can reduce the investment of labor factors. The impact of social insurance law on enterprise cost is mainly realized through the social insurance paid by enterprises for employees. However, if enterprises increase investment in Scientific and technological innovation, the labor productivity of enterprises will increase and the demand for labor factors will decrease. The reduction of labor factor input means that enterprises can pay social insurance for fewer employees, which essentially reduces the cost of enterprises. In short, after the promulgation and implementation of the social insurance law, the cost of enterprises will increase because they have to pay more social insurance fees. In order to reduce the cost, enterprises will increase R&D investment and carry out more innovative activities.

If before the implementation of the social insurance law, the social insurance coverage rate of provinces with high innovation level is relatively high, the improvement of their innovation level may not be caused by the impact of the social insurance law, but due to the original trend. Therefore, using the double difference model, it is necessary to investigate whether the experimental group and the control group meet the parallelism assumption before the pilot, otherwise the estimation result is biased. Referring to the research of Bertrand and Mullainathan (2003), this paper constructs a model of parallelism test, and investigates the dynamic effect of social insurance law on the innovation degree of provinces at the same time.

The results of the parallelism test are reported in the table 4. Before1 - before3 are dummy variables, which respectively represent 3 years, 2 years and 1 year before the implementation of the social insurance law, current represents the year of policy implementation, after1 and after2 represent the data samples of 1 year and 2 years after the implementation of the policy. If it is the data of the corresponding year, the value of the dummy variable is 1, otherwise it is 0. If the sample meets the parallelism assumption, before the implementation of the social insurance law, the innovation degree of provinces with different social security degrees has a parallel trend, that is, the interaction terms between before1 - before3, current and lnSci are not significant, or the change trend is opposite to that after the implementation of the social insurance law. After the implementation of the social insurance law, this parallel trend is destroyed, that is, the interaction coefficient between after1 and after2 and lnSci is significant, or contrary to the change trend before the implementation of the social insurance law, indicating that the implementation of the social insurance law significantly changes the innovation trend of provinces. The results in the table show that the interaction term coefficients of before1 - before3 and lnSci are negative and significant at 1%, the interaction term coefficients of current and lnSci are not significant, and the interaction term coefficients of after1 and after2 and lnSci are positive and significant at 1%. This shows that before the implementation of the social insurance law, the increase of social security will inhibit innovation behavior, but after the implementation of the social insurance law, the increase of social security will stimulate innovation behavior.

4.3. Robustness Check

In order to make the results more reliable, we conducted a robustness test. By replacing the explanatory variables, the social insurance is divided into endowment insurance, medical insurance, maternity insurance, industrial injury insurance and unemployment insurance, regress the insurance income and the number of participants respectively. The results are shown in Table 5 and Table 6.

According to the regression results in the table, we can find that after replacing the explanatory variables, the coefficient of the cross term is still significantly positive, indicating that the regression result is stable. This result supports that the promulgation and implementation of the social insurance law will have a positive impact on innovation behavior.

Table 4. Regression results of parallelism test

Variables	(R&D)/GDP
Before1*lnSci	-0.0006*** （-2.36）
Before2*lnSci	-0.0003*** （-1.70）
Before3*lnSci	-0.0009*** （-3.31）
Current*lnSci	0.0003 （1.61）
After1*lnSci	0.0007*** （3.05）
After2*lnSci	0.0008*** （3.67）
Constant	0.0125 (0.45)
Control variable	YES
Province fixed effect	YES
Year fixed effect	YES
Observations	180
R-squared	0.9705

[1] Standard errors in parentheses; [2] *, * *, * * * are significant at the level of 10%, 5% and 1% respectively.

Table 5. Regression results by insurance type

	endowment insurance	medical insurance	maternity insurance	employment injury insurance	unemployment insurance
Variables	(R&D)/GDP	(R&D)/GDP	(R&D)/GDP	(R&D)/GDP	(R&D)/GDP
Law*lnSci	0.0010*** （4.13）	0.0012*** (5.10)	0.0007*** (3.23)	0.0007*** (3.23)	0.0012*** (4.52)
Constant	0.0223* （1.69）	0.0082 (0.60)	0.0143** (2.58)	0.0144*** (2.58)	0.0138* (1.71)
Control variable	YES	YES	YES	YES	YES
Province fixed effect	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES
Observations	180	180	180	180	180
R-squared	0.9844	0.9850	0.9847	0.9847	0.9850

1 Standard errors in parentheses; 2 *, * *, * * * are significant at the level of 10%, 5% and 1% respectively.

5. Conclusions

The promulgation and implementation of the social insurance law in 2011 caused great controversy at that time. Critics believe that China is still in the developing country stage, and the implementation of the social insurance law will increase the cost of enterprises, reduce the competitiveness of Chinese enterprises, and is not conducive to China's long-term development. Supporters believe that the promulgation and implementation of the social

Table 6. Regression results of the number of insured persons of each insurance type

	endowment insurance	medical insurance	maternity insurance	employment injury insurance	unemployment insurance
Variables	(R&D)/GDP	(R&D)/GDP	(R&D)/GDP	(R&D)/GDP	(R&D)/GDP
Law*lnSci	0.0010*** （4.13）	0.0012*** (5.10)	0.0007*** (3.23)	0.0007*** (3.23)	0.0012*** (4.52)
Constant	0.0223* （1.69）	0.0082 (0.60)	0.0143** (2.58)	0.0144*** (2.58)	0.0138* (1.71)
Control variable	YES	YES	YES	YES	YES
Province fixed effect	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES
Observations	180	180	180	180	180
R-squared	0.9844	0.9850	0.9847	0.9847	0.9850

[1] Standard errors in parentheses; [2] *, * *, * * * are significant at the level of 10%, 5% and 1% respectively.

insurance law is conducive to promoting the Scientific development of the whole human resources and social security cause, is a major measure to deeply implement the Scientific outlook on development and build a socialist harmonious society, and is conducive to stimulating China's growth potential in the long run. There is no conclusion on such controversy. Compared with the existing literature, this paper provides empirical evidence between the promulgation and implementation of social insurance law and R&D investment. Firstly, using the data of social insurance fund income of 30 provinces except Tibet in China from 2008 to 2013, after controlling the fixed effect of time and provinces and adding other relevant control variables, we can find that the promulgation and implementation of the social insurance law has a positive stimulating effect on R&D investment, Human capital and foreign direct investment will also have a positive impact on R&D investment. By regional analysis, it can be found that the promulgation and implementation of the social insurance law has a significant positive effect on R&D investment in the central region, but it is not significant in the eastern and western regions. Secondly, this paper transforms the explained variable and uses the R&D cost investment intensity as a new explained variable for regression. The results show that the implementation of the social insurance law will significantly improve the innovation cost investment intensity. Without controlling the time fixed effect, the result is still significant, and adding relevant control variables does not change the significance of the result. Based on the above two data, it can be found that not only the promulgation and implementation of the social insurance law will have a positive stimulating effect on innovation behavior, but also human capital and foreign direct investment will stimulate innovation behavior.

The evidence provided by this paper from 30 provinces in China helps to understand the impact of the promulgation and implementation of the social insurance law on innovation behavior, and also helps to understand why the promulgation and implementation of the social insurance law can improve China's economic growth potential in the long term.

Conflict of interest: none

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Impact of Agricultural FDI on China's Agricultural Green Total Factor Productivity

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Abstract: The introduction of agricultural foreign direct investment (FDI) is of great significance to improve China's agricultural green total factor productivity (GTFP) and promote high-quality agricultural development. This paper measures the agricultural GTFP of 23 provincial samples in China from 2006 to 2018 and makes an empirical study on the impact of agricultural FDI on agricultural GTFP. The basic results show that agricultural FDI has promoted the growth of China's agricultural GTFP, and this impact shows non-equilibrium characteristics in the main grain-selling regions, the main grain-producing regions, and the grain production and marketing balance regions. Moreover, the regression results of the threshold effect show that the agricultural FDI has a threshold effect on the level of economic development of China's agricultural GTFP. In regions with a high level of agricultural economic development, the introduction of agricultural FDI can be conducive to agricultural GTFP. On the contrary, the effect is not obvious or even inhibition. Therefore, China should actively introduce foreign direct investment, further optimize the layout of regional opening up, and implement differentiated agricultural investment policies.

Keywords: agricultural foreign direct investment; green total factor productivity; panel threshold effect

JEL Classification: Q01; Q56; Q58

1. Introduction

Since the reform and opening-up, China's agricultural economic development has made brilliant achievements. From 1978 to 2019, the added value of the primary industry increased from 101.85 billion yuan to 704.67 billion yuan, and the actual average annual growth rate (excluding price factor) reached 4.3%. However, the extensive agricultural growth model, which has long relied excessively on the input of production factors, has caused serious problems such as tighter agricultural resources, prominent environmental issues, and ecological environmental degradation. These problems have become the constraints that restrict the sustainable development of agriculture. The results of the Second Pollution Source Census in China showed that the chemical oxygen demand and total nitrogen emissions of agricultural water pollutants in 2017 were 1,067.13 million tons and 141.49 million tons, accounting for 49.77% and 46.52% of the total emissions. It can be seen that agricultural pollution has become one of the most severe environmental pollution problems in China. The deterioration of the agricultural ecological environment not only affects agricultural

production but also threatens the quality of agricultural products and human health. Therefore, promoting the mode of agricultural economic growth from high carbon extensive to green intensive is the crucial measure to realize the green development of agriculture. And the core of promoting the transformation of agricultural economic growth mode is to improve agricultural GTFP.

At the same time, with the deepening of China's agricultural opening to the outside world, agriculture has gradually integrated into the international division of the labor system. This situation has promoted the continuous expansion of FDI in China, which makes foreign agricultural investment become an essential factor affecting China's agricultural environmental pollution and productivity growth. According to the data released by the United Nations Conference on Trade and Development (UNCIAD), China's agricultural FDI has averaged 2.456 billion USD since 2016, ranking first in developing countries.

So, does the growing scale of China's agricultural FDI promote the growth of GTFP? If so, are there any characteristics of regional heterogeneity? Is this effect linear or non-linear? It is an urgent issue to be revealed. Answering these questions will help to improve the quality of agricultural FDI and agricultural GTFP in China. In addition, it is of great significance to promote the green and coordinated development of China's agriculture.

Therefore, based on the provincial panel data of China from 2006 to 2018, this paper uses the directional distance function and the global Malmquist-Luenberger index to measure the provincial agricultural GTFP. On this basis, we use the two-way fixed effect model to examine the impact of agricultural FDI on agricultural GTFP. Considering the difference in regional economic development level, this paper further uses Hansen's non-linear threshold model to test the non-linear effect of agricultural FDI on agricultural GTFP.

2. Literature Review

2.1. The Impact of FDI on GTFP

On the relationship between FDI and GTFP, the existing literature has done a lot of research and achieved many valuable results. On the one hand, some scholars have found that FDI promotes GTFP growth by transferring production technology and constructing supervision mode. Yang and Wang (2016) claimed that FDI could promote GTFP through technology spillover and pollution halo effect, Jing and Chen (2018) also reached similar conclusions. By using the spatial econometric model, Wang et al. (2021) found that FDI significantly promoted GTFP growth in local and surrounding areas. By using panel data from seven industries in China, Li et al. (2021) found that FDI has a positive impact on the GTFP of China's equipment manufacturing industry. On the other hand, some scholars hold opposing views that FDI will produce congestion effect, crowding-out effect, and pollution haven effect, which is not conducive to GTFP growth. According to Li and Fan (2019), China's ability to absorb and introduce re-innovation is weak, which makes China introduce FDI with high pollution intensity for a while, resulting in FDI hindering the growth of GTFP. Ren and Zuo (2021) also claimed that FDI suppresses the growth of GTFP, which confirms

the pollution paradise hypothesis. In addition, some scholars consider that FDI does not have a significant direct impact on China's GTFP, but promotes the growth of GTFP through positive interaction with environmental regulation and fiscal decentralization (Yuan & Xie, 2015; Li et al., 2016). Based on the spatial econometric model, Feng et al. (2021) found that the impact of FDI on China's GTFP is not statistically significant. FDI can only promote the growth of China's GTFP without considering the dynamic effect of China's GTFP and under the assumption of the human capital matrix.

2.2. The Impact of Agricultural FDI on Agricultural TFP

In recent years, whether agricultural FDI can effectively promote TFP growth has attracted wide attention in academia. However, scholars have not reached a consensus on the impact of agricultural FDI on agricultural GTFP. Specific views or propositions can be summarized into three categories. First, FDI significantly promotes agricultural TFP growth. Based on data from 28 African countries from 1980 to 2014, Adom (2018) found that FDI was conducive to improving agricultural production efficiency in African countries. By measuring the TFP of 24 provincial samples in China from 2004 to 2016, Wang et al. (2019) also concluded that agricultural FDI has a significant promoting effect on agricultural TFP. Based on China's provincial panel data, Li and Huang (2021) pointed out that agricultural trade liberalization has a significant positive impact on China's agricultural TFP. Chen et al., (2021) also reached similar conclusions. Second, FDI inhibits agricultural TFP growth. Yin (2017) considered that agricultural FDI reduced agricultural TFP by using China's provincial panel data from 1997 to 2012. Third, the effect of FDI on agricultural TFP is not obvious. Based on bilateral FDI flows from 108 host countries and 240 home countries from 1990 to 2012, Demir and Duan (2018) showed that bilateral FDI flows had no significant effect on agricultural productivity growth in host countries.

3. Methodology

3.1. Theoretic Mechanism

Agricultural FDI promotes GTFP growth through demonstration imitation effect, competition effect, human capital effect, and correlation effect. First, the introduction of agricultural FDI can transfer advanced science and technology, high-yield and high-quality varieties, and modern management organization system to China, which has a demonstration and imitation effect on local agricultural business entities. This effect can not only enhance the technical level and management level of China's agricultural business entities, but also promote agriculture to the high-end value chain. Second, the entry of foreign agricultural enterprises will intensify the local internal market competition, forcing local agricultural enterprises to increase investment in agricultural science and technology, using more efficient agricultural production equipment. This competitive effect helps to promote agricultural technological progress and improve technical efficiency. Second, the entry of foreign agricultural enterprises can intensify market competition. This competitive effect makes local agricultural enterprises increase investment in agricultural science and

technology (Han et al., 2021), thereby promoting agricultural technological progress and improving technical efficiency. Third, agricultural FDI is conducive to expanding the scale of local agricultural employment. To make better use of the labor resources of the host country, agricultural foreign-funded enterprises increase agricultural knowledge training for employees and promote the level of rural human capital to increase, thus improving the production efficiency of local agricultural enterprises. Finally, foreign agricultural enterprises have more advanced environmental governance technology and pollution prevention experience. Foreign agricultural enterprises can effectively promote the transformation of the pollution control mode of local agricultural enterprises by strengthening the links between the front and rear ends of the industrial chain (Poelhekke & Ploeg, 2015). It can improve local environmental quality.

Furthermore, the difference in regional development level leads to the non-linear effect of agricultural FDI on agricultural GTFP. The technological digestion and absorption capacity of local enterprises are related to regional economic development (Ma et al, 2016). When the level of regional economic development is low, the ability of local enterprises to digest and absorb technology is limited. At the same time, the entry of foreign capital will inevitably intensify industry competition, and some mainland enterprises will be squeezed out of the market. On the contrary, when the regional economic development reaches a certain level, local enterprises will have strong competitive capacity and technology learning ability, to internalize the advanced technology brought by FDI and promote the growth of agricultural GTFP. It means that only when the level of regional economic development reaches a certain level, local enterprises have the primary conditions to internalize foreign advanced technology, to play the positive role of agricultural FDI on agricultural GTFP.

Based on theoretical analysis, the following hypotheses are proposed:

1. The introduction of agricultural FDI can promote the growth of China's agricultural GTFP

2. The impact of agricultural FDI on China's agricultural GTFP may exist threshold effect based on the level of economic development

3.2. Model Establishment

To examine the impact of agricultural FDI on agricultural GTFP, this paper constructs the following model:

$$LnAGTFP_{it} = \alpha + \beta LnAFDI_{it} + \theta X_{it} + \mu_i + \gamma_t + \varepsilon_{it} \tag{1}$$

Among them, the subscript i and t represent province and year respectively, $LnAGTFP_{it}$ and $LnAFDI_{it}$ stand for the agricultural GTFP and the agricultural FDI in each province, respectively. The β is the influence coefficient of agricultural FDI on agricultural GTFP. Furthermore, the control variable X_{it} indicates other control variables that affect agricultural GTFP apart from agricultural FDI, μ_i represents all other province fixed effects that are not included in the model but may have an impact on the explained variable, γ_t stands for time fixed effect, and ε_{it} is the error term.

Furthermore, through the above theoretical analysis, this paper found that agricultural FDI may have a nonlinear impact on agricultural GTFP growth. Thus, it is necessary to examine the threshold effect of agricultural FDI on agricultural GTFP growth. Based on the study of Hansen, this paper selects the level of economic development as the threshold variable to construct the panel threshold model of agricultural FDI on agricultural GTFP. The model is set as follows:

$$LnAGTFP_{it} = \alpha + \beta_1 LnAFDI_{it} \times I(Thr \leq \phi) + \beta_2 LnAFDI_{it} \times I(Thr > \phi) + \theta X_{it} + \mu_i + \gamma_t + \varepsilon_{it} \quad (2)$$

Among them, $I(\cdot)$ is the threshold indicator function, *Thr* is the threshold variable, ϕ is the specific threshold value, and the remaining variables have the same meaning as above.

3.3. Data Source and Variable Selection

This paper selects the data of 23 provinces in China from 2006 to 2018 as samples. The data of this paper mainly comes from the Statistical Yearbooks of China's provinces, China Agricultural Statistics Yearbook, China Statistical Yearbook, China Economic Network statistical database, and China Human Capital Index Report (2019).

The explained variable in this paper is agricultural GTFP. This paper uses the directional distance function considering undesirable output and the global Malmquist-Luenberger productivity index to measure the GTFP of each province in China from 2006 to 2018. On the one hand, this paper measures agricultural input from six aspects: labor, land, mechanical power, fertilizer, water, and livestock. Specifically, we use the number of workers in the primary industry as the proxy variable of labor input, the crop planting area as the proxy variable of land input, the total power of agricultural machinery as the proxy variable of mechanical power input, the amount of agricultural chemical fertilizer application as the proxy variable of chemical fertilizer input, the agricultural water consumption as the proxy variable of water input, and the number of end-of-year livestock stock as the proxy variable of livestock input. On the other hand, this paper measures agricultural output from the perspective of expected output and undesirable output. This paper measures the expected output of agriculture by referring to Gao's (2015) approach, that is, the added value of the primary industry at constant prices in each province from 2005 to 2018. Besides, this paper uses the method of Li (2011) to estimate agricultural carbon emissions in each province of China and uses agricultural carbon dioxide emissions as undesirable outputs.

