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Interlocking directorates under Polish merger control system182

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Abstract
Interlocking directorate is a situation when a member of a corporate board of directors serves on the boards of more than one corporation. Interlocking directorate is a phenomenon that is subject to ongoing debate between antitrust scholars. However, there is no uniform treatment of interlocking directorates in antitrust laws of various jurisdictions. Under Polish law, interlocking directorates have been subject to notification to the competition authority since mid-1990s. Originally, interlocking directorates have been a separate type of a transaction notifiable to the competition authority. However, since the adoption of currently binding Law on Competition and Consumer Protection in 2007, interlocking directorates are not a separate type of a "concentration" anymore, but – in line with the express provision contained in the Law – they are one of the factors that must be taken into account within the assessment whether the control (decisive influence) over undertaking has been acquired. The paper will include analysis of historical development of the relevant laws and the analysis case law.

Keywords
Interlocking directorates, merger control, competition law, antitrust.

JEL Classification
K21

1   Introduction

Interlocking directorate is a situation when a member of a corporate board of directors serves on the boards of more than one corporation. Interlocking directorate is a phenomenon that is subject to ongoing debate between antitrust scholars (see e.g., Gabrielsen, Hjelmeng and L. Sorgard, 2011; V. Petersen, 2016; Thépot, Hugon and Luinaud, 2016; Bielecki, 2016). However, there is no uniform treatment of interlocking directorates in antitrust laws of various jurisdictions.

In Poland, interlocking directorates have been subject to merger control regime since mid-1990s. However, during this period, the rules concerning interlocking directorates has been changing over time. Therefore, the first research problem is to identify trends in development of merger control regime in the context of interlocking directorates over the relevant period.

Secondly, it must be noted that the rationale for merger control regime is to provide the competition authority (in Poland - the Chairperson of the Office for Competition and Consumer Protection ("UOKiK")) with powers to prohibit or require modification of the notified transaction. In this context, the research problem is to analyse decisions issued by the Chairperson of UOKiK within merger control and which concern interlocking directorates. In particular, the analysis will try to answer the following research question: how frequently the Chairperson of UOKiK intervenes with respect to interlocking directorates within merger control regime?

The article will begin with a brief description of methodology and analyzed data. Then, I will provide brief overview of corporate governance model adopted in Poland as well as various theoretical approaches

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developed in social sciences trying to explain why interlocking directorates arise. This section will provide a background for the competition law analysis of interlocking directorates under Polish law. In the next section, I will present analysis of historical development of legal rules governing merger control and interlocking directorates in Poland. This section will be followed by analysis of the Chairperson of UOKiK's case law. The article will be completed by a short summary.

2   Methodology and data

In this paper I focused on methods specific to the legal science, in particular legal doctrinal method. Within the analysis of legal documents I used various methods of interpretation, including literal, systemic, teleological and historical methods.

Furthermore, the analysis of case law will be provided. The case law analysis was limited to the period between 2000 and 2017. This is because the website of the Office for Competition and Consumer Protection includes decisions of the Chairperson of UOKiK that were published since 2000.

The decisions were searched for via case search available on UOKiK's website.[1] The case search was limited to merger control decisions. Furthermore, the decisions were filtered via key words: "art. 12 ust. 3 pkt 2" (i.e. the specific provision mentioning interlocking directorates under the 2000 Law on Competition[2]) and "art. 4 pkt 4 lit. c" (i.e. the specific provision mentioning interlocking directorates under the 2007 Law on Competition[3]). All filtered decisions were also analysed using legal doctrinal method in order to exclude the ones that do not concern interlocking directorates.

3   What is the role for interlocking directorates?

3.1   Corporate governance model in Poland

Interlocking directorates is a phenomenon at the boundary between competition and corporate law. Therefore, even though the present analysis will be focused on merger control, which constitutes a part of competition law, in order to provide a context of the discussed phenomenon, it is necessary to provide a brief description of corporate governance model in Poland.

Under Polish corporate law, the two-tier board model has been adopted. Therefore, management and control functions within corporations are structurally split into two boards: management board and supervisory board. The role of management board members is to run the business of the undertaking on an ongoing basis.[4] Supervisory board is designed to monitor the activity of management board members. It stipulates manager's remuneration,[5] represents company vis-à-vis management board members,[6] suspends management board members and it may delegate its own members to temporarily act as management board members.[7]

3.2   Interlocking directorates in social sciences

Interlocking directorates have been the subject of numerous theoretical and empirical studies in social sciences in the last few decades leading foundations for many theoretical explanations of this phenomenon (for summary of these theories see e.g. M. Mizruchi, 1996; M. Pawlak, 2012). There are theories that explain interlocking directorates as primarily inter-organizational relationships (D. Schoorman, M. Bazerman and R. Atkin, 1981; B. Mintz, M. Schwartz, 1981; O'Hagan S. B., Green M. B., 2002) or the ones that highlight personal motives as a driving force for creation of interlocks (T. Koenig and R. Gogel, 1981; E. Zajac, 1988).

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[1] https://decyzje.uokik.gov.pl/bp/dec_prez.nsf
[2] Ustawa z dnia 15 grudnia 2000 r. o ochronie konkurencji i konsumentów (Journal of Laws from 2000, no. 122, pos. 1319).
[3] Ustawa z dnia 16 lutego 2007 r. o ochronie konkurencji i konsumentów (Journal of Laws from 2007, no. 50, pos. 331).
[4] Articles 208 § 1 and 371 § 1 of the Polish Commercial Companies Code (ustawa z dnia 15 września 2000 r. Kodeks spółek handlowych, Journal of Laws from 2000, no. 94, pos. 1037).
[5] Art. 378 § 1 of the Polish Commercial Companies Code.
[6] Art. 379 § 1 of the Polish Commercial Companies Code.
[7] Art. 383 § 1 of the Polish Commercial Companies Code.