Agricultural FDI is the core explanatory variable of this paper. This paper uses the proportion of actual agricultural use of foreign capital to the added value of the primary industry to express the level of agricultural use of foreign capital in each province. Due to the lack of data on the actual use of FDI in agriculture in some provinces, the final sample adopts the data of 23 provinces except Shanxi, Jilin, Fujian, Hainan, Sichuan, Tibet, Qinghai, and Ningxia.

Our research takes the level of economic development (LnAPGDP) as the threshold variable. This variable measures the level of economic development by calculating the actual

value-added of the primary industry per capita by the actual value-added of the primary industry/rural population.

Five control variables are selected in our research. First, this paper uses the proportion of agricultural expenditure to the added value of the primary industry to measure agricultural expenditure (GOV). Second, we use the ratio of crop planting area to total crop planting area to describe the agricultural structure adjustment (AS). Third, we reflect the agricultural natural disaster rate (DR) by the ratio of the affected area to total crop acreage. Fourth, urbanization (Urban), which uses the ratio of urban population to resident population in each region to represent the urbanization rate. Fifth, industrialization (Ind) is measured by the proportion of industrial added value to GDP.

The descriptive statistics of variables are shown in Table 1.

Table 1. Descriptive statistics of variables

Variables	Mean	St.d	Min	Max	N
LnAGTFP	0.648	0.376	-0.013	1.7267	299
AFDI	0.662	0.927	0.001	6.075	299
LnAPGDP	38.984	63.784	1.275	485.291	299
GOV	54.983	15.228	26.960	89.610	299
AS	55.578	12.399	21.240	86.090	299
DR	0.647	0.376	-0.013	1.727	299
Urban	0.725	0.441	-0.018	1.738	299
Ind	-0.079	0.173	-0.750	0.264	299

4. Results

4.1. Preliminary Results

Before the regression of the benchmark model, this paper analyzes the possible collinearity problem and spurious regressions problem. The panel data model form as follows: First, variance expansion factor (VIF) is used to test the possible multicollinearity. The test results show that the values are less than 5, indicating that there is no severe multicollinearity problem between variables. Second, the LLC and IPS tests are used to test the stability of the main variables. The panel data unit root test results show a single first-order integral I(1) between the main variables. Further panel cointegration test results show a long-term cointegration relationship between the main variables. Third, the traditional fixed-effect model only considers the differences between individuals but does not consider the influence of the time effect. The missing variables may lead to estimation bias. Therefore, to eliminate the estimation bias of the model, this paper uses the two-way fixed effect model to estimate the impact of agricultural FDI on agricultural GTFP.

In Table 2, columns 1 and 2 are the impact of agricultural FDI on agricultural GTFP without and with control variables, respectively. It shows that regardless of whether the control variables are added or not, the estimated coefficients of AFDI are positive at the 1% significant level, indicating that agricultural FDI has a positive promoting effect on improving agricultural GTFP. Specifically, for every 1% increase in the proportion of agricultural FDI, the agricultural GTFP will increase by 0.04%, which also verifies Hypothesis 1 of this paper. The Chinese government has long attached great importance to

improving the quality and level of FDI in agricultural utilization. The government limits the entry of agricultural projects with high pollution and high energy consumption by setting a negative list of agricultural foreign investment access. At the same time, the government encourages foreign investment in high-tech agricultural industries, biomass energy, energy conservation, and environmental protection industries. To achieve the goal of promoting agricultural industrial structure adjustment and promoting agricultural sustainable development. Besides, through the foreign investment projects, agricultural germplasm resources, modern agricultural equipment technology, agricultural environmental protection technology, foreign professional and technical talents, and advanced management concepts can be introduced. It can be seen that the introduction of agricultural FDI is conducive to global green technology transformation, to improve agricultural production efficiency and agricultural GTFP.

Table 2. The impact of agricultural FDI on agricultural GTFP: basic results

Variables	All regions	All regions	Main grain-producing regions	Main grain-selling regions	Grain production and marketing balance regions
	(1)	(2)	(3)	(4)	(5)
AFDI	0.040***	0.035***	-0.012	0.038***	-0.006
	(5.508)	(4.945)	(-0.791)	(3.089)	(-0.126)
Constant	0.076***	-0.616***	-0.751***	-2.363**	-1.909***
	(4.503)	(-3.388)	(-3.542)	(-2.033)	(-6.296)
Observations	295	295	142	65	88
R^2	0.951	0.957	0.977	0.954	0.983
Controls	NO	YES	YES	YES	YES
Individual	YES	YES	YES	YES	YES
Time	YES	YES	YES	YES	YES

Notes: The superscripts ***, **, * are significant at the level of 1%, 5%, and 10%, respectively. The t-statistic is in brackets.

To further investigate the regional differences in the impact of agricultural FDI on agricultural GTFP, this paper divides the national samples into three sub-samples according to the grain function zoning. These three sub-samples are the main grain-producing region, the main grain-selling region, and the grain production and marketing balance region. Specifically, the main grain-producing regions include Liaoning, Jilin, Heilongjiang, Henan, Hebei, Hunan, Hubei, Jiangxi, Anhui, Sichuan, Jiangsu, Inner Mongolia, and Shandong. The main grain-selling regions include Beijing, Shanghai, Tianjin, Zhejiang, Guangdong, Fujian, and Hainan. And the grain production and marketing balance regions include Guangxi, Chongqing, Yunnan, Guizhou, Shanxi, Shaanxi, Qinghai, Gansu, Ningxia, Xinjiang, and Tibet.

In Table 2, columns 3 to 5 show the regression results of three sub-samples. It can be found that, on the one hand, the agricultural FDI in the main grain-selling regions promotes the improvement of agricultural GTFP at a significant level of 1%. For every 1% increase in the proportion of agricultural FDI, the agricultural GTFP will increase by 0.038%. The possible reason is that the main grain-selling regions have a high level of economic development, and their capital is sufficient. In the process of introducing foreign investment,

these regions pay more attention to the quality of agricultural FDI rather than quantity. On the other hand, the introduction of agricultural FDI in the main grain-producing regions and the grain production and marketing balance regions will hinder agricultural GTFP. But, the result is not significant. The reason is that the primary purpose of agricultural FDI in these regions is to seek resources, and foreign-funded enterprises have blocked and protected their core technologies. At the same time, due to the lack of human capital, it is difficult to absorb and transform advanced agricultural technologies. Thus, there is no adequate technology spillover in these regions.

4.2. Results of the Threshold Effect

Before the panel threshold analysis, it is necessary to test a threshold effect and the number of thresholds. To this end, according to Hansen's bootstrap method, repeated sampling 1,000 times to calculate the corresponding P-value and threshold value. The test results are shown in Table 3. It can be found that when the level of economic development is used as a threshold variable, the impact of agricultural FDI on agricultural GTFP has passed a single threshold test, and the threshold value is 8.685.

Table 3. The impact of agricultural FDI on agricultural GTFP: basic results

Threshold variable	Hypothesis testing	P-value	Threshold	95% Confidence interval
LnAPGDP	Single threshold	0.000	8.685	[8.653, 8.689]

Table 4. The impact of agricultural FDI on agricultural GTFP: threshold model regression results

Variables	Estimated Coefficient
LnAPGDP ≤ 8.685	-0.089***
	(-4.589)
LnAPGDP > 8.685	0.036***
	(3.943)
Constant	-2.731***
	(-16.022)
Observations	260
R^2	0.919
Controls	YES
Individual	YES
Time	YES

Notes: The superscripts ***, **, * are significant at the level of 1%, 5%, and 10%, respectively. The t-statistic is in brackets.

Table 4 reports the estimation results with the level of economic development as the threshold variable. It can be found that when the actual per capita added value of the primary industry is lower than the threshold value of 8.685, agricultural FDI has a significant negative impact on agricultural GTFP. When the actual per capita added value of the primary industry crosses the threshold value of 8.685, agricultural FDI promotes the growth of agricultural GTFP. It shows that in the process of absorbing foreign investment in agriculture if the local economic development is low, the ability of local enterprises to digest

and absorb technology is limited, and cannot produce a technology spillover effect. On the contrary, the entry of foreign capital will inevitably intensify competition in the industry, which will squeeze some mainland enterprises out of the market and lead to the decline of agricultural GTFP. When economic development reaches a certain level, the local agricultural enterprises will have strong competitive capacity and technology digestion and absorption capacity. At this time, these enterprises can internalize the advanced technology brought by FDI, thereby promoting the growth of agricultural GTFP, which verifies Hypothesis 2.

4.3. Results of the Robustness Test and Endogenous Treatment

This paper conducts the following robustness tests. First, the calculation method of agricultural GTFP is replaced. The directional distance function and Sequential Malmquist-Luenberger productivity index recalculate the agricultural GTFP. On this basis, the benchmark regression model is estimated. Second, replace the proxy variable of agricultural FDI. The logarithm of the absolute value of agricultural FDI is used as the proxy variable of agricultural FDI. Based on this, the two-way fixed effect model is used for estimation. Third, control the fixed effect of province and time interaction. Although the individual fixed effect and the time fixed effect have been controlled in the benchmark regression, the sample still faces the problem of different time trends. That is, agricultural GTFP in different regions may show different trends over time. To this end, this paper uses Bai's (2009) proposed interaction fixed effect model to re-estimate. The results of the robustness test are shown in columns 1 to 3 of Table 5.

Table 5. The impact of agricultural FDI on agricultural GTFP: robustness test and endogenous treatment

Variables	Robustness test			Endogenous treatment	
	(1)	(2)	(3)	(4)	(5)
AFDI	0.035***		0.015***	0.081***	0.032*
	(4.945)		(4.159)	(4.698)	(1.882)
LnAFDI		0.012***		0.001***	0.001***
		(2.597)		(2.874)	(4.058)
Constant	-0.616***	-0.619***	-0.012	0.638**	-0.623***
	(-3.388)	(-3.239)	(-0.067)	(2.409)	(-3.303)
Observations	295	295	295	270	295
R²	0.957	0.954	-	0.945	0.957
Controls	YES	YES	YES	YES	YES
Individual	YES	YES	YES	YES	YES
Time	YES	YES	YES	YES	YES

Notes: The superscripts ***, **, * are significant at the level of 1%, 5%, and 10%, respectively.
The t-statistic is in brackets.

In addition, there is an endogeneity problem caused by reverse causality between agricultural FDI and agricultural GTFP, resulting in biased and inconsistent estimation results. Therefore, this paper uses the method of an instrumental variable to re-estimate to control and solve endogenous problems. It should be noted that this article selects tool variables from two aspects: First, this paper uses the lag phase of agricultural FDI as the

instrumental variable of current value. In general, agricultural FDI in the lag period strongly correlates with the current value, which affects agricultural GTFP through the current value. In contrast, the current agricultural GTFP has no effect on agricultural FDI in the previous period. Second, based on the method of He and Liu (2016), this paper uses the geographical distance between each province and its nearest port to construct the instrumental variable. On the one hand, the geographical distance between the provinces and their nearest ports is fixed and not affected by external factors, thus meeting exogenous conditions. On the other hand, the geographical distance between provinces and their nearest ports can reflect the cost of trade and transportation to a certain extent, thus affecting the trade of agricultural products. Therefore, there is a close correlation between geographical distance and FDI. The results of the endogenous treatment are shown in columns 4 to 5 of Table 5.

5. Discussion

This paper expands the existing research from the following aspects: First, the current literature mainly focuses on the impact of agricultural FDI on agricultural TFP (Jing & Chen, 2018; Li et al., 2021; Ren & Zuo, 2021), but the research on the impact of agricultural FDI on agricultural GTFP is slightly insufficient. The realization of high-quality agricultural development is not limited to improving agricultural TFP, but emphasizes the coordinated development between economic growth and environmental protection. Second, the existing research mainly examines the overall impact of agricultural FDI on agricultural TFP, without fully considering the differences among regions (Yang & Wang, 2016; Demir & Duan, 2018; Li & Fan, 2019; Feng et al., 2021). In fact, there are great differences in regional economic development in China. This difference will affect China's internalization of foreign advanced agricultural technology, and thus lead to a non-linear impact of agricultural FDI on China's agricultural TFP (Chen et al., 2021).

6. Conclusions and Recommendations

In this paper, we tried to prove that, firstly, agricultural FDI promotes the growth of agricultural GTFP in China. Besides, the impact of agricultural FDI on agricultural GTFP presents regional non-equilibrium characteristics. Specifically, the agricultural FDI in the main grain-selling regions has promoted the growth of agricultural GTFP. In contrast, the agricultural FDI in the main grain-producing regions and the grain production and marketing balance regions have no significant influence on agricultural GTFP. Thirdly, there is a threshold effect of agricultural FDI on agricultural GTFP. In regions with a high level of agricultural economic development, the introduction of agricultural FDI will be more conducive to agricultural GTFP. On the contrary, the effect is not obvious or even inhibition.

Based on the conclusions of this research and combined with the current situation of agricultural development in China, the policy recommendations of this paper include the following three aspects:

(1) The current agricultural FDI still plays a positive role in promoting green agricultural development. Introducing foreign investment is still an essential choice for China to promote agricultural technology progress and realize agricultural modernization.

Therefore, based on ensuring food security, on the one hand, we should steadily promote the opening up of the agricultural sector, reduce restrictions on the investment, and optimize the negative list of agricultural foreign investment access. On the other hand, it is necessary to expand the scale of foreign agricultural investment and attract high-tech agricultural enterprises to invest in China.

(2) We should continuously optimize the layout of regional opening, broaden the financing channels of foreign-invested enterprises, and reduce their logistics costs. Through these measures, agricultural FDI flows to areas with a low agricultural development level, thus narrowing the regional gap of China's agricultural GTFP.

(3) Local governments should rationally treat agricultural FDI and implement differentiated agricultural investment policies. For regions with a high economic development level, we should optimize the orientation of foreign investment and support the development of the foreign investment. At the same time, these regions should actively introduce high-quality agricultural FDI and advanced technology management experience. For regions with a low level of economic development, on the one hand, it is necessary not only to look carefully and comprehensively at the role of foreign agricultural investment, but also to introduce foreign investment targeted and selective. On the other hand, these regions should play the role of technology spillover of agricultural FDI by improving technological innovation ability.

Conflict of interest: none

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Intellectual Property Strategy and Urban Innovation: Experience from Intellectual Property Demonstration Cities

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Abstract: The protection of intellectual property is the protection of innovation. As a policy pilot of China's national intellectual property strategy, the construction of intellectual property demonstration city is of great significance to urban innovation. Based on the panel data of 283 cities in China from 2006 to 2018, this paper uses the double difference method to evaluate the impact of intellectual property demonstration cities on urban innovation. The research of this paper shows that: (1) Intellectual property demonstration cities have a significant effect on improving urban innovation, and the effect is stable. (2) Prefecture level cities with low administrative level and weak degree of government intervention are approved. Intellectual property demonstration cities play a greater role in promoting urban innovation. (3) The mechanism shows that the intellectual property demonstration city mainly promotes urban innovation by increasing the government's scientific and technological expenditure in finance and strengthening the protection of intellectual property rights.

Keywords: intellectual property demonstration city; urban innovation; intellectual property protection

JEL Classification: C51; D78; O31

1. Introduction

Innovation is the first driving force leading development. At present, China's domestic and international environment is facing complex changes and economic development is gradually changing from the stage of high-speed growth to the stage of high-quality development, it is urgent to strengthen the first driving force of innovation. In the environment of the new era, the original regional economic growth mode relying on demographic dividend and resource endowment has brought a series of challenges to the sustainable growth of urban economy, which no longer meets the requirements of high-quality urban economic development. Innovation is an important way to solve China's regional development and transform the existing urban economic development mode. Innovation activities do not occur in a vacuum. They need a series of resources such as capital, technology, personnel and system, most of which are inseparable from the participation of the government. In the process of practicing innovation and leading development, the Chinese government has carried out a number of policy pilot work. These measures provide a starting cradle for innovation activities from the aspects of financial supply, institutional guarantee and administrative support. Among them, intellectual property pilot and

demonstration cities is a new practice of promoting the reform of intellectual property governance model in China (Zheng & Li, 2020). Existing studies have proved that intellectual property demonstration cities can significantly promote the optimization and upgrading of urban industrial structure (Bo & Angang, 2020), but existing studies have not answered in detail the impact of intellectual property demonstration cities on innovation. Based on this, this paper attempts to study the impact of intellectual property demonstration cities on urban innovation, and how the pilot policies affect urban innovation.

2. Literature Review

Market economy can stimulate the innovation power of various micro market subjects to the greatest extent. In market economy, many micro innovation subjects can spontaneously build an innovation network and even an innovation ecosystem suitable for the birth of innovation activities (Tianyang & Lihong, 2019). At the same time, the government plays an indispensable role in the ecosystem composed of micro innovation subjects. The government will have an important impact on the innovation activities of micro market subjects by issuing fiscal and tax policies to support scientific and technological innovation, directly setting up guidance funds to provide funds for enterprise innovation, and legislating measures to protect innovation achievements (Lishan & Yuanhai, 2019).

The characteristics of high investment, uncertain income and long cycle of innovation make the traditional capital suppliers such as banks and financial institutions unwilling to provide or only provide less loans to many micro innovation subjects (Hart & Moore, 2008). At this time, in order to make up for market failure, it is necessary for government departments to intervene. On the one hand, they formulate policies to force financial institutions to complete a certain amount of loans for small and micro enterprises (Teixeira & Ferreira, 2019). On the other hand, they directly give certain financial support to micro innovation subjects through financial science and technology expenditure. Compared with other government policies, fiscal expenditure on science and technology plays a more targeted and exemplary role. The pertinence is to directly give funds to micro innovation subjects, bear part of the R&D costs of enterprises, and may be more efficient in operation than other methods (Chang, 2011).

Dexin et al. (2020) believe that for innovation activities with long-term and high-risk characteristics, a single enterprise cannot independently bear the innovation cost. The government's financial science and technology expenditure enters the enterprise R&D process and plays a role in sharing the enterprise cost, thus reducing the enterprise's innovation risk. The demonstration lies in the entry of government financial science and technology expenditure, which is equivalent to a kind of certification for enterprises, enhances the credibility of micro innovation subjects, gives them fishing, and weakens the adverse selection problem caused by information asymmetry in the financing market (Yue, 2018). At the same time, it can also be combined with a number of policies to leverage social capital into enterprises, so as to alleviate the problem of insufficient R&D funds (Bloom et al., 2019).

As one of the formal systems faced by innovation, the importance of regional legal environment to innovation activities has been recognized by theoretical circles (Chunye &

Zuyin, 2012). As a regional legal protection of innovation benefits, the weak level of intellectual property protection will cause free riding behavior of market participants and restrict the innovation motivation of micro innovation subjects. Appropriate intellectual property protection is a necessary condition for the existence of the incentive effect of independent innovation (Chaopeng & Di, 2016). Therefore, government departments design and implement more effective formal laws to strengthen the current intellectual property system, which is conducive to encouraging micro themes to engage in innovation and obtain patents.

One of the main sources of non-innovation related forces of patent surge is policy incentive. The competition between market participants not only occurs in the product market, but also in the court (Hu et al., 2017). Whether the legitimate interests of the intellectual property owner can be effectively maintained affects the incentive of the company's innovation power (Huang et al., 2017). In the work focus of Intellectual Property Demonstration City, it is mentioned to strengthen the protection, and the main tasks include improving the effect of urban intellectual property law enforcement and protection. Under the supervision of the assessment requirements, the importance of intellectual property law enforcement and protection in intellectual property demonstration cities will inevitably be improved. On the one hand, administrative penalties will be used to stop the infringement of market participants and reduce free riding; On the other hand, the legal system helps micro innovation subjects obtain their reasonable rights and interests and stimulate the innovation power of innovation subjects (Grimaldi et al., 2021).

3. Methodology

3.1. Model Building

This paper uses DID (Differences-in-Differences) to evaluate the performance of intellectual property demonstration cities on urban innovation, and constructs two virtual variables according to the basic steps of DID model.

$$Innovation_{jt} = \alpha_0 + \alpha_1 policy + \alpha_i X_{jt} + \varepsilon_{jt} + \mu_j + \delta_t \tag{1}$$

In formula (1), the subscript j represents the city and t represents the time. $Innovation_{jt}$ is the explanatory variable of this paper, which indicates the innovation of city j in t year; $policy$ is the core explanatory variable of this paper; X_{jt} represents a series of other control variables that change over time and affect urban innovation; ε_{jt} is the error term. Coefficient; μ_j is urban fixed effect; δ_t is time fixed effect. α_1 is the core parameter of this paper, which indicates the impact of intellectual property demonstration city on urban innovation. If intellectual property demonstration city can indeed improve the urban innovation, then the coefficient α_1 should be significantly positive.

This paper uses the intermediary effect model to explore the action mechanism of Intellectual Property Demonstration City on urban innovation, and constructs the following regression model.

$$Innovation_{jt} = \alpha_0 + \alpha_1 policy + \alpha_i X_{jt} + \varepsilon_{jt} + \mu_j + \delta_t \qquad (2)$$

$$ZS_{jt}(KJ_{jt}) = \beta_0 + \beta_1 policy + \beta_i X_{jt} + \theta_{jt} + \mu_j + \delta_t \qquad (3)$$

$$Innovation_{jt} = \gamma_0 + \gamma_1 policy + \gamma_2 ZS_{jt}(KJ_{jt}) + \gamma_i X_{jt} + \varphi_{jt} + \mu_j + \delta_t \qquad (4)$$

In equations (2) to (4), ZS and KJ respectively represent the intermediary variable intellectual property protection effect and financial science and technology support effect. μ_{jt}、φ_{jt} is the random disturbance term. If the regression coefficient α_1、β_1 and γ_2 are significant, if the regression coefficient of the core explanatory variable in equation (4) γ_1 less than α_1. Explain that the effect of the core explanatory variable on the explained variable is partially absorbed by the intermediary variable, and there is some intermediary effect; if γ_1 is not significant, indicating that the influence of explanatory variables on the explained variables is completely absorbed by intermediary variables, and there is a complete intermediary effect.

3.2. Data Sources

In this paper, the data of patents to measure innovation, financial science and technology expenditure to measure the effect of financial support and control variables are from China research data service platform. The missing data of some prefecture level cities in some years are supplemented through the statistical yearbook of the province (District) where the city is located. The data of intellectual property protection intensity to measure the effect of property protection comes from the magic weapon judicial case database of Peking University and is collected and sorted manually.

3.3. Index Selection

In this paper, the widely recognized patent index is adopted, and the total number of patents applied in that year represents the innovation of the city. The explanatory variable of this paper is the virtual variable of Intellectual Property Demonstration City (policy), if an intellectual property demonstration city is approved in a certain year, the value is 1, and other cases are 0. Government financial science and technology support (KJ) adopts the proportion of government science and technology expenditure in public financial expenditure; For the intensity of intellectual property protection, the degree of intellectual property protection (ZS) is measured by the number of intellectual property trial cases closed in the judicial case base of Peking University magic weapon, and logarithmic processing.

This paper selects the degree of economic development (GDP), which is calculated by dividing GDP by the total resident population at the end of the year; Financial market development level (Fin), calculated by dividing the balance of deposits and loans of financial institutions by GDP; Entrepreneurial activity (Act), calculated by the proportion of urban private and individual employees in the total resident population at the end of the year; Human capital level (Hum), calculated by the proportion of the number of students in Colleges and universities in the total resident population of the city at the end of the year; FDI level (FDI): calculated by dividing the actual amount of foreign capital utilized by GDP.

Table 1. Descriptive statistical analysis of variables

Variable	Variable Meaning	N	Mean Value	Std. Deviation
Innovation	innovation of the city	3,679	0.4516	11886
Policy	intellectual property demonstration city	3,679	0.0794	0.2704
KJ	financial support for science and technology	3,679	1.3809	1.4103
ZS	Intensity of intellectual property protection	3,679	2.1676	2.0927
GDP	economic development	3,679	4.3686	46142
Fin	Financial market development level	3,679	0.8505	0.4516
Act	Entrepreneurial activity	3,679	11.9066	13.7474
Hum	Human capital level	3,679	1.6768	2.2873
FDI	Foreign direct investment	3,679	0.0181	0.01922

3.4. Model Hypothesis

This paper puts forward the following assumptions from the analysis of policy effect and action path.

Hypothesis 1: Intellectual property demonstration cities can improve urban innovation.

Hypothesis 2: Intellectual property demonstration cities has significantly promoted urban innovation by increasing regional financial and scientific and technological expenditure and improving the protection of intellectual property rights.

4. Results

4.1. Results of the Benchmark Model

As a unique policy pilot, intellectual property demonstration city has a positive impact on promoting the cultivation of urban innovation environment and the supply of innovation resources, and then improves urban innovation. The net effect of intellectual property demonstration cities is given in column (1) of Table 2. Before the control variable is added, the estimated coefficient of the impact of intellectual property demonstration cities on the urban innovation is 1.727, which is significant at the level of 1%, indicating that approved intellectual property demonstration cities can significantly improve the innovation, which preliminarily verifies the rationality of theoretical hypothesis 1. After adding control variables in column (2) of Table 2, at this time, the net impact coefficient of Intellectual Property Demonstration City on urban innovation is 0.9269, which is significant at the level of 1%. It is reasonable to believe that intellectual property demonstration city can significantly promote urban innovation.

As a quasi natural experiment, Intellectual Property Demonstration City, as an institutional experiment, provides a strong boost to the creation of innovation atmosphere and the supply of innovation resources in pilot cities, which is of profound significance to China's urban economy from factor driven development to innovation driven development and realize high-quality economic development, and strongly supports the rationality of theoretical hypothesis 1.

4.2. Robustness Check

1. Elimination of unobservable variables. Due to the large number of prefecture level cities in China, there are great differences in their development endowments. As a special

Table 2. Impact of Intellectual Property Demonstration City on urban innovation

Variable	Innovation (1)	Innovation (2)	Innovation (3)	Innovation (4)	Innovation (5)
Policy	1.7270*** (34.06)	0.9269*** (18.65)	0.7806*** (15.41)	0.5658*** (17.03)	0.5307*** (23.92)
Fin	/	0.0312** (7.88)	0.0411*** (9.76)	0.0354** (9.07)	0.0707** (2.52)
Act	/	0.0052*** (3.25)	0.0066*** (4.52)	0.0031*** (2.91)	0.0040* (1.75)
FDI	/	-0.0249*** (-3.39)	-0.0373*** (-5.43)	-0.0224*** (-4.54)	-0.0167** (-2.07)
Hum	/	-0.1109*** (-5.68)	-0.1541*** (-6.15)	-0.0702*** (-5.37)	-0.0800*** (-3.91)
GDP	/	0.2489*** (30.66)	0.2167*** (28.79)	0.1539*** (28.37)	0.2040*** (22.22)
Cons	0.0863** (2.51)	-0.3081*** (-7.36)	-0.2462** (-6.71)	-0.1828** (-6.54)	-0.3238*** (-4.73)
City fixed effect	Yes	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes	Yes
N	3,679	3,679	3,341	3,679	3,679
R2	0.4569	0.5506	0.5141	0.5126	0.5574

Note: *, * *, * * * are significant at the level of 10%, 5% and 1% respectively. In parentheses is the value of t

policy pilot, intellectual property demonstration city plays an important role in the innovation of the pilot city. The provincial capital city may lead to systematic differences due to its unique urban characteristics. In order to eliminate the unobservable variables between cities, eliminate all provincial capital cities in the sample, and use the new sample for robustness test. The regression results are shown in column (3) of Table 2. It can be seen that the regression results are consistent with the above.

2. Replace the explained variable. Motivated by obtaining R&D subsidies, enterprises continue to increase the number of patent applications, but the average quality of patents is not necessarily improved. Therefore, the number of patent applications does not necessarily reflect the innovation of the city. According to the existing literature, this paper uses the number of inventions authorized in the current year in the number of patent applications as the proxy index of the innovation of the city, and re estimates the benchmark model. The results are shown in column (4) in Table 2. The results fully confirm that the intellectual property demonstration city can significantly promote urban innovation.

3. Avoid simultaneous equation errors. Considering that the pilot policy may not have an immediate impact, this paper deals with the pilot of the demonstration city in a delayed phase. At the same time, in order to avoid the error of simultaneous equations, all control variables are also treated with one-stage lag. The regression results are shown in column (5) of Table 2. It can be found that after the lag treatment, the estimation coefficient of the pilot demonstration city is still significantly positive, indicating that the error of simultaneous equations has not affected the estimation results.

4.3. Action Mechanism Test

After proving the innovation effect of intellectual property model city construction, this paper further explores the mechanism of promoting the effect. In the previous theoretical hypothesis, this paper believes that intellectual property demonstration city has financial support effect and property protection effect, and promotes urban innovation through the above two effects. According to the models (2) to (4) set up in this paper, this part makes an empirical test on the intermediary effect.

First, the test and analysis of the mechanism of financial support effect. The regression results of financial support effect after adding control variables and fixing time and city at the same time are shown in columns (2) and (3) of Table 3. The coefficient of the core explanatory variable policy is significantly positive at the level of 1%, indicating that intellectual property demonstration city has significantly promoted the level of urban financial science and technology expenditure. And $\gamma_1 = 0.8887$ less than $\alpha_1 = 0.9269$, indicating that intellectual property demonstration city can improve the level of urban innovation by increasing urban financial science and technology expenditure, and the intermediary effect is significant. The above test results confirm the view that intellectual property demonstration city promotes urban innovation through financial support effect.

Second, the test and analysis of the effect mechanism of property right protection. The regression results of property protection effect after adding control variables and fixing time and city at the same time are shown in columns (4) and (5) of Table 3, and the coefficient of the core explanatory variable policy is significantly positive at the level of 1%, indicating that intellectual property demonstration city can significantly increase the city's protection of intellectual property. After adding the variable of intellectual property protection, the promotion coefficient of innovation level of intellectual property protection cities will be increased $\gamma_2 = 0.1484$ is significantly positive at the level of 10%, and $\gamma_1 = 0.9186$ less than $\alpha_1 = 0.9269$ shows that intellectual property demonstration city can indeed promote the level of urban innovation by increasing the protection of urban intellectual property rights, and the intermediary effect is significant. Therefore, the test results support the view that intellectual property demonstration city promotes urban innovation through property protection effect.

Table 3. Function mechanism of Intellectual Property Demonstration City on urban innovation

Variable	Innovation	KJ	Innovation	ZS	Innovation
	（1）	（2）	（3）	（4）	（5）
policy	0.9269***	0.2574***	0.8887***	0.5730***	0.9186***
	（18.65）	（3.26）	（18.37）	（5.75）	（18.40）
KJ			0.1484***		
			（14.12）		
ZS					0.0146*
					（1.70）
Cons	-0.3081***	0.0616***	-0.3172***	1.0509*	-0.3234***
	（-7.36）	（0.93）	（-7.80）	（12.53）	（-7.56）
City fixed effect	Yes	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes	Yes
N	3,679	3,679	3,679	3,679	3,679
R2	0.5141	0.2401	0.5757	0.5933	0.5510

Note: *, * *, * * * are significant at the level of 10%, 5% and 1% respectively. In parentheses is the value of t.

To sum up, the promotion effect of Intellectual Property Demonstration City on urban innovation is mainly realized through two mechanisms: financial support effect and property protection effect. Among them, the effect of financial support is to provide financial support for the R&D and innovation of urban micro innovation subjects; The effect of property right protection is to protect the legitimate rights and interests of micro innovation subjects and improve their enthusiasm for innovation by cracking down on violations of law and infringement.

5. Discussion

As a special policy pilot, intellectual property demonstration city plays an important role in the innovation of pilot cities, which is easily affected by the degree of government intervention and urban administrative level (Ben & Lihua, 2018). Specifically, the decisive role of the market in resource allocation can realize the effective incentive of property rights, fair and orderly competition and the survival of the fittest. In a good market economic environment, it can stimulate the vitality and innovation willingness of microeconomic subjects to the greatest extent, while strong government intervention will affect the operation effect of market mechanism (Manfeng et al., 2019), and then weaken the role of Intellectual Property Demonstration City in improving urban innovation.

In terms of urban administrative level, provincial capital cities, sub provincial cities and cities specifically designated in the state plan have a unique aura in terms of access to policy care and resource preference due to their high urban administrative level. Therefore, even if intellectual property demonstration cities are approved, the resources obtained will not improve their urban innovation. The general prefecture level cities can obtain more policy preferences and financial subsidies than before in approved intellectual property demonstration cities, so they have the unique effect of late development advantage (Fuzheng & Guanghang, 2021). Therefore, the promotion effect of its approved intellectual property model city on the urban innovation is greater than that of sub provincial cities and above.

Table 4. Regulatory effect test results

Variable	Weak government intervention	Weak government intervention	Low administrative level	High administrative level
	Innovation	Innovation	Innovation	Innovation
	（1）	（2）	（3）	（4）
policy	0.8778***	0.5987***	0.7701***	0.6527***
	（12.46）	（7.20）	（19.55）	（3.16）
Cons	-0.8048**	-0.0181	-0.2072**	-0.0619
	（-6.02）	（0.68）	（-7.76）	（-0.13）
City fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
N	1,827	1,852	3,263	416
R2	0.5867	0.2631	0.5504	0.7294

[1] Note: *, * *, * * * are significant at the level of 10%, 5% and 1% respectively; In parentheses is the value of t.

This paper measures the degree of regional government intervention by the proportion of local fiscal expenditure in regional GDP. According to the cities higher and lower than the median degree of government intervention in each year, they are divided into two samples

for regression respectively. The results show that columns (1) and (2) in Table 4. Intellectual property demonstration cities with weak government intervention can significantly promote urban innovation, and its core explanatory variable is significantly greater than the coefficient of cities with high degree of government intervention. It fully shows that the intellectual property demonstration city with weak government intervention plays a stronger role in promoting urban innovation.

In this paper, provincial capital cities, sub provincial cities and cities specifically listed in the state plan are defined as high administrative level cities, and the rest are defined as low administrative level cities. The regression results are shown in columns (3) and (4) of Table 4. The promotion effect of demonstration cities with higher financial business environment on urban innovation is much greater than that of cities with lower financial business environment, which highlights that the promotion effect of demonstration cities on urban innovation with higher financial business environment has a higher marginal effect.

6. Conclusions

Institutional reform is the key boost to China's economic rise, and the policy pilot is the pioneer of the institutional reform test and has an important impact on the improvement of China's urban innovation level. As a part of the policy pilot, the construction of intellectual property demonstration cities with intellectual property as the theme has become an important step to drive urban innovation. Based on the panel data of 283 prefecture level cities in China from 2006 to 2018, this paper empirically tests the impact of the construction of intellectual property demonstration cities on the level of urban innovation and its channels by using the double difference model.

The conclusions of this paper are as follows: (1) the construction of intellectual property demonstration city can significantly promote the improvement of urban innovation; (2) The mechanism test shows that the construction of intellectual property demonstration city has significantly improved urban innovation by increasing regional financial science and technology expenditure and improving the level of regional intellectual property protection; (3) Heterogeneity research shows that the impact of the construction of intellectual property demonstration cities on urban innovation is significantly different due to their different administrative levels and the degree of government intervention. Specifically, the intellectual property demonstration cities with weak government intervention and low administrative level cities will play a greater role in promoting urban innovation.

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Free Trade Zone Construction and Value Chain Upgrading: Empirical evidence from China

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Abstract: Under the new development pattern of dual circulation, free trade zones (FTZs), as an important carrier and platform for linking domestic and international loops, will promote China to involve and take a lead in advancing economic globalization with a higher level of opening-up, thus facilitating the upgrading in value chain of country. Using a sample of 280 prefecture-level cities in China from 2012-2017 and combining input-output table data, this paper empirically examines the impact of FTZs construction on the upgrading of China's value chain. It is found that the construction of FTZs can significantly promote the upgrading of China's value chain; the heterogeneity test results suggest that the construction of FTZs is more effective in promoting the value chain upgrading in coastal FTZs, regions with higher intellectual property protection and better marketization. Furthermore, the concentric ring effect analysis indicates that the construction of FTZs in China currently shows more of a siphon effect.

Keywords: free trade zone; value chain upgrading; intellectual property protection; level of marketization; concentric ring effect

JEL Classification: E6; L6; R5

1. Introduction

Under the global value chain dominated by developed countries, China mainly participates in the international division of labor with low-end elements, and has the problem of strong dependence on imports in industries with high technological complexity, and the shortcomings of core technology cannot be compensated in the short term, thus inhibiting the high-quality development of the Chinese economy (Lu et al., 2020; Yang & Fan, 2015). At a time when the world is undergoing major development, transformation and adjustment, the global economy is faced with growing uncertainties under the influence of the fourth industrial revolution and the Coronavirus Disease 2019 (COVID-19) pandemic and many other factors. Considering the changing international situation and aiming to adapt the country to the new trends of economic globalization, on September 21, 2020, the State Council issued the Overall Plans for the Beijing, Hunan and Anhui Pilot Free Trade Zones and the Plan for the Expansion of the Zhejiang Pilot Free Trade Zone. So far, China's pilot free trade zones have formed a new pattern of "1+3+7+1+6+3", demonstrating country's firm determination to promote a comprehensive opening up to the outside world. Therefore, under the new economic paradigm of dual circulation which takes domestic circulation as the mainstay with domestic and international development reinforcing each other, this paper intends to enhance the

understanding about what role do China's pilot free trade zones play against the background and how does the FTZs construction contribute to the upgrading of value chains.