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There is also a group of theories emphasizing the fact that interlocking directorates may be means of control and coordination between firms (for assessment of the role of interlocking directorates in the creation of cartels see H. Buch-Hansen, 2014). Some of these studies emphasize the fact that interlocking directorates are sometimes associated with interfirm stockholding or lending relationships (C. Kono, D. Palmer, R. Frieland, M. Zafonte, 1998).

Empirical research on interlocking directorates in Poland focused on five specific industries (pharmaceutical, construction, food, energy and banking) in the period between 2012 and 2014 suggest that management boards members usually occupy multiple positions within a corporate group, considered as a group of entities having shareholding links (J. Szalacha-Jarmużek, 2014). With respect to managers, interlocking directorates between entities belonging to different corporate groups is much less common. This observation is valid across different industries. Therefore, it is argued that interlocking directorates involving managers serve bonding purposes within corporate groups (J. Szalacha-Jarmużek, 2014) On the other hand, supervisory board members in various industries are more frequently involved in interlocks between entities not belonging to a single corporate group (J. Szalacha-Jarmużek, 2014). Thus, interlocking directorates involving supervisory board members are considered as an element of bridging strategy.

4   Interlocking directorates and merger control in Poland. Historical development

4.1   Legal framework prior to the 2007 Law on Competition

The fall of communism in late 1980s resulted in complete transformation of the Polish economy. Under the communist regime, economy was subject to central planning and, therefore, economic activity was not lead by forces of competition, but rather it was subject to administrative decision making. However, in late 1980s the communist regime in Poland has started to fall and the move towards market economy has begun. This was also reflected by the introduction of the Law on Counteracting Monopolistic Practices in National Economy in 1987 , which was replaced in 1990 by the Law on Counteracting Monopolistic Practices. These legal acts included rules creating merger control regime. However, the scope of transactions notifiable to the competition authority was limited to mergers *sensu stricto* (*łączenie*).

In 1995, an amendment to the Law on Counteracting Monopolistic Practices has been introduced ("the 1995 Law on Competition"). The amended law, stipulated notification requirement for the core transactions constituting part of the merger control systems in the vast majority of jurisdictions, such as merger *sensu stricto* (amalgamation), acquisition of control and creation of a joint venture. Apart from these types of transactions, the 1995 Law on Competition also defined other types of transactions that were specifically named as being subject to ex ante review by the Chairperson of UOKiK. The notification requirement also covered acquisition of a minority shareholding enabling the acquirer to hold at least 25% of votes at the shareholders' meeting and the creation of interlocking directorates. The notification requirement for interlocking directorates covered situations when the same person took the position of a director, deputy director, board member, supervisory board member, audit committee member or chief accountant in competing economic entities, if the total value of annual sales of goods - in the calendar year preceding the year of notification of the intention - exceeded ECU 5 million.

The 1995 Law on Competition was replaced by the 2000 Law on Competition. The adoption of the new Law was related to the process of planned accession to the European Union, which eventually took place in 2004. Under the 2000 Law on Competition creation of interlocking directorates remained separate type of a concentration, but the scope of corporate positions covered by the notification requirement was narrowed and included only members of management as well as supervisory body.

Nevertheless, a broad list of transactions notifiable to the competition authority was subject to criticism in the Polish jurisprudence. Furthermore, in practice, interlocking directorate was not the most popular type of concentration. A review of the UOKiK's website shows that in the period 2000-2007 the Chairperson of UOKiK issued 18 published decisions concerning notification of interlocking directorates under the 2000 Law on Competition. The above statistics give an average of 6 notifications of interlocking directorates per year.

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Furthermore, all these decisions ended up with the Chairperson of UOKiK granting unconditional clearance for the creation of interlocking directorates.

Furthermore, limiting the scope of the merger definition to interlocks between competitors had negative impact on the easy-identifiability of the concept of concentration and, in fact, lead to problems for addressees of obligation to notify a transaction. This is because the term "competitor" may cover both actual competitors (i.e. undertakings that actually compete on at least one market) and, what is more problematic, potential competitors.

4.2   Legal framework after the 2007 Law on Competition

Taking into account the above, one of the driving points for the authors of the draft new Law on competition, who included also the competition authority's officials, was to limit the scope of transactions subject to notification to the competition authority in order to focus resources on the matters that were potentially more harmful to competition (Szwaj, 2010). As a result, acquisitions of minority shareholdings and the creation of interlocking directorates were no longer separate types of concentrations covered by the 2007 Law on Competition.

The 2007 Law on Competition defines four types of transactions that constitute notifiable concentrations. These include: (1) a merger of two or more independent undertakings; (2) acquisition of control – by way of acquisition or entering into possession of stocks, other securities, shares or in any other way obtaining direct or indirect control over one or more undertakings by one or more undertakings; (3) creation by undertakings of a joint venture; (4) acquisition by one undertaking of part of another undertaking's property (all or part of the undertaking).

However, interlocking directorates were not entirely removed from the 2007 Law on Competition. Under the 2007 Law on Competition interlocking directorates – instead of constituting separate type of concentration – constitute part of the definition of acquisition of control. The 2007 Law on Competition defines "acquisition of control" as: any form of direct or indirect acquisition of rights by the undertaking, which, individually or jointly, taking into account all legal or factual circumstances, allow it to exert a decisive influence upon another undertaking or undertakings. The 2007 Law on Competition specifies a catalogue of situations which are particularly considered as leading to acquisition of control ("in particular, such powers are created by: (…)". This catalogue includes holding majority of voting rights, right to appoint members of corporate bodies, ownership of assets and rights related to management or profit of the target undertaking. Apart from the above, it includes also the clause according to which decisive influence over target undertaking can be obtained if "members of [*acquiring undertaking's*] management board or supervisory board constitute more than one half of the members of another undertaking's (target undertaking's) management board". Furthermore, unlike its predecessors, the 2007 Law on Competition covered interlocking directorates regardless of the fact whether interlocked undertakings were competitors or not.

The decisional practice related specifically to mergers involving interlocking directorates is not well developed and there are only three decisions in which creation of interlocking directorates were considered as potentially constituting notifiable concentration under the 2007 Law on Competition.

4.3   Trends in historical development of merger control regime over interlocking directorates

Based on the above, certain trends can be observed. First of all, the scope of positions covered by the merger control regime has been limited over time. Furthermore, the scope of positions becomes more closely related to corporate decision making process. Positions with no specific powers provided by corporate law (e.g., Chief Accountant) were initially covered by notification requirement, but they are no longer within the scope of merger control regime.

Moreover, it seems that there was a modification of the role of merger control over interlocking directorates. In the beginning, creation of even single interlocking directorate between competitors was subject to

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notification to the competition authority. This can be associated with the fact that even single interlocking director is enough to exchange information between competitors. On the other hand, in light of later amendments to the merger control regime, creation of interlocking directorate was considered as an element of acquisition of control. To this end, interlocking directorates were subject to notification requirement only when they involved majority of management board of target undertaking, which can be associated with enjoying majority of decision making power within the company. Consequently, the primary risk to competition resulting from creation of interlocking directorate was no longer information exchange. Instead, in general, the competition authority should be focused on theories of harm related to mergers.

5 Interlocking directorates and merger control in Poland. Analysis of the Chairperson of UOKiK case law

The list of decisions concerning interlocking directorates issued by the Chairperson of UOKiK within the merger control regime in the analysed period is presented in the table below.

Table 1. Chairperson of UOKiK's case law concerning interlocking directorates in the period 2000-2017

Decision no.	Date of the decision	Parties
DDF-61/2001	2001-10-12	Accor Polska Sp. z o.o. / Hotek Polska Sp. z o.o. / Sociéte d'Exploitation Hotek Polska Sp. z o.o. / Hotel Muranowska Sp. z o.o. /Hekon-Hotele Ekonomiczne S.A. / Orbis S.A.
DDF-72/2001	2001-11-16	Provimi Polska Holding Sp. z o.o. / Rolimpex S.A.
DDF-4/2002	2002-02-04	Orfe S.A. / Dr Pokorowski S.A.
DDF-17/2002	2002-03-25	Komercyjne Centrum Płatnicze Sp. z o.o. / BusinessPoint S.A.
DDF-18/2002	2002-03-25	Komercyjne Centrum Płatnicze Sp. z o.o. / BusinessPoint S.A.
RKT-21/2002	2002-06-12	STALPROFIL S.A. / Huta Katowice S.A.
RKT-22/2002	2002-06-12	STALPROFIL S.A. / Huta Katowice S.A.
DDI-97/2002	2002-11-05	„Polskie Huty Stali" S.A. / „Stalprofil" S.A.
DPI-28/2003	2003-04-24	Zjednoczone Przedsiębiorstwa Rozrywkowe S.A. / Orbis Casino Sp. z o.o.
DAR-16/2003	2003-10-30	Towarzystwo Ubezpieczeń i Reasekuracji "Warta" S.A. / Towarzystwo Ubezpieczeń w Rolnictwie i Gospodarce Żywnościowej "Agropolisa" S.A.
DOK-21/2004	2004-03-29	Zjednoczone Przedsiębiorstwa Rozrywkowe S.A. / Finkorp Sp. z o.o.
DOK-3/2005	2005-01-06	Orbis Casino Sp. z o. o. / Zjednoczone Przedsiębiorstwa Rozrywkowe S.A.
RWA-8/2005	2005-03-18	ABG S.A. / Ster-Projekt S.A.
RKT-45/2005	2005-08-30	SIMON HOLDING S.L. / KONTAKT-SIMON S.A.
RKR-37/2006	2006-08-09	VISTULA S.A. / Wólczanka S.A.

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DOK-142/2006	2006-11-21	Asseco Poland S.A. / Softbank S.A.
RLU-3/2006	2006-02-28	Perła S.A. / Royal Unibrew
RWA-3/2006	2006-01-20	Energomontaż –Północ S.A. / Sices S.p.A.
DKK-88/2008	2008-11-18	Kutnowskie Zakłady Drobiarskie „EXDROB" S.A. / Płockie Zakłady Drobiarskie„SADROB" S.A.
DKK-89/2008	2008-11-18	Kutnowskie Zakłady Drobiarskie „EXDROB" S.A. / Płockie Zakłady Drobiarskie„SADROB" S.A.
DKK-132/2013	2013-10-22	TERG / Electro.pl

Source: own research based on database of Chairperson of UOKiK's decisions available on uokik.gov.pl

All of the above decisions were unconditional merger clearances. In this context, it should be noted that the Chairperson of UOKiK approves unconditionally the transaction if it does not lead to a significant restriction of competition. Otherwise, it prohibits the transaction. It is also possible that a transaction is cleared by the Chairperson of UOKiK subject to certain conditions, e.g. divestment of assets. Furthermore, in exceptional cases, the Chairperson of UOKiK may clear a transaction leading to a significant lessening of competition if it simultaneously contributes to economic development or technical progress or has a favorable impact on the economy.

On the one hand, the fact that all analysed decisions are unconditional merger clearance may suggest that interlocking directorate are very rarely dangerous to competition. In particular, at least in the Chairperson of UOKiK's view, creation of interlocking directorate in none of these cases could lead to restriction of competition.

On the other hand, the fact that the Chairperson of UOKiK has not prohibited nor imposed any conditions on planned creation of interlocking directorates may suggest that standards and methods used by the competition authority for assessment of mergers may not be best suited for interlocking directorates. In particular, in publicly available versions of decisions the Chairperson of UOKiK tends to focus primarily on market shares and, to a large extent, it seems to disregard other factors that could impact the assessment.

Nevertheless, based solely on the analysis of the case law using traditional legal methodology, in particular legal doctrinal method, it is not possible to decide which of the abovementioned explanations is correct. Therefore, a more detailed analysis of these cases using other methods, including economic approach, is required.