The existing literature mainly focuses on the impact of FTZ construction on regional economic development. For example, the construction of FTZ not only brings about the improvement of regional location advantages, but also strengthens the synergistic and complementary relationship between regions (Ren et al., 2016), promotes regional economic growth through the "trade effect" and "investment effect" (Wang et al., 2020), and provide incentive for the development of central and peripheral cities through the institutional innovation effect (Wang, 2020). Although the construction of FTZs exerts an obvious positive influence on regional economic growth, there is a certain lag, showing obvious regional and industrial heterogeneity (Ye, 2018; Li & Liu, 2021). In addition, a small part of the research has also explored the impact of FTZ construction on trade development, for example, Xiang Houjun et al. (2016) emphasized that FTZ construction triggers a differentiated effect on the import and export of goods trade and only has a significant impact on the net import of goods trade. But some scholars have also found that FTZ construction leads to the growth of urban exports and has not changed the way of goods trade exports (Jiang Lindo et al., 2021). In summary, numerous researches have been conducted to explore the factors affecting the upgrading of value chains, however, very limited studies have provided empirical evidences from policy implementation perspective, especially the impact mechanism of China's FTZs construction on the upgrading of value chains. The continuous expansion of China's FTZs construction has advanced opening-up at a higher level, thus accelerating the pace to set up new pattern for development. It is foreseeable that the construction of FTZs will have a profound and sustained impact on the structure of China's export products, providing strong impetus for upgrading of the value chain.

2. Methodology

In this paper, annual data of 280 prefecture-level cities in mainland China from 2012-2017 were selected as the research sample. The empirical data were obtained from the 2012-2017 China Statistical Yearbook, China Labor Statistical Yearbook, China Science and Technology Statistical Yearbook, and the statistical yearbooks of prefecture-level cities. In addition, data on patent infringement cases were gathered from the State Intellectual Property Office.

Value chain upgrading refers to the gradual transformation of the industrial chain from manufacturing-centered to service-centered. From the perspective of the "smile curve", the servitization of manufacturing can extend the industrial chain to the downstream with higher added value by improving the R&D and innovation system, exerting economies of scale and scope, and adopting product differentiation strategies (Liu et al., 2016). In this paper, we chose the degree of servitization in manufacturing as an estimator to measure industrial chain upgrading (vcu), which can be obtained through calculating the direct consumption coefficient matrix and complete consumption coefficient matrix based on the input-output tables for each Chinese province in 2012, 2015 and 2017, as shown in equation (1).

$$vcu_{ij} = a_{ij} + \sum_{k=1}^{n} a_{ik}a_{kj} + \sum_{s=1}^{n}\sum_{k=1}^{n} a_{is}a_{sk}a_{kj} + \cdots \qquad (1)$$

where vcu_{ij} indicates the servitization level of the manufacturing sector j, a_{ij} represents the complete consumption coefficient of the manufacturing sector j to the sector i, $\sum_{k=1}^{n} a_{ik}a_{kj}$ and $\sum_{s=1}^{n}\sum_{k=1}^{n} a_{is}a_{sk}a_{kj}$ denotes the first and second round of indirect consumption respectively. Further, this paper applied the method of mean and interpolation for filling the missing data in 2013, 2014 and 2016. Considering that the higher the ratio of tertiary industry to secondary industry, the higher the impact on value chain upgrading correspondingly, therefore, we selected the ratio of tertiary industry to secondary industry in prefecture-level cities and interpolate with the value chain upgrading index at the provincial level to obtain the value chain upgrading data reflecting the prefecture-level city level.

In addition, the control variables selected in this paper are the level of economic development (gdp): expressed by using GDP per capita; the level of human capital investment (edu): expressed by using the ratio of education expenditure to fiscal expenditure; the degree of foreign trade dependence (trade): expressed by using the proportion of total import and export to regional GDP of each prefecture-level city; the level of fixed asset investment (fixinv): expressed by using the proportion of fixed asset The level of fixed asset investment (fixinv): expressed by the proportion of fixed asset investment to regional GDP of each prefecture-level city; government intervention (gov): expressed by the proportion of government financial expenditure to GDP; R&D level (rd): expressed by the proportion of R&D expenditure to GDP of each prefecture-level city.

Table 1. Descriptive statistics of variables

Variable	N	Mean	St.d	Min	Max
ftz	1,680	0.0238095	0.1525007	0	1
vcu	1,680	0.1898697	0.1607246	0	3.271856
gdp	1,680	33.44872	560.3687	0.01534	11492.17
edu	1,680	18.16449	3.954222	4.362782	35.62073
trade	1,680	1.121153	6.277398	0	97.63366
fixinv	1,680	0.9067985	2.368057	0	74.24695
gov	1,680	19.57282	9.074226	0.0001946	70.09467
rd	1,680	1.597342	1.465738	0.0658214	12.64753
mkt	1,680	6.827304	1.564273	2.53	10

3. Results

3.1. Construction of the Economic Model

During the study period over 2012-2017, there were 25 prefecture-level FTZs established in China, located in Shanghai, Guangzhou, Shenzhen, Zhuhai, Tianjin, Xiamen, Fuzhou, Dalian, Shenyang, Yingkou, Zhoushan, Hangzhou, Ningbo, Jinhua, Zhengzhou, Kaifeng, Luoyang, Wuhan, Xiangyang, Yichang, Chongqing, Chengdu, Luzhou, Xi'an and Xianyang. Aiming to examine whether FTZs can promote the value chain upgrading, this paper draws on the study of Bertrand and Mullainathan (2003) to run regressions by employing a multi-period DID model, a model that describes the situation where individuals are not perfectly

aligned at the point in time of treatment. In this paper, the interaction term (*Treat × Post*, replaced by *ftz* in this paper) between the treatment group dummy variable and the treatment time dummy variable is incorporated directly into the regression model. Among them, the magnitude and significance of the coefficient β is the main focus of this paper. The coefficient reflects the impact of the FTZ construction on the upgrading of the value chain before and after the implementation of the FTZ, and if β is significantly positive, it means the FTZ construction helps to promote the upgrading of the regional value chain. The specific regression model is presented as follows.

$$vcu_{it} = \alpha + \beta FTZ_{it} + \lambda X_{it} + \mu_i + \delta_t + \varepsilon_{it} \tag{2}$$

where, vcu_{it} is the independent variable measuring the level of the value chain in region t at time i. FTZ_{it} is the core dependent variable indicating whether region i has established an FTZ at time t and is a dummy variable which equals 0 for every year before the establishment of the FTZ and equals 1 for every year after the establishment of the FTZ. X_{it} is the set of control variables, μ_i is the region fixed effect, δ_t is the time fixed effect, and ε_{it} is the random error term.

3.2. Results of the Benchmark Model

Table 2 shows the results of the benchmark regression of the establishment of the FTZs on value chain upgrading, where model (1) only controls the core explanatory variables, model (2) controls the core explanatory variables and the control variables, model (3) further controls regional fixed effects based on model (2), and in model (4) a double fixed effects test is performed. The findings in Table 2 reveal that the coefficients of the core explanatory variables ftz are all significantly positive at the 1% statistical level.

Table 2. The impact of FTZ on value chain upgrading

	(1)	(2)	(3)	(4)
	vcu	vcu	vcu	vcu
ftz	0.0962	0.0752	0.0988	0.0657
	(0.0003)	(0.0037)	(0.0000)	(0.0000)
Control	YES	YES	YES	YES
_cons	0.1882	0.1996	0.7042	0.5980
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
μ_i	NO	NO	NO	YES
δ_t	NO	NO	YES	YES
N	1,680	1,680	1,680	1,680
R2	0.0079	0.1285	0.3690	0.4402

3.3. Results of the Heterogeneity Test

Initially, the total 25 FTZs in China has been assigned with different tasks according to their own geographic benefits, thus there may exists regional differences in the impact of FTZs construction on promoting value chain upgrading. Therefore, in order to test regional heterogeneity, this paper divides the sample into coastal FTZs and inland FTZs two groups based on the criterion of whether the location of FTZs are on China's coastline or not, then conducts a partition test, with the results shown in columns (1) and (2) of Table 3.

Moreover, stronger IPR protection contributes to protect the legitimate rights and interests of innovators, reduce the risk of enterprises' high-tech investments, optimize technology investments returns, and motivate enterprises to increase their innovation R&D investment, which in turn improves the quality of export products (Li & Miao, 2018) and promotes the upgrading of regional value chains. Therefore, this paper seeks to further validate the heterogeneity analysis of IPR intensity. Regarding the measurement of the strength of IPR protection, we draw on the sub-index of IPR protection in the Fan Gang Marketization Index (Fan et al., 2011). Regions are divided into two categories according to the median, those below the median are regions with poor IPR protection, and those above the median are regions with better IPR protection, and the test results are shown in columns (3) and (4) of Table 3.

Ultimately, market integration can ensure the smooth flow of factors between regions, which creates the favorable conditions for regional value chain upgrading. Therefore, we can reasonably expect that the effect of China's FTZs construction on value chain upgrading is more significant in regions whose market is better integrated. To further verify the heterogeneous impact of market integration, this paper selects the marketization index proposed by Fan Gang and Wang et al. (2011) as an estimator of market integration level, then divide the sample into regions with lower marketization and regions with higher marketization two kinds based on the median value, and the regression results are shown in columns (5) and (6) of Table 3.

Table 3. Heterogeneity test of FTZs for value chain upgrading

	(1)	(2)	(3)	(4)	(5)	(6)
	Coastal	Inland	Low level of IPR	High level of IPR	Less market-oriented	Highly market-oriented
ftz	0.0777	0.0169	0.0036	0.0854	0.0383	0.0896
	(0.0161)	(0.0197)	(0.0413)	(0.0160)	(0.0418)	(0.0144)
Control	YES	YES	YES	YES	YES	YES
_cons	-0.1110	0.6147	-0.0383	0.6817	-0.0100	0.6173
	(0.0537)	(0.0530)	(0.0318)	(0.0800)	(0.0549)	(0.0657)
μ_i	YES	YES	YES	YES	YES	YES
δ_t	YES	YES	YES	YES	YES	YES
N	678	1,002	815	865	850	830
R2	0.362	0.504	0.591	0.598	0.424	0.549

3.4. Analysis of Concentric Ring Effects

In order to further explore the spatial effect of the FTZ construction, this paper draws on the study of Lu et al. (2019) to calculate the spatial distance of each city. Firstly, using Amap to obtain the latitude and longitude information of all prefecture-level cities, and measuring the spatial distance between two of cities. Secondly, exploring the spatial effect of FTZs by examining the cities whose geographical location is within a 50 km radius of the FTZs, and then gradually extending to 300 km. Compared with the traditional spatial measurement model, this method can not only examine the existence of the spatial effect of FTZs establishment, but also detect the direction of this effect and the scope of influence. The specific model is constructed as follows.

$$vcu_{it} = \gamma_0 + \gamma_1 FTZ_{it} + \sum_{n=1}^{6} \sigma_n Ring((n-1),n)_i \times Post_t + \lambda X_{it} + \mu_i + \delta_t + \varepsilon_{it} \qquad (3)$$

In equation (3), $Ring((n-1),n)$ is a set of dummy variables that equals 1 when the city i is located within $((n-1),n]$ of the FTZ, and 0 otherwise, where = 1,2,...,6. For example, when n =1 means that the city is located within 50 km of the FTZ, when n =2 means that the city is located within 50-100 km of the FTZ, and so on. Figure 3 plots the estimated coefficients σ_n in 95% confidence intervals as the location of the concentric ring changes.
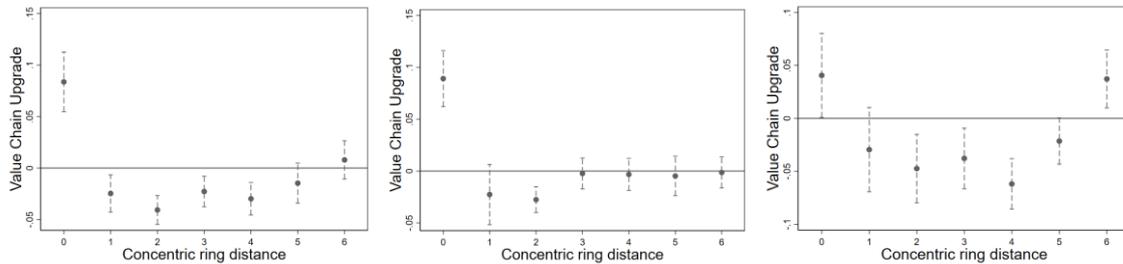
Figure 1. Concentric ring effect test results (the first figure is the overall concentric ring effect, the second figure is the coastal FTZ concentric ring effect, and the third figure is the inland FTZ concentric ring effect)

4. Discussion

In order to examine the impact of the China's FTZs construction on value chain upgrading, this paper explores the correlation between the two by employing a multi-period DID model with a research sample of 280 prefecture-level cities in China. The data analysis demonstrates that the establishment of FTZs plays a positive role in upgrading of regional value chains. Moreover, the construction of FTZs has obvious regional heterogeneity and the empirical evidence indicates that coastal FTZs are better able to promote the upgrading of regional value chains, while inland FTZs' positive effect is not significant at present. The main reason for this is that due to geographical constraints, the development of inland FTZs is relatively immature, and the trade scale effect has not yet been formed for the possessed resources, however, with the continuous deepening and improvement of FTZs, the potential of factor resources may be gradually unleashed. Furthermore, this study found that only in areas with better protection of intellectual property rights and better market integration level, the positive effect of FTZs construction on value chain upgrading is more obvious, suggesting that the strength of intellectual property rights protection and a perfect market-oriented environment can provide a good external condition for value chain upgrading.

In addition, the construction of China's FTZs showed different degrees of siphoning effects on cities located in different rings of the value chain upgrading, while the positive spillover effects on cities located farther away were not significant. The siphoning effect is more pronounced in coastal FTZs than in inland FTZs, while cities outside the 5 rings of inland FTZs show positive spillover effects. The economic reason behind this phenomenon is that, according to the theory of agglomeration effect, the construction of FTZs will first produce a siphon effect on cities closer to them, and a large amount of resources will rush to

the core cities, and only when a certain distance is exceeded can they get rid of their negative siphon effect, and the positive spillover effect will appear.

The construction of China's free trade zones (FTZs) is a major carrier for exploring system-based opening-up, and has an important impact on promoting the upgrading of a country's value chain. Compared with existing studies, this paper makes an empirical contribution from the following three aspects: firstly, this paper takes the layout of FTZ construction as access point for the first time to examine the impact of China's FTZ s construction on the upgrading of regional value chains, providing empirical evidence on how FTZs construction optimizes regional value chains and enriching the related research on value chain upgrading. Second, this paper examines the impact of FTZs construction on value chain upgrading using a multi-period DID approach based on data from 280 prefecture-level cities in China and input-output table data from 2012-2017. The statistical findings reveal that the construction of FTZs can significantly increase the upgrading of the value chain. Third, this paper further inspects the heterogeneous impact of FTZs construction on value chain upgrading by conducting the analysis from four perspectives: geographical location of FTZs establishment, intellectual property protection strength, market environment and concentric ring distance.

There are still some limitations in this study. This paper studies the upgrading of industrial value chain, using the data of China's input-output table. Unfortunately, the data of China's input-output table is updated every five years and only updated until 2017. Served as pioneers of country's reform and opening-up, China's FTZs strategy has been proposed and implemented for eight years, and is still in a process of continuous exploration and improvement, therefore, this article only focuses on the short-term effect brought by FTZs and the research for the long-term effect can be expected in the further study. Moreover, there are many policies on reform and opening up in China, such as The Belt and Road initiative, National New Area policy, development zone policy, etc., due to the limitation of data, this paper cannot completely divorce other policies from the FTZ policy. Additionally, this paper explores the impact of China's FTZs construction on domestic value chains, but in fact, it can be extended to global value chains for a deeper study.

5. Conclusions

Following the new development vision of dual-circulation, China's FTZs, as pacesetters of opening-up in the new era, is providing important support for the new round of economic globalization. This paper examines the impact and mechanism of the establishment of China's FTZs on the upgrading of the value chain by using panel data of prefecture-level cities from 2012-2017, and the main findings are as follows: first, the construction of FTZs can significantly promote the upgrading of China's value chain and the conclusion remain robust after parallel trend tests; Second, this paper also researches the impact of China's FTZs establishment on the value chain upgrading based on heterogeneity tests, conducting sub-sample regressions based on regional heterogeneity, intellectual property protection heterogeneity and market environment heterogeneity. The test results highlight that the effect of FTZ construction on value chain upgrading is greater in coastal FTZs, regions with

higher degree of intellectual property protection and better market-oriented environment. Third, the paper further finds after concentric ring effects that the impact of China's FTZs construction on the value chain is currently more manifested as a siphon effect, whether it is located on the coast or inland.

Conflict of interest: none

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Price Transmission for Beer Sector in Covid Era: Case of Czechia

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Abstract: The paper examines (in covid era) the extent to which the beer market has been affected and also the consequences it has in the phase of the strictest measures due to the Covid-19 in the years 2019-2020. The analysis examines the difference between the development of consumer beer prices and the trend development and qualifies this difference. Due to differences in the cost of production of beer with lower and higher degrees of Plato, so for each type (light beer, lager) the analysis is performed separately. Based on at least 132 price observations (monthly data 2010-2020, or 2021) obtained from the Czech Statistical Office, trend functions are compiled, as well as forecasts for the years that were most affected by the Covid-19. Furthermore, after a suitable adjustment of the data for ADL-modeling in SW Gretl for lager and light beer, the expected (theoretical) and actual price differences are compared and evaluated. The results show that the Covid-19 pandemic did have a negative impact on the market and a certain hypothesis was confirmed that this impact was smaller for light beers, where there is a presumption of higher competition in the market and relatively higher price influence by retail chains.

Keywords: beer; Covid-19 impact; consumer price; producer price, price transmission

JEL Classification: C01; C22; L66

1. Introduction

It was very difficult in the Czech Republic to look for any branch of the agri-food sector that brought the Czechia such a higher opinion than in the case of brewing. The most widespread style of beer in the world is essentially connected with the Czech Republic, which is Czech lager, sometimes called pils or pilsner, which was so successful that especially in the second half of the 19th century in most countries it pushed older beer styles to the margins of the market. And it was this Czech lager that was born in 1842 in Pilsen, when Bavarian brewer Josef Groll used the Bavarian advanced bottom fermentation technology, but using purely Czech raw materials (Basařová et al., 2011).

At the beginning of the new millennium, not only the Czech brewing industry had to face two significant structural shocks. The first was the financial crisis, which erupted at the turn of 2008/2009. However, this event was not significantly unprecedented in human history. The brewing sector is coping with economic crises in its own way.

However, the Covid pandemic is a completely new phenomenon, precisely because it is global; all previous epidemics were only local, such as the Spanish flu epidemic.

Wardell et al. (2020) examined several hypothesized coping motive path-ways to alcohol use and problems from various factors that were thought to be relevant for drinking to cope early in the pandemic. One of them is that it's closely related with lower social connectedness.