6   Conclusion

As presented above, certain trends in the historical development of merger control over interlocking directorates in Poland can be observed. These trends include limitation of the scope of interlocked positions covered by notification requirement and making the notification requirement more closely related to corporate decision making process. Furthermore, the role of merger control in the context of interlocking directorates has changed over time. In the beginning, it was focused primarily on preventing information exchange, but later on it became related to more broader spectrum of merger related theories of harm.

Moreover, the analysis showed that the Chairperson of UOKiK has not prohibited nor imposed conditions on any transaction concerning the creation of interlocking directorates. This may be because interlocking directorates are very rarely dangerous to competition or because standards used by the Chairperson of UOKiK for assessment of mergers may not be best suited for interlocking directorates. In any case, more research in this area is necessary.

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CLIENTS PROTECTION IN INSURANCE LAW - WHERE ARE WE HEADING?

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Abstract
In recent years Polish insurance market has been subject to significant changes which were due to the transposition of European Union directives into the national jurisdiction. All the implemented directives pay special attention to the protection of the client within the financial services, including insurance. The article contains an analysis of selected protection measures relevant exclusively for the insurance market. At the beginning, it is discussed who is subject to this special protection and a distinction between "consumer" and "client" is addressed. Further, the research pertains to the selected instruments which are to provide such protection: obligation to analyze demands and needs of the client and obligation to include content of the contract model form (so-called index). In the following paragraphs, it will be discussed whether the adopted regulations actually meet the goal of protecting the client and what are their consequences for the insurance undertakings and insurance intermediaries.

Keywords
Insurance Law, Consumer Protection, Distribution Directive, Customer, Polish Law

JEL Classification
K12, K22, K23

1. Introduction

Drawing on the analysis of the recently adopted legal regulations, both national and European ones, it can be reasonably claimed that the consumer's protection is one of the common legal trends of recent years (Marak, Poroś, 2007, pp. 135-136). This thesis is supported by the actions continuously taken by the European legislator, e.g. launching European consumer agenda and a multiannual consumer programme for the years 2014-20. Both Polish and European legislators are particularly interested in the financial market.

What renders financial market particularly unique and worthy of attention is its impact on the economy on the one hand, and its complex and vague nature to majority of society on the other. Additionally, it is worth to point out that using financial services seems to be inevitable in the modern world (Więcko-Tułowiecka, 2014, p. 13). Bearing in mind the above, European Union Member States put the activity of banks, insurance undertakings and investment funds under particular supervision. They also undertake various legislative actions aimed at enhancing consumer protection on the financial market. The goal is further fostered by soft-law regulations (i.e. recommendations, guidelines).

Over the past years, insurance business has been significantly changed as a consequence of the entry into force act of 11 September 2015 on insurance and reinsurance activity (UDUR), act of 5 August 2015 on claims handling by financial market entities and on the Financial Ombudsman (URR) and act of 15 December 2017 on insurance distribution (UDU). The major common value underlying all these acts, which mostly implement provisions of the relevant European Union directives, is the need for special protection of entities involved in the insurance relationship, other than the insurer.

While analysing issues related to the protection of the insurance services clients, it should be mentioned that a substantial part of the regulations refers to all of the contractual relations concluded between entrepreneur and consumer, regardless of the activity pursued by the entrepreneur (e.g. Article 385 of Polish Civil Code (KC)). Further protection measures are provided for in the acts dedicated specifically to the insurance market, such as

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the abovementioned UDUR, URR, UDU. It is said that the necessity of their existence results from the insufficient effectiveness of civil law instruments aiming at protecting the weaker party to the contract (Szaraniec, 2007, p. 165).

The analysis provided in this paper pertains only to the second type of the measures - applicable exclusively to the insurance market. At the beginning, the author draws attention to the question of who should be protected in the view of both national and European legislator. Subsequently, selected protection measures will be discussed. In the following paragraphs, it will be considered whether the adopted legislative solutions meet the objective of protecting the client and what are the consequences for insurers and insurance intermediaries resulting therefrom.

2.   Methodology

The analysis methods involve the followings: formal and dogmatic method as a leading method and empirical method as a supplementing one. Formal and dogmatic method has been used to primarily analyse national legal acts, having regard in particular UDUR and UDU. This method has been also applied while analysing relevant insurance law doctrine.

Bearing in mind specifics of the legal studies, application of the empirical method within this research is limited. Though, it has been used to analyse practice of the insurance market with respect to the discussed issues. It shows the way in which market mechanisms verify the legislator's assumptions.

3.   Who should be protected

Although provisions of the Civil Code referring to the insurance contract leave no doubts that, besides the insurer, the policyholder constitutes party to the insurance contract, it is not entirely clear what persons or entities are to be protected according to the legislator's intention (Gnela, 2011, pp. 19-31).

Pursuant to the Article 805 KC, any civil law entity can be a policyholder. Notably, it can be both consumer and entrepreneur. Polish civil law defines consumer as a natural person who carries out with an entrepreneur a juridical act which is not directly related to his economic or professional activity (Article 22^1 KC). Thus, the policyholders which conclude the insurance contract related to their sphere of private life undoubtedly enjoy the status of consumer (Ziemiak, Marszelewski, 2017, pp. 103). In turn, natural persons who conclude the insurance contract directly related to their economic or professional activity are entitled only to some of the consumer's rights, in particular the right to enjoy the benefits of the abusive clause regulations (Article 385^1– 385^3 KC).

Granting enhanced protection to the consumers, particularly within the financial services, is a common practice across European Union Member States. However, recent insurance regulations are more far-reaching. The said regulations do not longer refer to the 'consumer' as an entity requiring special protection as they substitute the term 'consumer' with the term 'client'.

According to the explanatory memorandum to URR, which entered into force in 2015, the main goal of the introduced regulation was 'increasing the level of protection of persons using financial services'. Due to the definition stipulated in the Article 2 of URR, client of the financial market entity is a natural person who has a specific relationship with a financial market entity. Contrary to the consumer definition, client of the financial market entity can be also a natural person concluding an insurance contract related to his or her economic or professional activity. The legislator has reasonably noted that the mere fact the entrepreneur pursues a business activity does not necessarily equalise his position to a bank or an insurance undertaking (Młynarski, 2018, pp. 38). However, the way in which the above mentioned regulation extends the scope of protection is questioned by the legal doctrine. It is argued that by extending protection over so-called small entrepreneurs, the regulation refuses the protection to non-profit organisations such as foundations and associations at the same time (Maśniak, 2015, pp. 24).

According to the recital 16 of the Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009 on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II), the main objective of insurance and reinsurance regulation and supervision is the adequate protection of policyholders and beneficiaries. Beneficiary should be understood as any natural or legal person which is

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entitled to a specific right on the basis of the contract. UDUR, which implements Solvency II into Polish legal system, grants specific rights to the policyholder, insured or person entitled from the insurance contract, regardless of whether or not they enjoy the status of consumer. Specific duties, such as an obligation to include in the contract model forms information about the provisions of the contract model form which contains the most important elements of the insurance relationship (content of the contract model form) (Article 17 UDUR), not only should be performed with respect to the contract model forms concluded with the consumers but with respect to any contract model forms.

In turn, Directive (EU) 2016/97 of the European Parliament and of the Council of 20 January 2016 on insurance distribution (IDD) refers to both terms 'consumer' and 'client', although, without providing their definitions. Therefore, on the one hand, Article 17 of IDD obliges the Member States to ensure that, when carrying out insurance distribution, insurance distributors always act honestly, fairly and professionally in accordance with the best interests of their customers. On the other hand, though, according to recital 6 of IDD, it is the consumer who should benefit from the same level of protection despite the differences between distribution channels. It seems that the intention of the European legislator was to grant equal insurance protection, regardless of the insurance channel, to a wider group of entities which is not limited to the consumers.

Article 3 sec. 1 point 10 of the act on the insurance intermediaries, which implements IDD, with respect to the insurance contracts defines client as policyholder, insured and person seeking insurance coverage and does not distinguish the clients by the reference to their legal status (natural and legal persons) nor to the aim of concluding the insurance contract (consumers and entrepreneurs). It means that the obligations set out in the act (such as client's demands and needs analysis or obligation to issue key information document which will be further described in paragraph 4.1. below) should be performed with respect to both consumers and non-consumers.

Indeed, before the above mentioned acts have entered into force, there was a lively discussion among the scholars about the extension of the protection related to the conclusion and execution of the insurance contract to the entities other than consumers (Gnela, 2007, pp. 39). However, it was difficult to predict a few years ago that the legislator - both Polish and European - would define this protection so widely.

4. Client protection measures

Three acts mentioned in the introduction to this paper have implemented a number of instruments which are to strengthen the position of clients towards insurers - with respect to both obligations imposed on the insurers and rights granted to the clients. An in-depth analysis has been limited only to two of them: client's demands-and-needs test stipulated in the Article 8 UDU and obligation to include in the contract model forms, including general terms and conditions of the insurance contract, co-called index (content of the contract model form) resulting from the Article 17 UDUR.

4.1 Client's demands-and-needs test

Article 8 sec. 1 UDU provides that prior to the conclusion of the insurance contract or insurance guarantee contract, the insurance distributor shall specify, on the basis of information obtained from the client, the demands and the needs of that client and shall provide the client with objective information about the insurance product in a comprehensible form to allow that client to make an informed decision. The legal doctrine unanimously agrees that in fact the cited provision refers to two obligations: obligation to analyse the client's demands and needs in order to offer him the best insurance coverage and obligation to inform the client in an objective manner about the characteristics of the product in order to allow him to make an informed decision on which product to choose (Pokrzywniak et al, 2018, pp. 71-72). As it results from recital 44 of IDD, the aim of those obligations is to avoid mis-selling of the insurance products.

Further considerations have been made exclusively with respect to the first of the above mentioned obligations. Obligation to analyse client's demands and needs by the distributor (i.e. insurance undertaking, insurance agent, ancillary insurance agent or insurance broker) alters the current scheme due to which it is the client who assesses appropriateness of a product or service on his own (Długosz, 2017, pp. 133). Under the new regulations insurance distributor is obliged to 'actively' obtain the information from the client (Długosz, 2017,

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pp. 133), although neither IDD nor UDU specifies the scope of such information. According to the literal meaning of the Article 8 sec. 1, the information obtained is to help the distributor to specify demands and needs of the client. Moreover, it has not been clarified that the demands and needs should refer to a specific insurance product. However, it would be absurd to carry out a wide and non-product-oriented analysis covering client's insurance needs with respect to both his private and professional life. Usually, the client who calls on the distributor is not an expert in terms of insurance products, which, indeed, justifies the need for his additional protection. Yet, the client contracts distributor for a specific purpose, such as conclusion of a motor or real estate insurance.

It is worth noticing that lack of precision in defining the term 'demands and needs' of the client may lead to the conclusion that the client's need is to buy an insurance coverage providing a wide and void of liability exclusions scope of insurance where the insurance / guarantee sum is not limited, for a minimum premium. Consequently, distributor should recognise that none of the products available on the insurance market fits the client's demands and needs. Clearly, a rational interpretation of the legal provision suggests that the analysis should be rather carried out with respect to a specific insurance product, its scope and liability exclusions - e.g. autocasco insurance covering exclusively vehicles not older than 18 years old will not fit the demands and needs of the client who owns 20 years old vehicle.

A major argument raised by the doctrine against the adopted Article 8 sec. 1 UDU is that its wording is too general and in consequence, it may create serious interpretation doubts. The most important concerns have been mentioned above, however, it should not be overlooked that the legislator did not provide for specific regulations in terms of the client's demands and needs analysis with respect to special types of insurance: mandatory insurance or insurance contracts concluded under the act of 29 January 2004 - Public Procurement Law. Also, it is not entirely clear what steps the distributor should take if the client refuses to inform about his demands and needs (Pokrzywniak et al, 2018, pp. 78-80).