The impact of Covid-19 on natural indicators of the brewing industry was huge, while on others it was marginal or completely insignificant. One of them was the value of exports and imports, respectively, according to organization Brewers of Europe (2021), total EU27 imports in 2020 were 43.005 million hl, which was a year-on-year decrease of only less than 6% and was even higher than in 2017, when it amounted to 41.050 million hl. The situation was similar for exports. In 2020, EU27 exports amounted to 83.639 million hl of beer, the YoY decrease was recorded only at 2.2% and was even higher than in 2018, when it amounted to 83.435 million hl. The explanation is quite simple, the vast majority of the on-trade channel consumes local production for many reasons, and draft or tank beer is exported very limited. Czechia exported 5.317 million hl of beer in 2019, compared to 4.936 in 2020, a decrease of less than 7%. It is interesting that the Czechia recorded a slight increase in exports outside the EU countries, so the decline is clearly only due to beer transported only to other EU countries.

The consumer is a social creature and is therefore very close to consuming alcohol in the company of other people, mostly in restaurants, i.e., in the on-trade distribution channel. And since all Covid-19 measures were primarily intended to prevent or limit people contacts, the amount of beer flowing through this distribution channel was shock-greatly reduced.

As Covid-19 restrictions have directly affected on-trade channel, Table 1 clearly shows, in selected EU countries, movements (in chosen years) in relative beer sales through the on-trade and off-trade channels, i.e. beer that is consumed at the point of sale (restaurants and pubs) and beer that is consumes outside the point of sale. However, the pandemic does not have the same impact on the decline in on-trade, because Vandenberg, Livingston and O'Brien (2021) shows that in countries with no so strong beer traditionals (Australia), after the abolition of the restrictive the level of on-trade beer consumption has significant immediate increase, but no changes on off-trade consumption. Pitts and Witrick (2021) state, that in another country (US) beer sales and production have been down and this drop in sales has been majorly felt by brewers, especially small breweries, by 80% in extreme cases.

In Baltics countries (Estonia, Lithuania, and Latvia), the on-trade consumption of beer is traditionally low, usually below 10%. Descriptive statistics show that the Iberian states have relatively surprisingly high on-trade values, followed by Ireland and the lowest in Estonia. Spanish participants indicated more frequent beer consumption (almost at least once a week) than wine (more than at least once a month). The decrease of drinking with friends and family was greater for them. Interestingly, a new social context for drinking flourished during lockdown: virtual meetings, which were more relevant (Rodrigues et al., 2021). Beer has become popular especially among younger people, mostly drunk in bars, at leisure events. (Osterberg & Karlsson, 2003).

The analysis was performed for a change in the sales channel on-trade due to the economic crisis, this is indicated by the index 2010/2008, then the index 2019/2008 shows us a permanent change in the sales channel on trade and finally the index 2020/2019 shows us the power of the Covid pandemic.

Table 1: On-trade values, in % from total sales, Brewers of Europe

	2008	2009	2010	2019	2020	2010/2008	2019/2008	2020/2019
PT	70	70	69	70	60	99	100	86
ES	69	67	66	68	44	96	99	65
IE	69	71	66	63	30	96	91	48
BE	51	49	48	42	27	94	82	64
CZ	51	50	48	35	26	94	69	74
FR	24	25	24	35	35	100	146	100
PL	20	15	15	11	8	75	55	73
SK	40	40	40	29	20	100	73	69
AT	34	34	33	27	17	97	79	63
DE	29	27	22	18	18	76	62	100
EE	5	8	9	7	5	180	140	71

In other countries (e.g., the United Kingdom, although not part of the EU) beer purchases have fallen slightly but preferences have changed – confinement was associated with a shift in purchases from lower to higher strength beers (Anderson et al., 2020).

The economic crisis caused the greatest damage to the on-trade distribution channel in the case of Germany, which fell by 24% (over two years in period 2008-2010), and in Poland, where it fell by a quarter in the same period. In the Czech Republic, the impact was not so significant, there was a decline of only 6%, much larger declines were recorded later. On the contrary, somewhat surprisingly, they increased by 80% during the economic crisis in Estonia, but there was an increase of only a few percentage points. In the long run (but not yet influenced by the Covid pandemic), the biggest declines in the on-trade sales channel were recorded in Poland (45%), Germany (38%), and the Czechia, where the decline was 31%. Table 1 shows the impact of the Covid pandemic, which represents the 2020/2019 index. Pandemic Covid-19 didn't move with France and Germany, where there had been a big drop before. Czechia recorded a decline of 26%, which can be considered a slightly better result than in most countries.

The organization Brewers of Europe (2021) explains, that this suggests some of the lost consumption in on-trade shifted to the retail sector. The impact of this can be seen in the change in the split of consumption between markets: whilst on-trade used to account for around one third of the volumes consumed in Europe (against two thirds for off-trade), the situation is starkly different in 2020, with only 22% of the volumes being consumed in the on-trade.

The paper aims to find out if the pandemic Covid-19 has had an impact on beer price transmission in Czechia, where this sector plays an important economic and social role. If it had, the paper aims to quantity this impact.

2. Methodology

The analysis is performed using the data from the Czech Statistical Office (CZSO, 2021). This institution keeps statistics on average consumer and producer beer prices since 1994 on an annual basis and since 2010 on a monthly basis. The data are aggregated; the development of consumer prices is monitored on consumer baskets based on a set of selected types of goods and services paid by the population. After 2021, the methodology changed

(reassessment of the consumer basket) and therefore monthly data on the consumer price of lager are not available.

There is the hypothesis:

H0: The Covid-19 pandemic has a negative effect on beer prices.

H1: The Covid-19 pandemic has no effect on beer prices.

The research uses an ex-post forecast to compare estimated and real prices. Hušek (2009) explains that by comparing the ex post forecast with the actual value of the predicted variable, it is possible to determine the prediction error, which can be used to verify the strength between estimated and real prices. An adjusted time series is needed for the forecast, ie without the seasonal component, because seasonal changes are caused, among other things, by human habits institutionalized in economic activity. Adjustment is performed by additive decomposition.

Dynamic models of economic time series are assumed to be constructed from observed economic variables that meet the requirement of stationarity. Since the augmented Dickey-Fuller test established nonstationarity of both time series, it was transformed to stationary using the first differences. The model works with first-order integrated series. Dickey-Fuller's test statistics are derived from a regression relationship including constant and trend (Cipra, 2008).

In the paper, there is used the ADL model. The ADL (4; 4) model is a multidimensional time series model and is derived from two stationary adjusted time series with 132 (for lager) and 144 (for light beer) observations. Monthly data are in the years 2010-2020, resp. 2010-2021, so those data were user for estimation.

Lag effects can be assessed by deriving a backward shifted variable and including this along with the original version in the model. This would specify the associations between past values of x and current values of y plus current values of x and current values of y, while adjusting for each other (Beard, 2019).

In addition to its error-correction form, ADL models in general may have complex dynamic specifications, including multiple lags, first differences, and lagged first differences (Jordan & Philips, 2018).

Statistical procedures which yield exact finite-sample inference in simple linear models have an indeterminate distribution in more general models, due to the effects of unknown nuisance parameters. In the context of dynamic models, such problems do not occur when the relationship can be modeled according to the normal classical linear model with finite distributed lags (Dufour & Kiviet, 1998).

Two unrelated one-equation models for each type of beer describe a one-way relationship between variables. The model is estimated using the ordinary least squares method. After ADL models estimation, the predicted values are calculated manually in MS Excel.

Both models are econometrically verified, namely the Jarque Bera test for normality of residues testing, the White test for heteroskedasticity testing, and the Breusch-Godfrey test for autocorrelation testing. Based on the p-values of all tests, the models were econometrically verified.

As an endogenous variable (y) in both models is chosen the consumer price of beer, as exogenous (x) – producer prices, also in previous periods. The models also have predetermined variables - consumer prices in previous periods. Prices are in CZK per hl.

In this research, beers are divided into lager (11 – 12.99% extract of original wort) and light beer (7 – 10.99% extract of original wort), according to the regulation of the Ministry of Agriculture. This difference gives rise to different characteristics, buyer preferences, excise duty and production costs.

The program Gretl was used for estimations and for testing of models.

3. Results

The difference between the real and estimated consumer price of beer varies according to the degrees of Plato. The impact of the economic shock caused by Covid-19 is obvious and most affected lager, because it's beer with higher production costs. Figure 1 and Figure 2 show the estimated results by forecast and the real consumer price of beer.
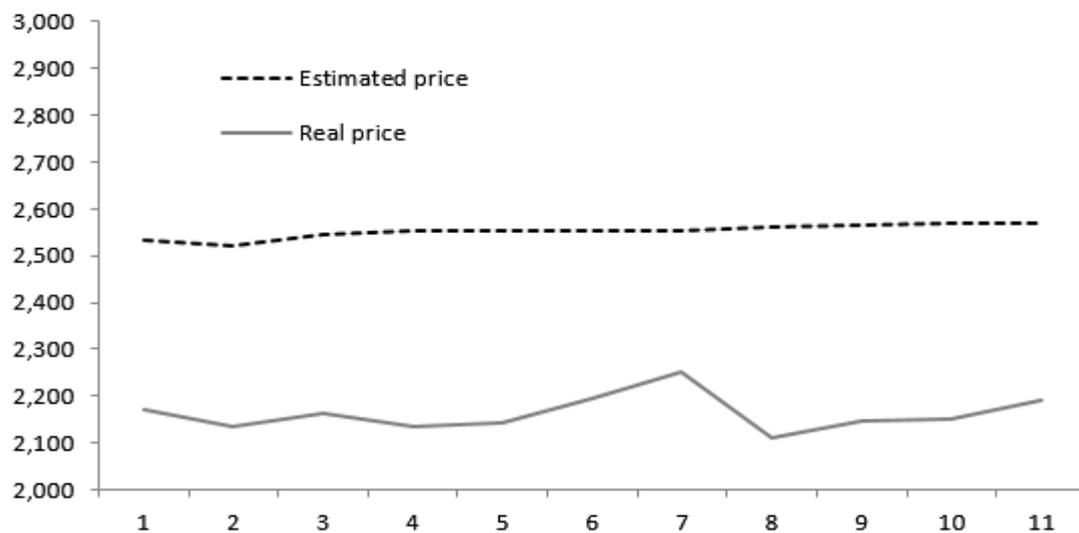
Figure 1. Estimated and real price of the light beer. CZK per hl. Jan 2021 – Nov 2021 (CZSO, 2021).
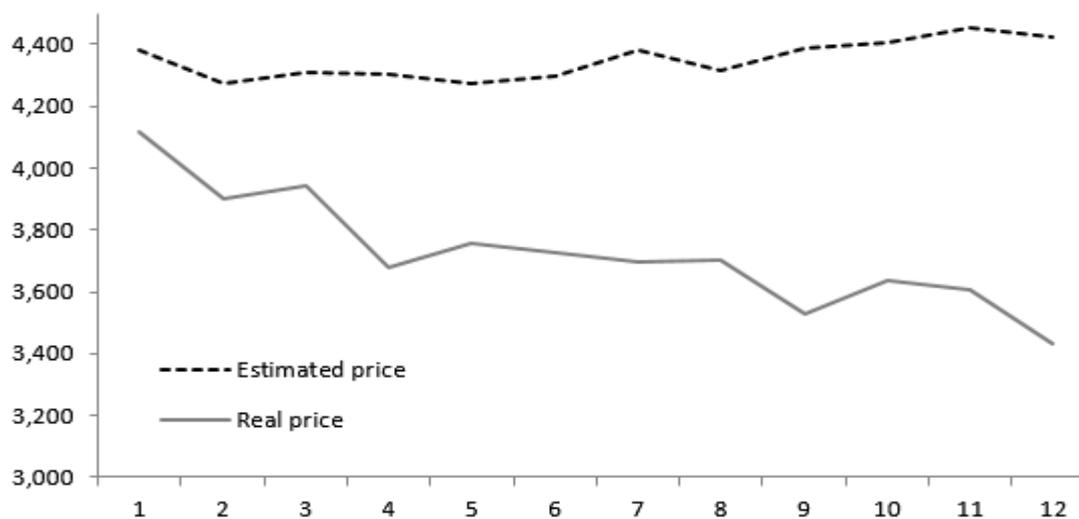
Figure 2. Estimated and real price of the lager. CZK per hl. Jan 2020 – Dec 2020 (CZSO, 2021).

It is clear that the real price for both types of beer is lower than expected, but the biggest difference is in case of lager. While the price of light beer does not fluctuate, it is underestimated but stagnant, the price of lager shows a markedly declining trend, the opposite direction of price development than it should (according to expectations). Table 2 shows the absolute difference between lager prices in 2020. For light beer the table is not in the paper, because the difference between estimated and real price it is not so important and considerable, we focus on lager.

Table 2. Estimated and real price of lager and its difference, CZK per hl

	Estimated price (CZK/hl)	Real price (CZK/hl)	Absolute difference
Jan 2020	4,379	4,116	-263
Feb 2020	4,275	3,900	-375
Mar 2020	4,312	3,944	-368
Apr 2020	4,303	3,680	-623
May 2020	4,275	3,758	-517
Jun 2020	4,300	3,726	-574
Jul 2020	4,384	3,696	-688
Aug 2020	4,318	3,704	-614
Sept 2020	4,386	3,526	-860
Oct 2020	4,407	3,634	-773
Nov 2020	4,456	3,608	-848
Dec 2020	4,425	3,434	*-991*

The key figure is for December, when the largest absolute difference is observed, namely 991 CZK per hl less than forecast, i.e., 22.4%. The real value of light beer is 17% lower than expected.

From the figures it can be deduced that the price of lager is more sensitive to shocks than the price of light beer. This is also due to the fact that light beers are cheaper for production and at the final (consumer) price. The consumer prefers to buy it due to its lower degrees of Plato and for everyday consumption. In the case of lager, on the contrary, it is consumed more on-trade, and so at the time of the pandemic, for many breweries, due to the excise tax, it was cheaper to throw the beer out, than to sell it, even at a discount.

Although beer prices have been seasonally adjusted, the seasonal price increase (July) for the light beer can still be seen in Figure 1. However, in the following months, the price returns to its original state. Lager does not show this seasonality.

Two unrelated equations for the ADL model (4; 4) for the forecast of beer prices are compiled in the form:

for light beer:

$$y_t = 6.33 - 0.57y_{t-1} - 0.36y_{t-2} + 0.31y_{t-3} - 0.2y_{t-4} - 0.14x_{t-1} + 0.2x_{t-2} - 0.18x_{t-3} + 0.02x_{t-4} + u_t \quad (1)$$

for lager:

$$y_t = 6.33 - 0.57y_{t-1} - 0.36y_{t-2} + 0.31y_{t-3} - 0.2y_{t-4} - 0.14x_{t-1} + 0.2x_{t-2} - 0.18x_{t-3} + 0.02x_{t-4} + u_t \quad (2)$$

where the consumer price of beer is explained by its development in previous periods (y) and the development of the producer price (i.e. breweries) in previous periods (x). Since the

original time series did not show stationarity, the model applies to the first differences of the variables. The model only examines the relations between the producer price and the consumer price.

Although the BIC recommendation was the best for ADL (6; 6), ADL (4; 4) showed better significant relations and better statistical significance of the variables. The same procedure applies to lager price modeling.

Table 3 shows only the individual statistically significant variables for the light beer price forecasting model:

Table 3. Statistical values of chosen variables. The model for the light beer

Variable	p-value	Alfa
CP-1	<0.001	0.01
CP-2	0.001	0.01
CP-3	0.004	0.01
CP-4	0.039	0.05

The coefficient of determination is 0.27. The model is econometrically verified.

The economic assumption is that the consumer price is affected by the producer price. However, the results of the analysis show that the consumer price of light beer is not affected by the price of producers at all, but is dependent on its development in previous periods. In practice, this means that there is a different pricing and price transmission mechanism for light beer. The interlink plays a major role in determining the prices of these beers - retail chains that have bargaining power and market position, so they can use final margins, for example, to set final beer prices. This displaces the breweries from determining the final price of the light beer.

This is not the case with lager (see Table 4), because it has higher production costs and is more expensive in itself, and the average consumer in Czechia is not repelled by a higher price when buying it, because he is aware of the worth of lager. Therefore, the producer has more scope in determining the final price, respectively, retail chains do not interfere so much.

Table 4. Statistical values of chosen variables. The model for the lager

Variable	p-value	Alfa
PP-3	<0.001	0.01
CP-1	<0.001	0.01
CP-2	<0.001	0.01
CP-3	0.03	0.05
CP-4	<0.001	0.01

The coefficient of determination is 0.33. The model is econometrically verified.

The analysis performed for the series of lags 4, 5 and 6 showed that the final price of lager is always dependent on the development of the consumer price in previous periods, but also on the production price before 3, respectively, 4 periods. After adding the dummy variable to indicate the Covid years, the level of statistical significance of the variables improved, but

no other significant variables were added, so it follows that the consumer price of lager is affected more by its development over time but also by the producer price in the previous periods, inertia is present.

It follows from the analysis that for both types of beer, the impact of the Covid-19 pandemic on the beer market and beer prices is negative, especially for Czech lager.

4. Discussion and Conclusion

The main goal of this paper was to find out whether the Covid-19 pandemic affected beer prices in the Czech Republic and, if so, to quantify this effect. Using a forecast based on ADL models, the estimated beer prices were determined and compared with the actual ones. The significant difference was explained not only from an economic point of view, but also from a social point of view. The analysis included 132, resp. 144 observations. These were time series with a monthly periodicity from 2010 to 2020, or 2021. The only limitation was the incomplete length of the lager time series, which was associated with the fact that lager was no longer included in the consumer basket in 2021. However, this did not significantly disrupt the analysis.

In the paper it proved that the pandemic did hit the beer market in the Czech Republic and a more significant impact was observed for Czech lager – traditional Czech beer. Lager here means the classification of beer according to its degrees of Plato, not according to the method of fermentation. It can be supposed that there was not influence of the inflation on the consumer price, because the prices of inputs had not increased in the significant period and the competition among the retail chains is too significant. There is a correlation between the impact on beer prices, especially lager, and the decline in on-trade sales, which is explained not only by the economic relations between these phenomena but also by the social aspect both in distant cultures (McAllister, 2003; Kirkby, 2003) and in the Czech Republic, where beer traditions are strong. It was the reduction in contact between people and the associated lockdown that led to the disappearance of the social context of beer consumption. Fleissig (2021) states that beer has the most inelastic demands, which confirms that beer is the most popular type of spirit.

The case of the Czech Republic can be compared with the case of the USA (Pitts & Witrick, 2021), where the decline in sales and prices was felt for the beer sector. In contrast, the situation is quite different from other EU countries; for example, in Spain, where beer consumption increased during a pandemic, despite the fact that the Iberian states consider themselves like wine countries (Rodrigues et al., 2021). Among other things, beer consumption per capita in the Czech Republic has decreased over the last two years, from 141 l / person per year to 135 l / person (Brewers of Europe, 2021).