4.2 Content of the contract model form (index)

Pursuant to the Article 17 of UDUR an insurance undertaking is obliged to include in the contract model forms used by such insurer, in particular in the insurance general terms and conditions, specific type of information. Some of the information to be included in the index will apply only to a specific type of the insurance (e.g. unit-linked insurance where the insurer's service is determined on the basis of certain indexes and other reference values). Whereas, with respect to each of the insurance product, the insurer is obliged to indicate the prerequisites for payment of indemnity and other benefits or the insurance surrender value, as well as the limitations and exclusions of the insurer's liability giving the right to refuse to pay indemnity and other benefits or to reduce the same.

Although the obligation to include these kind of information in the insurance general terms and conditions does not seem controversial, certain doubts may arise over the lack of terminology precision (referred to in below) and detail form in which the information should be transferred. Regulation of the Minister of Finance of 16 December 2015 on information included in the model forms of contracts used by an insurance undertaking, which has been adopted on the basis of the Article 17 sec. 3, specifies, among others, size and type of font or size of the line spacing.

Notwithstanding the fact that the aim of the legislator was to facilitate the client's orientation in the insurance general terms and conditions by highlighting key information defining scope of the insurance coverage, it is doubtful whether the adopted legislative solutions pursue this goal. Legal doctrine points out that not only do exclusions constitute insurer's liability limitation but the same function is also performed by the definitions or sum insured (Pokrzywniak 2016, pp. 38-39). If the insurer decides - for prudential reasons - to put such information in the index, there is a risk that the index becomes unclear to the client.

M. Orlicki rightly notices that Polish legislator diagnoses 'low awareness of the insured persons as to their rights and obligations" resulting, among others, from the 'broadness and complexity of the model forms of contracts'. Nevertheless, neither UDUR nor other legal acts implement instruments which could actually simplify those model forms of contracts (Orlicki, 2017, pp. 4). It is difficult to claim that implementation of the discussed index referring to the provisions containing required information brings a revolutionary change. Tabular form and 'official' look of the index renders the information presented therein unattractive to the client.

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5. Consequences of the adopted client friendly solutions

In view of the relatively recent entry into force of the above discussed solutions aiming at protecting the clients of the insurance market and minimizing information asymmetry on the part of the policyholders, insured persons and persons seeking insurance coverage, it is not possible to fully evaluate the results of their implementation. Still, there is a lack of research into the extent to which the clients enjoy the rights obtained and no established case-law.

Therefore, the analysis carried out in this paragraph is based mainly on the analysis of the insurers' practice. Furthermore, the author draws the attention to the risks resulting from imprecise wording of the legal provisions.

The above mentioned instruments increasing standard of the client's protection derive from European Union's directives which have been transposed into the national jurisdiction. EU directive constitutes a legal act which on the one hand gives the Member States greater freedom to implement the regulations adopted at the European level to the national specifics, but on the other hand, it increases the risk of 'gold-plating'. The phenomenon of gold-plating appears where while implementing EU directive a Member State seize this opportunity to introduce additional regulations which are not popular and difficult to adopt within the normal legislative process. Introduction of the discussed index (Article 17 ust. 1 UDUR) perfectly reflects gold-plating example in Poland.

Legislator's actions undertaken to enhance the client's protection create serious concerns on the part of the insurance undertakings. Main doubts raised over the costs of adjusting the insurers' activity to the new legal requirements. In consequence, as the insurers will be forced to invest money into adjustments, their insurance activity could be inhibited (Łańcucki, 2015, pp. 15). The experience gained through recent years shows that such concerns are justified. The need to include the index in the model forms of contracts has eventually caused substitution of all the insurance general terms and conditions with the new adjusted ones. Such process of substitution included the followings: substantial preparation of the index, consultations with the legal departments, adoption of the new general terms and conditions by way of a resolution of the board, graphic design of the index, and finally printing and distribution. In turn, UDU imposed on the insurers obligation to prepare and issue a number of documents supplementing particular products, such as standardised key information document, client's demands-and-needs questionnaires. Further to this requirements, the insurers had to establish new mechanisms allowing e.g. to obtain the client's confirmation that the demands-and-needs test has been completed. The volume of information that the distributor should provide to the client and the excessive formality of contact with the client lead to the situation in which many distributors boil down the analysis of the client's demands and needs to the obligation to "click off" the checklist in the system.

The lack of appreciation of the analysed regulations is also observed amongst the entities which are to enjoy their benefits. It should be clearly stated that bigger amount of information does not necessarily mean better quality of such information (Łańcucki, 2015, pp. 16). Obviously, a modern consumer lives in times of a visual culture where the amount of paper documents is reduced to the minimum. Multiplication of written declarations, questionnaires and standardised documents may lead to the situation in which the adopted regulations would achieve a counter goal - the client will not be willing to read anything and would conclude the insurance contract in trust to the information provided to him orally by the distributor. This is a picture of information overload risk to which the clients are exposed (Łańcucki, 2017, pp. 11). Additionally, it should be mentioned that the client does not understand the reason of answering the additional questions while his mere objective is to conclude the insurance contract as he did last year. Role of the documents which he receives remain totally vague to the average client. It is assumed that such misunderstanding results from the lack of proper information campaign directed at the clients which should have accompanied changes introduced to the insurance market. Such action should have been definitely organised by the national authorities (Orlicki, 2017, pp.11).

6. Conclusion

Analysis of the selected legislative solutions aiming at protecting clients of the insurance market highlights whole bunch of problems which result from the legislator's activity. First of all, it should be underlined that setting a goal is not enough to build an efficient solution. Secondly, too many solutions which partially overlap

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or create inconsistencies pose a real information risk on the part of the client. In consequence, it results in even greater discouragement of insurance services and reconsider stereotype that the financial market is complex and unfriendly. Thirdly, it must not be overlooked that the costs incurred by the insurance undertakings in order to adjust their activity to the new requirements, costs of additional employees recrutement, systems and model forms of the contracts amendments will be eventually borne by the clients.