In conclusion, however, it must be stated that the current partial or comprehensive analyzes of Covid's impact on the brewing industry in the Czech Republic are not yet effective in general, it is a completely new phenomenon, which also has not only its economic aspect, but perhaps even more cultural or social. Consumers are not much affected by the price of beer, but by its qualitative properties, as well as the environment of consumption - Czech consumers prefer the presence of a social element, which greatly reduced the Covid-19

pandemic. (Svatošová et al., 2021). The fact is that the pandemic certainly had a negative effect on the development of beer prices. Another problem is the complete heterogeneity of consumer channels in individual countries (not only the EU), which is due not only to different consumer preferences, but perhaps most of all the share of the ot-trade and of-trade channels. It is difficult to compare countries as diverse as Ireland and Estonia.

One of the directions of further research may be the search for the most important factors influencing the decline in beer consumption in the Czech Republic, apart from the pandemic, because the decline in on-trade consumption began before it.

Conflict of interest: none

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The Importance of Knowledge – from the Perspective of SME Leaders in Nitra Region at the Time of COVID-19 Pandemic

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Abstract: The aim of our research is to assess the opinion of the leaders of SMEs in the Nitra Region about the concept of knowledge and the importance of its sharing. We used a structured in-depth interview to prepare the practical part of our research. We were able to conduct a total of 75 interviews using various online platforms. The results of our research have shown that most owners expect their employees to share their knowledge with them. In contrast, less than half of them share their own knowledge with their employees. More than 20 percent said, that an employee had already withheld knowledge important to the company. It was also indicated in such a proportion that the transfer of knowledge isn't rewarded in any way. If an employee isn't properly motivated, he/she will not share his valuable knowledge in future. The employee should feel the success of the organization as his or her own. Appropriate communication between subordinates and senior management should be established to support knowledge sharing. Based on the majority of owners, there is nothing hindering the transfer of knowledge in their organization – previous research does not confirm this.

1. Introduction

The importance of knowledge was also evident in the rudimentary forms of society. Think of the tribes for whom those with different knowledge (e.g., shamans, healers) enjoyed great respect in their own community. But such were the masters, or later the doctors, priests, and teachers.

In general, it can be said that the management of knowledge is not new among organizations either, however, in the past this was not due to conscious planning and management. As one of the prominent branches of management, knowledge management is already a planned and conscious process that ensures the survival and even development of companies (Rácz & Magyar-Stifter, 2015; Nagy & Velencei, 2019; Maris, 2020; Galabova et al., 2021).

There are several perceptions of the concept of knowledge organization. One view is linked to Dahlberg's name and the International Society of Knowledge Organization (ISKO) – she created. In 1989, the institute used first the term Knowledge Organization (KO). The term

quickly became accepted in the field of layout and classification. The term they coined is now a widely used Komarov at universities, informatics, research institutes, professional journals, conferences, domestic and international companies too. Dahlberg (1998) has previously stated that knowledge organization involves the organization of knowledge units (concepts) and related objects in order to systematize and share our knowledge with others. Dahlberg (2006, online) later stated that knowledge organization is the science of organizing and arranging concepts based on characteristics. The organization aims to promote knowledge organization through various tools such as databases, libraries, dictionaries and the Internet. Its members are mostly philosophers, linguists, computer scientists and other experts in the field of science (Hjørland, 2016; Ohly, 2012; 2018).

Nevertheless, the concept of knowledge organization used in the literature has become confused with the term knowledge management and has become synonymous with it. On this basis, the concept of knowledge organization means more than the storage and making available of knowledge. Accordingly, the term knowledge organization is used hereafter as a synonym for knowledge management by the authors of the present study.

In order for companies to be successful, they definitely need to manage their internal knowledge properly. Companies need to be aware of their goals. They need certain tools to achieve these goals. The most important of these is knowledge itself. Another question is how consciously managing this knowledge is in each company. In our opinion, to this day, there are companies – especially the smaller ones SMEs – that do not consciously manage knowledge, just "float before their eyes" to achieve their goals and therefore do everything they can (including striving to acquire, preserve, multiply the knowledge). However, the term knowledge management is already used to manage consciously designed knowledge. This branch of management is relatively young, and professionals began to work on the subject in the 1990s (Davenport & Prusak, 1998; Ganguly et al., 2019; Mura, 2020; Sánta, 2021).

A number of definitions have emerged in relation to knowledge management. According to the classical interpretation of Davenport (1996) and Gholami et al. (2013) by managing human knowledge we mean all activities including mapping, collecting, organizing, sharing, further developing and effectively utilizing the accumulated, documented and implicit knowledge, expertise and experience within an organization.

2. Methodology

The aim of our research was to assess the opinion of the leaders of SMEs in Nitra Region regarding knowledge management. We wanted to examine all this in the special situation caused by the current COVID-19 pandemic.

To achieve our goals, we chose the interview as one of the qualitative research methods. We conducted a structured interview and formulated our questions so that they could be easily analyzed. This also saved time and energy, as it was relatively easier to organize and analyze responses – using this method.

During the interview, we used open-ended questions that allowed us to interpret simply. Our research was conducted in the Nitra Region between December 23 and March 31, 2020 (100 days). Due to the pandemic, we used online applications to conduct the interviews

(Messenger, Meet and Zoom). We have tried to adapt to the needs of leaders regarding the platform. We recorded the answers, and then we started checking and processing them. We used Microsoft Excel to describe the answers we received.

The aim of our research was to examine the views of owners on knowledge sharing. A total of 85 managers responded positively to the request, but one-person-enterprises ("self-employed") could not be considered because they did not have employees. In some cases, the interview was canceled. Thus, we were finally able to work with 75 responses during data processing. Our interview consisted of 12 open-ended questions consisting of two main sections. At first, we were interested in demographics. Then we wanted to examine the main area we examined - knowledge management - based on the answers.

We assumed that owners who characterize knowledge with positive attributive are more likely to share their personal knowledge. For examining this we formulated one hypothesis: *There is a relationship between the characterization and the actual knowledge sharing of owners*. For testing the hypothesis, we used Fisher's exact test – since our date could be summarized in a 2x2 table. We used a significance level of 95% (α = 0.05) when testing the hypothesis.

In our research, we had to reckon with some limitations. These included material and time constraints, which limited our research in several ways. A further disadvantage of a structured interview is that it is not possible or only minimal to deviate from the pre-prepared interview outline. In addition, the lack of personal presence during the interview may have reduced trust in the interviewees.

3. Results

In this part of our study, we describe the results of our qualitative research in more detail, which we prepared based on the responses to the interview questions. In our first two interview questions, we wanted to assess several factors. Some of these are summarized in the table below. Based on the results, men (66.2%) were in the majority compared to women (33.8%). The result is in line with the generally accepted fact that the majority of entrepreneurs are men.

Regarding age, the respondents indicated a specific number, but from these we created groups using the generational grouping based on the work of Berkup (2014). However, we made a change from the original theory. The oldest members of "Generation Z" were born in 2009 (Garai-Fodor et al., 2021). However, in our research, we marked 2002 as the upper limit for "Generation Z" because only individuals over 18 years of age could complete the interview. In the end, this group finished in last place (6.0%). In our opinion, this is not a coincidence, as in many cases it takes a few years of experience to start a self-employed business (Godany & Mura, 2021; Timonen et al., 2018). The highest proportion were individuals born between 1980 and 1994 (41.8%). They were followed by individuals born between 1965 and 1979 (38.8%) and then by individuals born between 1946 and 1964 (13.4%). We could also determine the mean age, which was 42 years. The standard deviation was 11, the median was 43, and the mode was 39.

In our opinion, the proportion of the older generation may be even higher, however, they may run a company that does not have an absolute need for the internet, so we could not reach them with the interview. This is despite the fact that although they have an e-mail address, they

are only used for the necessary things (e.g., to order raw materials, products) and for these relatively infrequently. In our opinion, the higher representation of the older age group can also be explained by the change of regime, as this may have greatly influenced the entrepreneurial spirit at that time.

We also wanted to survey general information about companies. One of the essential data is the number of employees, based on which we can also identify the size of the company. Based on the results, micro-enterprises predominate (80.5%). This is followed by small companies (13.0%) and medium-sized companies (6.5%).

Regarding the age of the company, our subjects indicated a specific number, but we used to group again. In this case, the individual groups were not compiled on the basis of previous theories, but on the basis of the answers obtained. This is how the starting year for the foundation was 1989. However, this cannot be a coincidence, as it was a year of regime change. However, the proportion of companies set up between 1989 and 1999 is not the highest (21.2%). Based on our results, most (38.6%) companies were founded between 2010 and 2019. This is followed by companies formed between 2000 and 2009 (30.7%). Last place was taken by the companies that were founded in 2020, but overall, their share is high (12.0%). We could also determine the average age of the companies, which was 12 years. The standard deviation was 10, the median was 11, and the mode was 1.

Table 1. Demographics of business leaders and basic characteristics of companies

Gender		Number of employees	
Male	66.2%	1-9	79.2%
Female	33.8%	10-49	14.3%
Age group		50-249	6.5%
1946-1964	13.4%	Foundation	
1965-1979	38.8%	1989-1999	21.2%
1980-1994	41.8%	2000-2009	29.9%
1995-2002	6.0%	2010-2019	37.7%
		2020-	11.7%

We also wanted to assess in which sector the companies of the sample operate. According to the results, most of them (13.0%) are trading. At the same time, the construction industry also reached 13.0%. This is closely followed by other services (12.9%). Services that did not fall into any of the categories used were included here. This was followed by telecommunications with 10.4%. The share of companies engaged in transportation and manufacturing was the same (9.1%). The proportion of companies in other categories that did not provide services – but could not be classified in any of the main categories – was the same (9.1%) too.

At the beginning of our interview, we also asked our subjects what prompted them to undertake. Based on the responses received, we were able to distinguish 3 main and one other category. Most of them (33.7%) decided to start their own business because of their independence. Some respondents had a bad experience as an employee in their previous job. There have also been individuals who – as they claimed – have always wanted to be independent and now can't even imagine not being in control.

The group of forced entrepreneurs (22.1%) included those subjects who – according to their claims – were forced to start a business solely on the basis of subsistence. One of the main reasons for this was that their previous jobs had ceased and so they were trying to solve the shortage of money that arose from the situation. Our next group includes companies that started their own businesses because of an emerging opportunity (22.1%). Part of this group founded their company in the early 1990s, but there were also young individuals with an entrepreneurial spirit who saw the opportunity in 2020. While in the previous case the change of regime brought the appropriate changes, the latest entrepreneurs were inspired by today's extraordinary awareness and endless wealth of opportunities. While for some it was "chaos", for others the pandemic provided a unique opportunity. Some of the owners (22.1%) could not be classified in any of the categories, as other or mixed reasons were given.
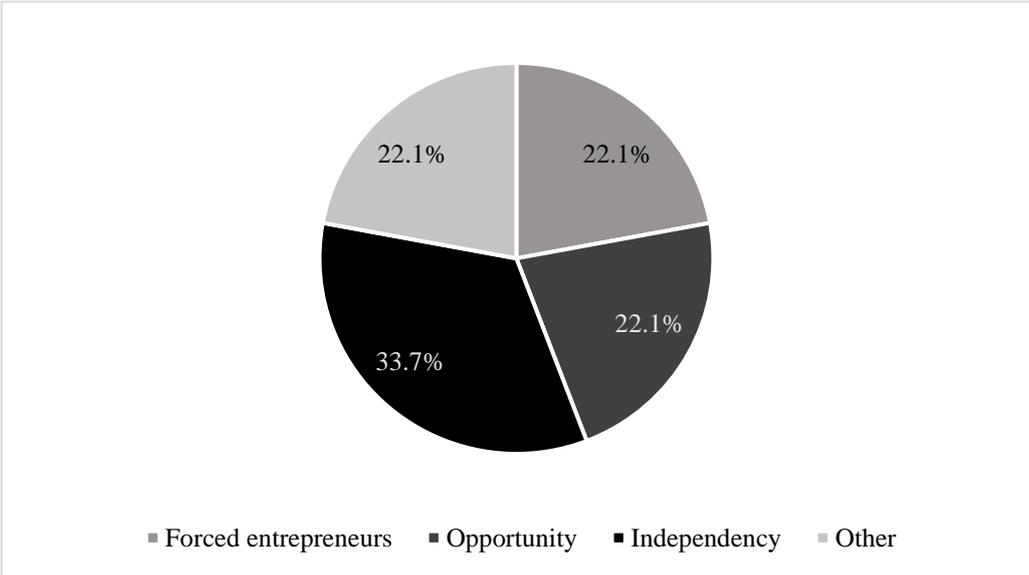
Figure 1. Motivation of entrepreneurs to start a business

The third question of the interview was already related to knowledge management. We asked SME leaders what they though about knowledge sharing. We received a variety of responses, however, we tried to categorize each response into as few categories as possible. As a result, we were able to classify the responses of our subjects into three main groups.

Based on the "Figure 2", it can be said that more than half of the owners (53.2%) attributed the knowledge to the word "important". A further 32.5% characterized it by a positive attributive. Among the individual answers, the following attributives can be highlighted: "useful", "good thing", "essential" and "indispensable". Some of these individuals also indicated that they would be happy to share their own individual knowledge with their employees - although we asked this separately in the next question. On the other hand, 14.3% of respondents described knowledge sharing as something negative. We listed there the responses that call for caution too — they highlighted that knowledge is "double-edged," so we need to think about with whom and what we share. There have been individuals who told that sharing knowledge is "dangerous" because everyone interprets it

differently and can only work with proper communication. In our opinion, these answers can be considered positive too, since they contain some truth. The attitude of these individuals is understandable, because they are just careful about what they share.
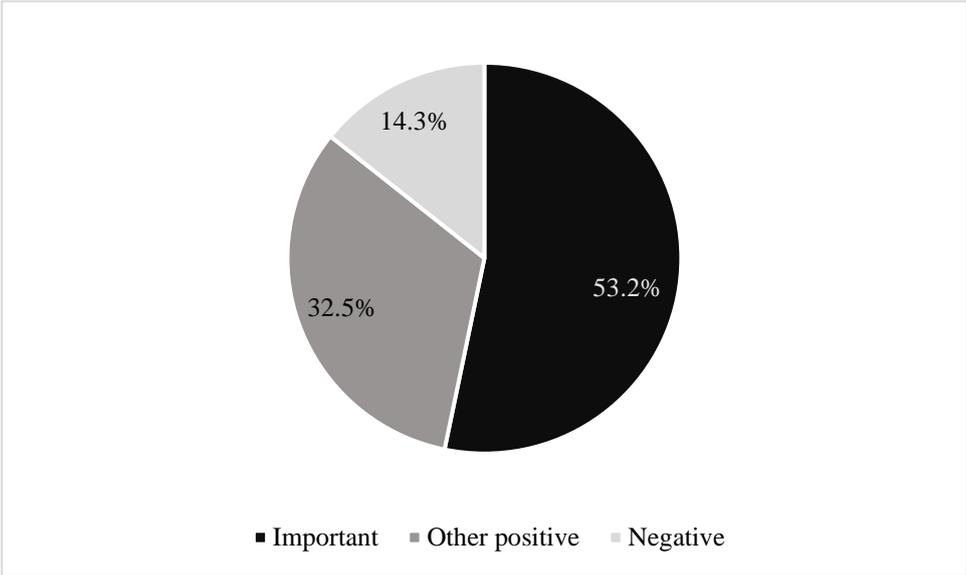

Figure 2. Entrepreneurs' views on knowledge sharing

To draw further conclusions, it is also important to look at the results of our next question, which specifically examined whether individual owners share their individual knowledge with employees. The responses of our subjects were classified into categories based on Figure 3.
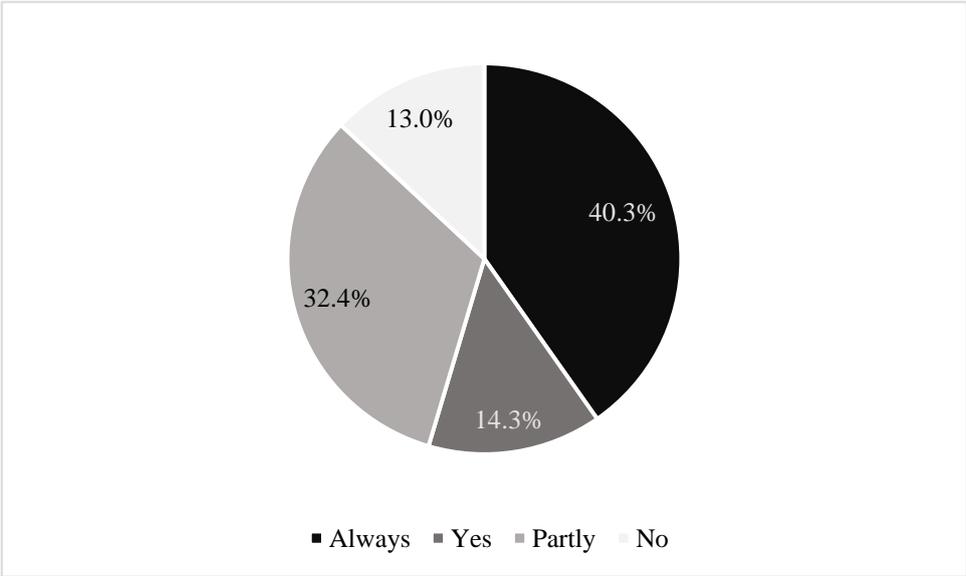
Figure 3. Do you always share your knowledge with your employees?

Based on the results, 40.3% of the owners stated that they always seek to share their knowledge with their employees. A further 14.3% answered "yes". These two categories can

actually be examined together, yet we made a distinction between them to show the slight difference between the meaning of them. Nearly one-third of the subjects (32.4%) stated that they did not share all their knowledge, while a further 13.4% answered "no". The majority of respondents argued that it is not necessary to pass on all their knowledge to employees in order to do their job properly. Some were outright afraid that their valuable knowledge would be used against them in the future. In this case, the subjects thought that employees could go to competing companies or even start a self-employed business. Overall, the results are also positive and cannot be judged by owners who treat their individual knowledge more carefully.

We wanted to examine the relationship between how the owners characterize the knowledge and if they share it or not – based on their answers. We had to aggregate some of the groups seen in Figure 3 – since the criteria for executing Pearson Chi-square test were not met. The categories seen at Figure 2 were aggregated too (positive – negative). The results are presented in a cross-table (Table 2).

Table 2. Relationship between the characterization and the actual knowledge sharing of owners

		Sharing the knowledge	
		"Not" or "partly" sharing	"Yes" and "always" sharing
Characterizing the knowledge	Negative	81.8%	18.2%
	Positive	39.4%	60.6%

According to the results it is apparent that there is a relationship between the characterization and the knowledge sharing of owners. The ones who characterized the knowledge with positive attributive were more likely to share their knowledge (60.6%). On the other hand, those who characterized the concept "knowledge" with negative attributive were more likely to "not" or just "partly" share their knowledge (81.8%).

It is not likely that the above mentioned results are coincidental – since the ditribution is solid – but can proven by Fisher's exact test (Table 3).