It is not the author's intention to criticise the thesis that increase of the clients' protection standard, especially on the financial markets, should be a primary goal of the legislator. Nevertheless, the best way to protect the client within the insurance or financial sector is to increase his awareness of financial instruments. However, it is impossible to achieve such objective by keeping producing new documents and questionnaires, even in a simplified form. Proper actions such as financial education programs should be undertaken towards the youngest citizens, as well as they should be of long-term nature. Poland can be definitely taken as an example in order to warn other European Union Member States not to duplicate the pattern adopted in Poland and to act on the level of education rather than regulation.

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MODERN EQUITY PORTFOLIO' OPTIMAL SELECTION CREATED OF US SECTORS

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Abstract
This paper is based on the modern portfolio theory created back in 1952 by Harry Markowitz, the man who might be considered as "the father of modern portfolio theory". Data was collected on the monthly basis since September 1989 not only for main wide US stock market benchmark index S&P 500, but also for eleven specific sectors. Calculations were made for average monthly returns, their risk measured by variance as well as by standard deviation and beta. All sectors are then compared in the covariance and correlation matrices one with each other. The main objective is to set up a low-risk equity portfolio from monthly data across eleven US sectors and whole wide market index under different scenarios, optimised based on MPT with risk measured by standard deviation, and see whether diversification has contributed to better risk-return proportion than market itself. There were set up three scenarios to select from. Firstly, portfolio analysis was proceeded on 10 years and 30 years time range. Second condition whether portfolio is created just of the sectors, or including widely broad S&P 500 index too. And thirdly whether market timing is efficient, and so has been better to omit financial crisis period. Three attributes with two options per each have provided us with eight possible scenarios to be evaluated. Short sales have been allowed.

Keywords
Markowitz modern portfolio theory, Diversification, Stock index S&P 500, market timing.

1   Introduction

Optimal portfolio selection process is a long-term issue for most of portfolio managers, traders and speculators in the investment world. Markowitz' modern portfolio theory (further as "MPT") based on mean-variance method is even more viable nowadays with the greatest global equity market capitalisation in the history reaching 80 trillion dollars (WFE, 2017).

The main objective is to set up a low-risk equity portfolio from monthly data across eleven US sectors and whole wide market index under different scenarios, optimised based on MPT with risk measured by standard deviation, and see whether diversification has contributed to better risk-return proportion than market itself.

All portfolio selections have been set up under several various conditions, and been compared then. First condition was the time range to observe over 10 years and 30 years. Second condition whether portfolio is created just of the sectors, or including widely broad S&P 500 index too. And thirdly whether market timing is efficient, and so has been better to omit financial crisis period. Three attributes with two options per each have provided us with eight possible scenarios to be evaluated. Short sales have been generally allowed.

2   Modern portfolio theory

This topic was firstly set up by Harry Markowitz[8] back in 1952. His seminar study was much later appreciated by the public when brought him and his later colleagues William Sharpe and Merton Miller a Nobel Prize for

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[8] Harry Max Markowitz (*1927) is an American economist that published this idea in his paper "Portfolio Selection".

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Economics in 1990. The idea seems much more obvious and simple today, but it was not always the case. Basically, the efficient portfolio is set up in the manner that investing into additional asset might decrease the portfolio risk itself while not necessarily negatively affecting its return due to considering correlation between individual assets. That means minimisation of the risk per a return unit or alternatively, to seek for the maximum returned portfolio per a risk unit. *Sharpe ratio* is measurement of return exceeded risk-free rate per a risk unit, in this paper simplified ratio is used with no risk-free rate. That is set up on the basis of diversification among several assets. It had changed the way of investing as added basics of mean-variance mathematical framework to construct a several-assets efficient portfolio. The model is based on assumption of Gaussian normally distributed data. Mean-variance method is a useful tool for estimating best trade-off between returns and risk on the efficient frontier of optimal portfolios.

Markowitz' MPT is based on few assumptions:

- All investors are economically rational about maximising their utility through return per a risk unit and all are the same risk averse as minimising their risk,
- Investments are heading into risky assets only,
- Static model observing the investment period that is the same to all investors,
- All information is publically available and reachable,
- The markets are efficient and liquid with infinite divisibility of assets,
- No transaction costs, no spreads, no taxes involved,
- Investors' indifference between dividends and capital gains,
- Non-systemic risk is the reducable only by diversification,
- No short sales allowed (weights 0 to 100 % only).

The last condition has not been followed in this paper. While total portfolio return is calculated as weighted arithmetic average of all individual assets returns, the portfolio risk measured by variance and standard deviation (square root of variance) is weighted average with one more aspect affecting it. That is correlation, or alternatively its non-standardised version covariance between each two assets included in the portfolio.

$$R_P = \sum_{i=1}^{N} w_i R_i \tag{1}$$

$$\sum_{i=1}^{N} w_i = 1 \quad \forall i \in N \tag{2}$$

$$\sigma_i = \sqrt{\frac{\sum_{i=1}^{N}(r_i - \bar{r}_I)^2}{n-1}} \tag{3}$$

$$\sigma_{ij} = \frac{\sum(r_i - \bar{r}_I)(r_j - \bar{r}_j)}{n-1} \tag{4}$$

$$\rho_{ij} = \frac{\sigma_{ij}}{\sigma_i \sigma_j} \tag{5}$$

$$\beta_i = \frac{\sigma_{iM}}{\sigma_M^2} \tag{6}$$

$$\sigma_P^2 = \min \sum_{i=1}^{N} \sum_{j=1}^{N} w_i w_j \sigma_{ij} \tag{7}$$

where R_P is the total portfolio expected return, R_i is expected return of *i*-asset, w_i is weight of *i*-asset in the portfolio, σ_P is the total portfolio risk (standard deviation), σ_{ij} is the covariance between i and j asset, ρ_{ij} is the correlation between i and j asset, β_i is beta of *i*-asset, σ_M^2 is the variance of market index and N is the number of assets included in the portfolio. Beta is implied volatility of the asset compared to the market index fluctuation simply corresponding to the economic systemic risk.