Table 3. Fisher's exact test

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.844	1	.009		
Continuity Correction	5.240	1	.022		
Likelihood Ratio	7.173	1	.007		
Fisher's Exact Test				.019	.010
Linear-by-Linear Association	6.756	1	.009		
N of Valid Cases	75				

According to Fisher's Exact Test the significance is 0.19 – Exact Sig. (2-sided). This is smaller than 0.05, so there is a relationship between the characterization and the actual knowledge sharing of owners.

In question 5, we asked owners if they expect their employees to share their knowledge that is essential to the company. Based on the responses received, 9.1% said they expect this in every case, while a further 81.8% also said "yes". Only 6.5% of owners indicated that they only partially expect their employees to share their personal knowledge that is important to

the company. Within this, some responded that only if it "makes the job run smoothly" and "if it affects the company". Our question specifically wanted to survey opinions about this type of knowledge sharing, so we can actually consider these answers to be "yes" as well. Only 2.6% of owners indicated that they not expect their employees to share knowledge important to the company. In our opinion, we got an overall result that could be expected. For every company, there is knowledge that is essential for trouble-free operation. Sharing these should be a basic requirement.
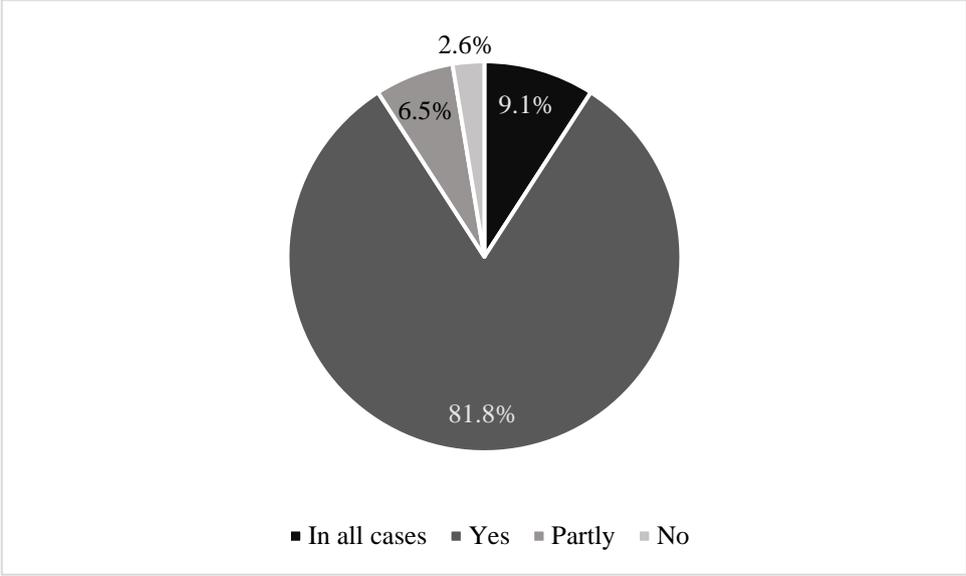
Figure 4. Do you expect employees to share their knowledge with you?
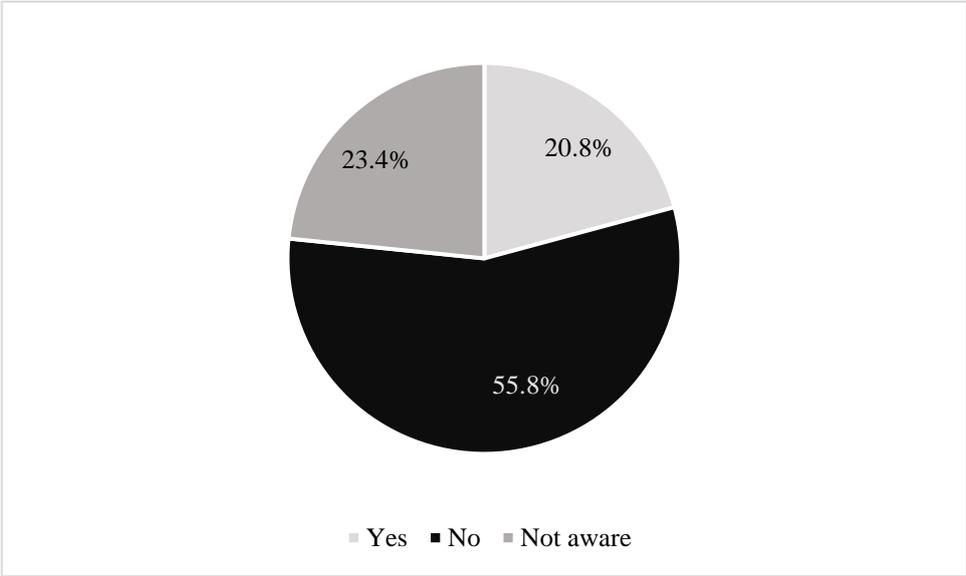
Figure 5. Were there any examples of your employee silencing important individual knowledge?

In the following, we also asked the owners if an employee had already silenced important data, information, or knowledge. We tried to categorize the responses received from the subjects into as few categories as possible. The responses received could eventually

be divided into three main categories. The majority (55.8%) of owners it has never happened before at their enterprises. Unlike the above, in the Figure 5, the respondents with "no" are marked in black this time, because the answer "no" is a positive phenomenon (that employees do not withhold knowledge from the manager). Only 20.8% said that such a case had already occurred. Another 23.4% are unaware that an employee has withheld important information, knowledge in the past or not.

Individuals who claimed to be aware of such a case were also asked what the employee's motive was. Most (25.0% of those who answered "yes") stated that employees had withheld valuable data, information or knowledge due to "laziness". 18.8% cited "jealousy" as a reason. Furthermore, "fear" and "selfish interest" were cited as further reasons by the owners. In one case, an employee of a company joined a competitor, causing great damage.

Owners were also asked about the means by which they motivate the transfer of knowledge within the company. Subjects gave extremely colorful responses, but these were categorized into six main categories and one "other" category. The latter included responses that could not be grouped into any of the main categories. Some responses fall into more than one category, so there may be overlaps. Based on the answers, the most common (39.0%) motivating tool is the cash benefit. 19.5% of owners said did not reward the transfer of knowledge with anything. Other motivational tools were listed by 10.4%. Of the other options, "day off" should be highlighted, which was mentioned by 3.9% of all respondents. This is 37.5% of the responses in the "other" category. Learning and development opportunities were mentioned as a tool in a small proportion (6.5%). It is worth mentioning three more categories - these are "praise, appreciation" (16.9%), "conversations" (15.6%) and "creating a good atmosphere, improving cooperation" (9.1%).
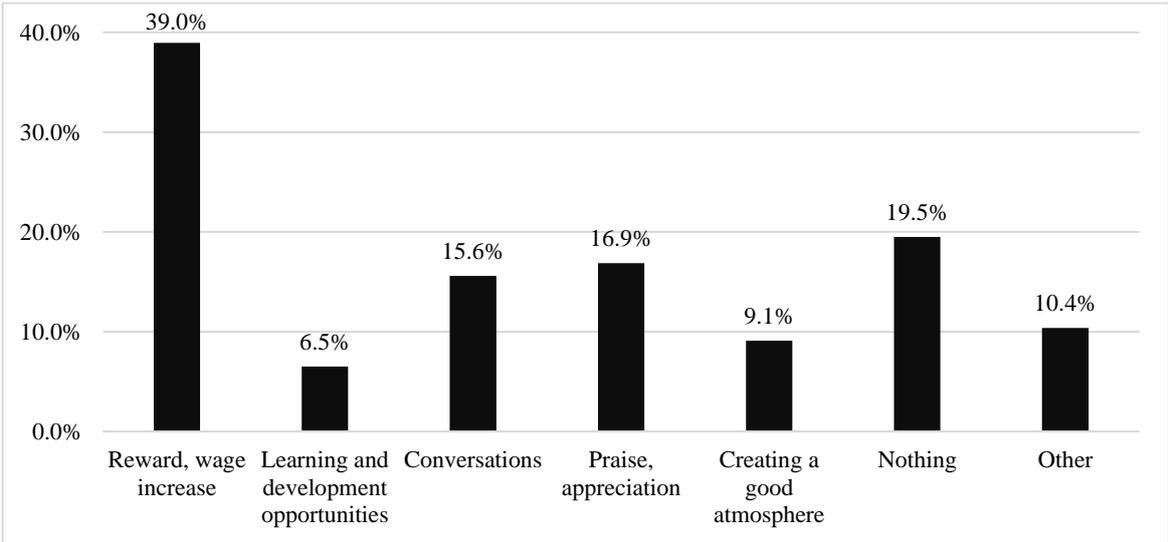

Figure 6. Motivating the knowledge sharing

In our next interview question, we asked managers what they thought was the biggest barrier to knowledge sharing. Based on the responses received, we were able to develop seven categories and one "other" option. The responses received are detailed in Figure 7.
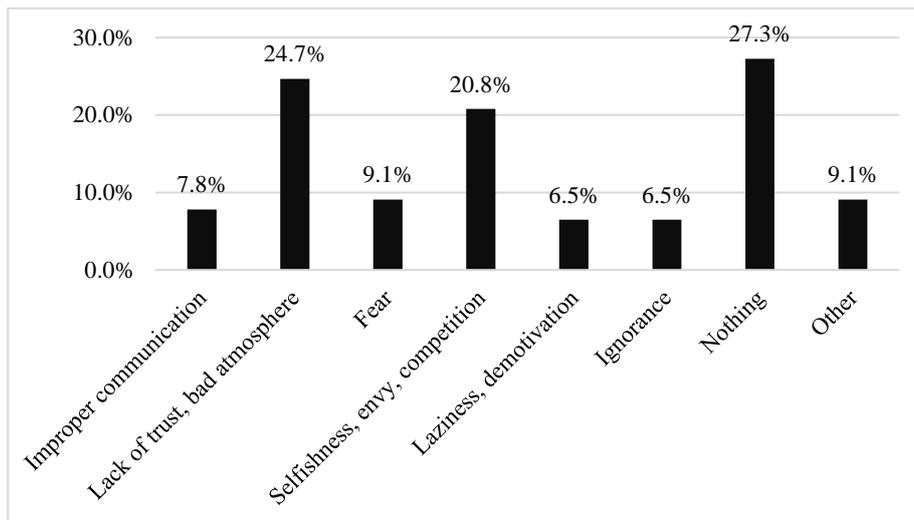
Figure 7. Barriers to knowledge sharing

Based on the results, most (27.3%) think "nothing" affects it Furthermore, only one person mentioned lack of time, so we classified it into category "other". In our opinion, this may not be a true reflection of reality, as former studies – Siuta-Tokarska (2013) and KPMG (2014) - identified lack of time as the biggest disadvantage of knowledge management. In the case of the former, 64% of companies indicated that lack of time was the biggest impediment, while in the latter 58%. It is necessary to add that the former research examined large Polish companies, while the latter examined Hungarian companies that already included SMEs. According this, companies should pay more attention in the future to allow time for knowledge transfer. They have to make sacrifices in the short term, but it can pay off in the long run. Careless knowledge can easily find "prosperity" elsewhere. In second place (24.7%) was a lack of trust and a bad atmosphere. 20.8% of owners think that selfishness, envy and competition can also cause problems.

4. Discussion & Conclusions

The aim of our research was to assess the opinion of the leaders of small and medium-sized enterprises operating in Nitra Region of Slovakia, about the knowledge and the importance of sharing it during the pandemic. For all this, we conducted a structured interview, which was conducted online due to the current situation caused by the pandemic. In addition to the difficulties, we can generally appreciate this solution, as it has managed to overcome geographical distances. This saved time and money.

90.9% of owners expect their employees to share their valuable individual knowledge with him. In contrast, only 40.3% said they sought to share their knowledge with their employees in all cases, while a further 14.3% answered "yes". However, this is understandable in some ways.

20.8% of managers said that their employee had already withheld some knowledge. It is important to highlight that 23.4% of managers were not entirely sure if such an incident had occurred – they said they were unaware of it. Based on these, it is possible that some of the cases will never surface and remain hidden from the owners.

19.5% of owners said they rewarded the transfer of knowledge with nothing. Knowledge sharing should be encouraged, because if an employee is not properly motivated, it may easily be that after a while they will not share their valuable knowledge with their supervisor because they do not see the point of it. If the position of the individual is not at risk and the incentive is lacking, it is unlikely that he/she will seek to put the company in a better position. It is important for the employee to feel the success of the organization as their own success. In order to support the willingness to share knowledge, it is essential to identify the appropriate channel of communication between subordinates and senior management.

Based on the results, most owners (27.3%) stated that there is nothing hindering the transfer of knowledge in their organization. Only one leader identified lack of time as a barrier to knowledge transfer. In our opinion, the lack of time is certainly present in most enterprises, so the results obtained based on the responses of managers do not faithfully reflect reality. This is also confirmed by the research of Siuta-Tokarska (2013) and KPMG (2014). Based on the results of the former 64%, and according to the latter 58%, the lack of time was firstly ranked in the list of factors hindering the sharing of knowledge. However, we should also add that the former research examined large Polish companies, while the latter examined Hungarian companies that included SMEs. Furthermore, some time has elapsed since that research, but such an improvement is unlikely. In light of this, we recommend that enterprises to devote sufficient time to knowledge transfer. This can be costly in the short term (time, energy, money) but can be a worthwhile investment in the long run. Owners ranked third (20.8%) that selfishness, envy, and competition can also hinder knowledge sharing. It would be worth improving this in the future. We can mention communication again, which can have a positive effect on this problem.

Among our future plans is to use a questionnaire to look at the opinions of employees, which we could compare with those of managers. We would also like to conduct research in other V4 or Western European countries.

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Sport Consumption Habits in Terms of Generations

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Abstract: Consumer behavior involves the experience resulting from using the product or service, as well as show we share our experience and opinions about the product with others. The way of sharing this experience and opinion can vary significantly in terms of generations. The aim of the study is to introduce the differences in sport consumption habits in terms of generations and to examine the services and products offered by a football club in the Slovak "Fortuna Liga" based on the consumers' opinion and experience Research is based on a questionnaire survey (the number of items is N = 434). 16.8% of respondents can be considered as distant fans as their residence is at least 50 km away from the town of the football club. Analysis was performed by Pearson's Chi-square test, descriptive statistical methods, setting hypothesis and determining Gamma coefficient. Based on the performed analyses, there is no significant relationship between the division of consumers into different generations and the detected followers of the football club's social media site. A relationship can be detected between the division of consumers into different generation groups and the fact whether they bought or received a gift from the web-shop or shop of the football club.

Keywords: consumer behavior; consumer loyalty; generations; sport consumption habits; sport tourism

JEL Classification: D12; L83

1. Introduction

Fact that the consumers and their environment is constantly changing underlines the importance of a continuous research and analysis of the consumer. In order for marketing managers to be able to monitor and respond to important development trends, it is necessary to continuously address the target group of consumers, monitor their behavior on the market as well as the changes of factors that influence the consumer behavior. Consumer behavior includes the purchase, consumption or disposing the goods and services, involving the decision-making processes that precede these acts (Novotný, 2015; Musová, 2015).

We live in an age of advertising. Advertisers use different types of advertising media to convince customers to buy the product or service. A good advertisement is funny, while it contains important information about the product, but never can be boring. Advertisements are a good tool to inform the customer about the new product of the company or the introduction of the redesigned version of the existing product. They also warn the attention of the customer for sales, discounts and the latest offers (Gerhat & Balázs, 2018; Kitukutha & Widyatama, 2020; Bruns, 2020).

Our research focuses on Generations X, Y and Z, who represent a relevant purchasing power in the society.

1.1. Generations

Scientific literature provides different definitions and division of generations in terms of the individual's age. To understand the generational differences in terms of social life, consumer behavior or lifestyle, it is necessary to define the term „generation". The term refers to a group of individuals born at the same or similar time interval (no more than 15 years). They can be characterized with similar social features, in other words, a group of people united by age and values, surrounded by the same technological environment, accompanied by the same historical events and experience (Zhitomirsky-Geffet & Blau, 2016; Duffet, 2017; Okros, 2020; Maciaszczyk & Kocot, 2021). According to Llopis-Amoros et al. (2019), generations might be perceived as a group of individuals, where the members are connected by the same way of thinking, they experience the most important events of their personal biography in the same historical and cultural environment, who will attend educational institutions at the same time, will meet their life partner and choose profession during the same time interval. According to Berkup (2014), the generations fall under the following categories:

- „Traditionalists" (born between 1900 and 1945);
- „Baby Boomers" (1946–1964);
- „Generation X" (1965–1979);
- „Generation Y" (1980–1994);
- „Generation Z" (1995–2009).

„Baby boomers" were followed by Generation X, who were influenced by the political atmosphere of the era. The war in Vietnam, fall of the Berlin Wall, end of and the Cold War, the era of Margaret Thatcher government influenced the culture and life of Generation X. They started with use the Internet as adults, and they used it in their everyday life for work purposes. Despite of being introduced the modern technology, they still prefer handwriting and face-to-face communication, especially in the case of informal relationships. They prefer meeting their friends personally (Page & Williams, 2011). Compared to the previous generation, Generation X is open to diversity, learnt to accept religious differences, different sexual orientations, race, and ethnicity issues. The difference between these two generations is also reflected in expectations towards their parents. Generation X is the generation of planners, planned pregnancies and families, so it is not surprising that the life of Generation Y (children) was influenced by control of their parents. The parents of Generation Y supervise both school achievements and free time activities of their children. The key coordinates of Generation Y are electronic media, globalization of space and time. Generation Y is being brought up in a globalized world, where the lack of time and space is overcome by the development of information and communication technology. It is a generation brought up on technology and use smartphones, computers, e-mails, the Internet and social media in their everyday life. Generation Y lives in a virtual freedom, while having weak verbal skills.

We can call them the first generation of consumers. As employees can be characterized as those, who enter their office in flip-flops and listen music on their iPods while working. They want to work, but their life is not about work. They would like to work better, faster and try to find creative forms of education. They are goal and deadline oriented, imagine fair bosses for themselves. Need for love and the need for belonging somewhere is still a priority in the life of this generation (Korcsmáros et al., 2019).

Group of individuals born between 1980–1994 is referred to as Generation Y. This generation is also called „Echo Generation", „Nintendo Generation" or „Nexters". Generation Y is referred to those who were brought up on the Internet, electronic devices, and social media sites. According to DMR (Digital Marketing Ramblings), the representatives of this generation spend 18 hours on their smartphones weekly. This generation is more likely to be influenced by the Internet than the TV. They are more familiar with electronic devices than their parents or bosses. Most of them are registered on Facebook or Instagram or both of them. They are used for multitasking and use multiple channels. Unlike Generation X, they prefer online communication instead of face-to-face contact (Page & Williams, 2011). Some of the facts provided by the Pew Research Center indicate that members of this generation are more likely to be university graduates and high is the probability that they will live with their parents until the age of 25–35 (Korcsmáros et al., 2019).

Generation born between 1995 and 2009 has a distinctive name after the last letter of the alphabet. The generation proceeding them will be called the Alfa. The arrival of Generation Z meant the end of clearly defined tasks and traditions, which had been accepted automatically until now. Scientific literature or studies refer to Generation Z as the Zeds, Zees, bubblewrap Kids, The New Millennials, Digital Natives, Wired Generation, Screenagers or iGen (Zhitomirsky-Geffet & Blau, 2016; Duffet, 2017; Okros, 2020; Maciaszczyk & Kocot, 2021). World Health Organization has revealed that this generation has passed through more different life phases than the generations before them. Representatives of Generation Z enter different phases of their life earlier than expected, which means that they are growing up faster. Differences are visible in the way of bringing up children and looking after the household. The life of Generation Z was also determined by significant events. e.g., terrorist attacks, which started on 11th September 2001 with an attack on the Twin Towers in New York. These served as a basis for war against terrorism and the global unrest between East and West. One of the characteristic features of Generation Z is that they have been surrounded by technology since their childhood e.g., laptops, tablets, smartphones, iPhone, iPads, etc. Technological development is not the only factor that has influenced this generation (Nadanyiova et al., 2020). Generation Z has become far more financially conscious than the generations before. The research conducted in the USA present a situation, where the members of Generation Z would like to buy something. They are willing to postpone the purchase of product until they compare the prices on the Internet and choose the best price in relation to quality. (Williams, 2015).

1.2. Consumer Behavior

„Consumer behavior refers to all activities conducted in the process of purchasing and

using products and services (choosing the product and the outlet) that result in increasing consumer satisfaction" (Gáti et al., 2018). The concept of consumer behavior includes also the experience related to use of the product and how we share our experience and opinion about the product with others (Shaw et al., 2017). Consumer behavior is a type of behavior shown by a consumer when looking for purchasing, using, evaluating products and services, while expecting the satisfaction of their desires. (Repanova & Profietova, 2018; Poliačiková, 2017; Benda-Prokeinová et al., 2017; Loucanova et al., 2018, Mura & Kajzar, 2019; Prince et al., 2020)

The intrinsic or psychological factors are the most difficult to define. These are individual characteristics that shape the perception of the consumer and the integration into the environment. The most important intrinsic factors are personality, sense, motivation and attitude. They also include the learnt and developed skills. (Repanova & Profietova, 2018; Loucanova et al., 2018; Matijová et al., 2019)

Not only the everyday experience but also the research results show that mostly women are the engines of consumption in the family, they have positive attitude to shopping. This assumption is also questioned by male consumers (Bezuidenhout et al., 2016; Delong et al., 2017; Hassim & Zahid, 2017; Chacko et al., 2019).

Factors influencing consumer behavior can be divided into two major groups: social factors and psychological factors. Social factors affecting consumer behavior focus on the relationship between people that are essential in terms of the purchasing process. These relationships are the family, social status reference groups, which are related to consumers (Biscaia et al., 2012; Sudbury-Riley et al., 2014; Çevik, 2020; Baša & Sánta, 2021).

Since people living in the same household manage the available finances together, the financial decisions will be taken together with other members of the household, where each member is participating. The consumer behavior of the family as a unit is influenced by what kind of members the family is made up.

Psychological factors influencing consumer behavior

- Perception – creating a direct connection between the external environment and the personality is called perception.
- Learning theory – learning is a process that results in the change of performance, behavior or knowledge.
- Motivation and personality – there are three stages of motivation. The first influences the behavior. The second stage is behavior driven by instincts and needs. The third is achieving goals e.g., if we are hungry, will go shopping.
- Attitude – those positive and negative emotions assigned to different objects or groups of people are called attitudes (Sudbury-Riley et al., 2014).

Since consumer behavior is not constant, it is very difficult to define or describe the phenomenon. The consumers are exposed to external factors that might influence their decision-making any time. Examining the consumer behavior is addressed by marketing specialists. The increasing number of customers does not allow to examine all the individuals separately, they examine the market asking several questions. This is called the seven „O" of the market (Kotler et al., 2021).

Who make up the market?	**Occupants**
What do they buy?	**Objects**
Why do they buy?	**Objectives**
Who is participating in buying?	**Organization**
How do they buy?	**Operations**
When do they buy?	**Occasions**
Where do they buy?	**Outlets**

Based on the differences between the brands and the complexity of purchase, we differentiate 4 types of consumer behavior:

- Complex consumer behavior – collecting information of the product, the consumer is intended to buy is high, the consumers are aware about the differences between the brands.
- Dissonance-reducing purchasing behavior – the buyer has a significant individual interest in the purchase, but experiences minimal differences between the brands.
- Routine purchasing behavior – there is no relevant difference between the brands, so buying the product does not involve greater consumer interest.
- Consumer behavior looking for change – low interest for consumption with significant differences between the brands. In this group, the consumers change brands frequently. (Schmidt et al., 2016; Repanova & Profietova, 2018)

Advertising efficiency refers to the return resulting from costs invested into advertising to generate profit. The advertising costs may be measured efficiently, but the return resulted as a result of advertising is less measurable. The investors are trying to support the decisions related to advertising with statistics on return. (Gáti et al., 2018)

The goal of advertiser is to achieve an impact that makes the customer to choose a particular product. Long and complex is the emotional process to become a purchaser. The advertisements have to provide information why the product is good, what are the specific features, and why it is useful to buy the product or the service (Csapó-Horváth, 2021).

The primary role is to convince the customers why the products or services offered by the given company are better than the products or services of the competitors. The goal of advert is to shift the consumer's opinion about the product or service into a positive direction. More and more we can hear about the anti-advertising campaigns, protests and more and more consumers protest on the content of the adverts (Schmidt et al., 2016; Repanova & Profietova, 2018). Sport consumption can be a part of sport tourism as well (Tiimub et al., 2021; Luu & Galan, 2021)

2. Methodology

The main purpose of this paper is to examine the services and products offered by a football club in the Slovak "Fortuna", based on the consumers' opinion and experience. A questionnaire survey was used to collect data about the consumer purchasing habit. The online survey began on 1st September 2021 and finished on 30th October 2021. The survey

included demographic questions, which made it easier to identify the social background of the participants. The next group of questions asked the respondents about the services and products of the club, thus we obtained basic marketing research data for our research. The summary of this data served to find correlations between the partial results gained. The survey included open-ended questions that allow respondents to answer in open text. These types of questions were used at the beginning and at the end of our survey. A snowball sampling method was also applied in the survey.

Most of the questions were multiple-choice questions and rating scales. The questionnaire was shared in a closed Facebook group of more than 12.3 thousand fans. Sharing the questionnaire in the targeted group generated a relevant number of filled questionnaires. The questionnaire was filled in and returned by 434 respondents, which is approx. 3.53% feedback rate compared to the size of the group. Based on the collected data, we decided to analyze 3 generations (Gen X, Y, and Z). We formulated the following two hypotheses:

H1: The ratio of representatives of younger generation distant fans following their favorite team on social media sites is high.

Distant fans form a group of fans living further than 50 km from the headquarters of the club. The most known social media sites are Facebook and Instagram. These definitions were also part of the questionnaire survey to avoid misunderstanding.

H2: Members of the younger generation received a higher proportion of fan souvenirs than they gave to others as a gift.

The term „younger generation" is used for the representatives of Generation Z. They were compared with the representatives of Generations X and Y.

3. Results

Only 34.6% of the respondents were female, the remaining ratio of 65.4% were male respondents. The examined sample shows that most of the fans of football can be found among the male respondents, so the fans of the examined football club are also formed dominantly by men. When examining the age of the respondents, we were interested in the age of the youngest and the oldest respondent. 32.9% of the respondents represented Generation X, 32.7% fall into Generation Y, and 34.4% belonged to Generation Z.

A multiple-choice question was offered to provide information about the employment type of the respondents. According to the survey results, 55.1% of the respondents work as employees, 15.7% are self-employed, 1.2% are unemployed, 24.9% are students, 2.3% are pensioners and only 0.8% of the respondents chose the „other" option.

Following the question about employment, we found it necessary to ask the average monthly income of the respondents. The options for answer were the following: less than 200 EUR/month, 200-500 EUR/month, 500-750 EUR/month, 750-1500 EUR/month, above 1500 EUR/month. The answers provided for this question were diverse. 21.7% of the respondents had less than 200 EUR/month. The answer is not surprising since there are many students among the fans. 14.3% of the respondents have an income of 200-500 EUR/month. The highest ratio of our respondents belongs to the group with monthly income between 500 and 750

EUR. They are represented with 28.1%. 26.7% of the respondents were from the group of 750-1500 EUR monthly income. Based on the questionnaire survey, 9.2% of the respondents had more than 1500 EUR monthly income.

The last question of this type addressed the highest education degree of the respondents. The options to choose were the following: basic school, high school without final exam, high school with final exam, college/university, and postgraduate studies. 8.8% of the respondents have a basic school degree, 24.0% high school degree without final exam. The highest ratio of the respondents had a high school degree on final exam (46.05%). The ratio of the respondents with university degree was 19.6%, and postgraduate studies were completed by 1.2% of the respondents.

Our first hypothesis was the following: *The ratio of representatives of younger generation distant fans following their favorite team on social media sites is high.*

To test our hypothesis, we had to select the collected data. Only those fans were included in the survey who live 50+ km from the headquarters of the sport club. We wanted to examine the relationship between the generation groups (independent, ordinal) and the frequency of following social media site of the club (dependent, ordinal). We had to conduct an independence test. We obtained the following observed values (Figure 1):
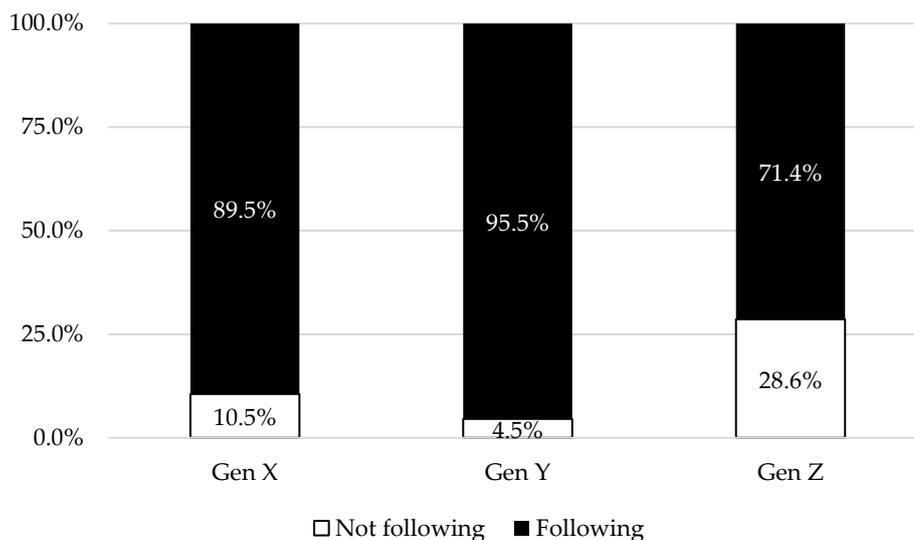

Figure 1. The relationship between the age of the respondents and the frequency of following the social media site of the club

Since both variables are ordinal – not metric variables – we applied a crosstab. Our statement sounds that there is no relationship between the observed variables. Pearson's Chi-square ($\chi2$) test was used to perform the test. We obtained the following values by applying SPSS.

The value of the Chi-square is 5.881; the value of the degree of freedom (df) is 2; the significance (α) value is 0.05. The critical value of the $\chi2$ (in case that the degree of freedom (df)=2, the level of significance is 0.05) based on the table of quantile values of the Chi square distribution is 5.991. According to this, 5.881 < 5.991, which means that *$\chi2 < \chi2$ crit.*

Table 2. The result of the Pearson Chi-Square test – Hypothesis 1

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.881	2	.053
Likelihood Ratio	6.116	2	.047
Linear-by-Linear Association	3.345	1	.067
N of Valid Cases	69		

The value of P (empirical significance level) is 0.053, which is higher than the significance level ($\alpha = 0.05$). Based on these results, there is no relationship between following social media site of the football club and the differentiation based on the age of the fans. Since there is no relationship, it is not necessary to examine the relationship between the two variables.

According to our H2 hypothesis: *Members of the younger generation received a higher proportion of fan souvenirs than they gave to others as a gift.*

We wanted to examine the relationship between differentiation based on age group (independent, ordinal) and whether the representatives of age groups had purchased a souvenir from the webshop/souvenir shop of the football club (dependent/ordinal). We performed an independence analysis. First, we got the following value (Figure 2):
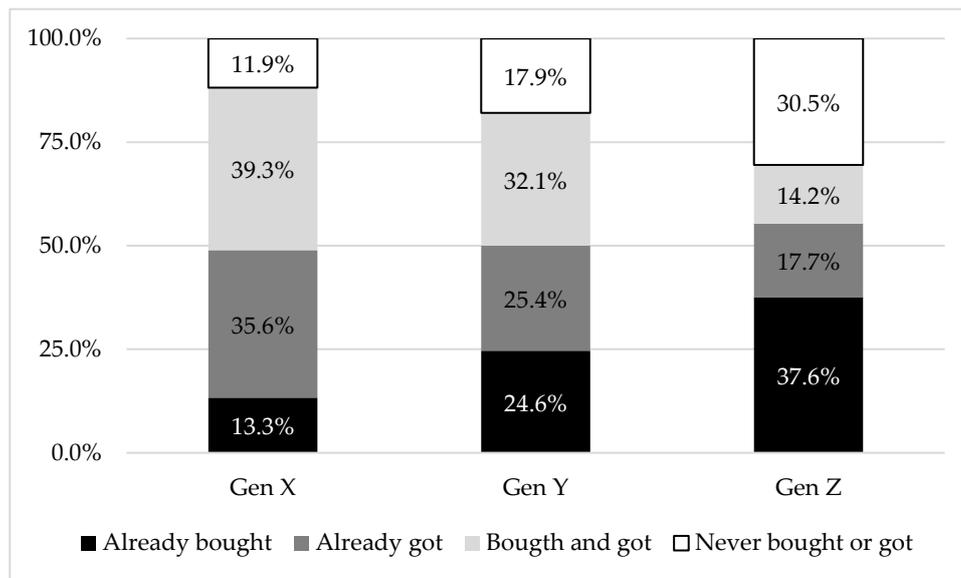

Figure 2. The relationship between the age of the respondents and the purchase

Table 3. The result of the Pearson Chi-Square test – Hypothesis 2

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	53.195	6	.000
Likelihood Ratio	55.196	6	.000
Linear-by-Linear Association	.861	1	.353
N of Valid Cases	410		

Again, both variables are ordinal in nature, so a crosstab was used in this case as well. Our basic statement was that there is no relationship between the two examined variables. The rule of the feasibility of the test was met, so we applied the Pearson's Chi-square ($\chi2$)

test. Our basic statement was that there is no relationship between the examined variables (income, expenditure). Using SPSS, we obtained the following values (see Table 3).

The value of the Chi-Square is 53.196. The value of the degree of freedom (df) is 6. The significance value (α) is 0.05. The critical value of $\chi 2$ distribution (degree of freedom (df)=6, significance level=0.05) based on the table of the quantile values of Chi-Square distribution is 12.592. According to this, 53.195 > 12.592, which means that $\chi 2 > \chi 2\ crit.$

Furthermore, the value of P (empirical significance level) is 0.000, which is lower than the level of significance (α = 0.05). The obtained results prove that there is a relationship between belonging to a generation group and whether members of these groups received or purchased a gift from the web-shop or souvenir shop of the football club.

Since there is a significant relationship between the two ordinal variables, it is necessary to examine the Gamma coefficient. The results were obtained by using SPSS program. The value is −0.06, which shows a weak negative relationship between the variables.

Table 4. The value of Gamma coefficient – Hypothesis 2

		Value	Asymp. Std. Error	Approx. T	Approx. Sig.
Nominal by Nominal	Phi	.360			.000
	Cramers's	.255			.000
	Contingency Coefficient	.339			.000
Ordinal by Ordinal	Gamma	-.060	.062	-.974	.330
N of Valid Cases		410			

The opposite of our hypothesis was confirmed, the representatives of younger generation purchase frequently not only receive gifts from the club's shop. The representatives of the older generation received gifts more frequently than purchased.

4. Discussion

The examination of sport consumer habits is basically formed by examination of consumer habits and mapping the factors influencing the consumer behavior. In exploring the factors influencing consumer behavior, many scientists (Biscaia et al., 2012; Sudbury-Riley et al., 2014; Çevik, 2020; Baša & Sánta, 2021) agree that consumer behavior is fundamentally influenced by social and psychological factors. While social factors primarily focus on interpersonal relationships, respectively the power to influence the purchasing process, the most relevant psychological factors are perception, learning theories, motivation, and personality.

As the consumer behavior is not constant, it is very difficult to define or describe. The consumers are exposed to external factors that allow them to change their decision at any time, which results in brain work for researchers and marketing specialists as well.

By analyzing the obtained data based on primary research, we wanted to know whether the younger generation of distant fans follow their football team on social media sites more frequently than the rest of the fans; and whether the representatives of younger generation received fan souvenirs more frequently than they gave. According to the Statista (2019) people belonging to age group 18–35 are the most active when it comes to consuming sports

content on social media. The statistical analysis of our research shows no relationship between belonging to certain age groups and following the football team on the social media site. The reason behind this difference could be that Statista (2019) dealt with "sport consumption" but not necessarily with following a sport club's fan page at social media. On the other hand, Statista (2019) did not deal with the distance as affecting factor.

According to KPMG (2017) research Generation X make more transactions (18.6) than Millennials (15.6) and Baby Boomers (15.1). On the other side Baby Boomers spend the most at one transaction (203 USD). We were assuming that this could lead older generations buying more gifts to their family members, while younger generations getting more gifts than giving away. Our analysis showed that significant relationship was detected between being a member of a certain generation group and purchasing, resp. receiving a souvenir from the gift shop of the football club – but the representatives of the older generation received gifts more frequently than purchased.

Based on these facts, we find it easier to get familiar with fan groups of different generations and apply targeted methods and tactics to stimulate consumption.

5. Conclusions

The obtained research results can contribute to improve the marketing activity of football clubs. The following suggestions are related to our research:

As fans of different age groups are active in following the social media sites of the football club, the content appearing on the site should target both the younger and older generation. The information provided to fans should be exciting, easily understood e.g., the communication of events, adverts, and sponsorship should be designed to reach a wider scope of audience.

As the representatives of the younger generation purchase fan souvenirs more frequently and not only receive them from the souvenir or web shop of the club, it is important to design a shop to target the needs of the younger customers, as well as active presence in social media is advised. The management cannot forget about the fans representing the older generation, so it is essential to find those communication channels that can be used to address these fans directly and motivate them for purchase. Identification of consumers representing different generations is essential, as it plays a key role in determining the appropriate marketing strategy, which can help the fans to develop strong commitment to be interested in the examined Slovak football club.

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