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Until Markowitz's work got published, investing had been always considered as a one-asset topic. Markowitz has changed the investors' mindset by thinking of investments in the bigger picture as a whole portfolio of all assets included in it.

Tobin (1958) laid down foundations of CAPM model by adding risk-free rate into MPT creating model known as "separation theorem". That was deducted to the optimal portfolio selection between two investable assets: risk-free rate with zero variance and a whole stock market portfolio. That is about balancing between risky assets and borrowing and lending dependent on individual' risk tolerance. Optimal portfolios lie on tangency line touching efficient frontier curve and starting from a risk-free intercept. Total market portfolio is being used in this paper with use of S&P 500 index while no risk-free bond is considered. Due to the distorted post-crisis conditions close to zero interest rate policies there is no meaning in investing into extremely low-return government bonds with sovereign risk at the same time. Moreover, debt markets have not been considered in this paper, hence risk-free rate to be zero and capital market line to be intercepting at zero on the risk-return diagram.

Black[9] added one more condition into MPT in terms of short sale. Regarding to the current financial markets, original MPT was limited by this constraint not allowing shorting stocks. Black enabled this option that targeted on the greater or equal returns per the same risk unit. Nevertheless, in order to set up a low-risk and unleveraged portfolio in this paper the individual weights would not go further beyond –100 %.

Rom and Ferguson (1993)'s post-modern portfolio theory (further as "PMPT") has addressed the issue with required rate of return. While MPT's return is based on historical mean, PMPT sets up sort of internal rate of return in order to receive certain level of necessary profitability. Proposed Gaussian symmetrical distribution has been criticised when used on the financial time series as in practice these have usually positive skewness of their returns, not equal to zero. That makes MPT look more risky than really is. PMPT measures risk as proportion of volatility during bull markets to the volatility during bear markets. That would consider MPT as only one of many cases, the most ideal with risk equalled to one as volatility during negative returns is considered by MPT to be the same like volatility during days with positive returns.

Value at Risk (further as "VaR") is one of quantitative statistical methods used for measure of the risked loss for a given portfolio, time horizon and probability. Simply said, on appointed chance and time what minimum loss to expect. Campbell et Al. (2001) concluded that considering normal distribution of returns would lead to comparable results using mean-variance and VaR model.

Conditional Value at Risk (further as "CVaR") is weighted average of expected loss under the worst scenario of given threshold and time on the negative side of tail of the returns distribution.

Vo et Al. (2018) examined ten industries in South-East Asia applying CVaR and concluded that during period 2007 to 2016 the best risk-return industry was healthcare in Vietnam and Singapur while consumer sector was the winner in Thailand and Malaysia.

Research time period is of important role as all variables vary during time. Ledoit (2003) stressed out on the changes in the correlations over time while Moskowitz (2003) confirmed this fact based on covariance, both of them on the US data.

3   Data

The paper focus has been aimed in the US market that is mostly watched and highly liquid. Its financial markets would be nowadays considered that what we could call strong efficient markets. The World Bank (2017) estimated US equity market capitalisation at 32 trillion dollars that would represent 40 % of the global equity capitalisation. Moreover, US markets provide the most of the publically available data. However Harvey (1995) concluded that emerging markets play important role in creation of the efficient global diversified equity portfolio as involving of developing markets decreases the total portfolio risk while its anticipated return remains.

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[9] Fischer Black (1938-1995) was an American economist well known for Black-Scholes-Merton financial derivatives valuation model from 1973 that awarded Scholes and Merton with the Nobel Prize for Economics in 1997.

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S&P 500 index was set up as the main benchmark[10]. This asset index is gathered of approximately 500 largest global public corporations quoted in the USA across all sectors (representing particular investable assets). Those are Consumer Staples, Consumer Discretionary, Information Technology, Energy, Financials, Health Care, Utilities, Telecommunications, Industrials, Materials and Real Estates. Thirty years of data were collected on the monthly basis (to the monthly end date) since September 1989 (with exception of Real Estates that were since October 2001) until November 2018.

Average monthly returns and risks (measured by standard deviation) have been calculated for every individual asset. After that, there have been calculations of covariance and correlation matrices. Finally, regarding to MPT there have been created optimal equity portfolios with lowest possible risk with calculations of their total expected return and risk.

There is no consideration of hedging against systemic risk in this paper, only diversification across individual assets included in the equity portfolio that could contribute to the lower non-systemic risk as a whole. There have been several scenarios and criteria when evaluating optimal portfolios:

Firstly, there have been two time ranges analysed: nearly ten years (2/2019 – 11/2018) and thirty years (9/1989 – 11/2018). That is the largest publically available time period for US sectors that Bloomberg provides. Ten-year period has been selected for the reason of economic boom as it's been recently a decade from the greatest financial crisis since the Great Depression.

Secondly, one portfolio selection has been generated from US sectors only and another from US sectors combined with widely broad market index. The reason has been to evaluate whether there are particular sectors outperforming in the long-term and if the most reasonable investment includes whole market, and whether the best would be not trying to specify the outperformers.

Thirdly, there have been selected portfolios for all the period of time and alternatively for only period of economic booms without financial crisis being excluded. This condition has been referred to the hypothesis of market timing. One of investment strategies is to be restlessly trying to correctly time the markets meaning attempting to predict periods of economic boom and depressions. Regarding to this aspect, investor buys at the bottom, consistently purchasing during early boom and sells during top economical conditions in the market. Since release of Efficient Market Hypothesis[11] in 1970 however that strategy has been losing its shine. In this paper there are nevertheless both scenarios mentioned, one "buy and hold" strategy, second actively purchasing and selling stocks based on "right market time". The National Bureau of Economic Research ("NBER") sets up economic cycles ex-post public. Official economic crisis announced by NBER were 7/1990 – 3/1991, 3/2001 – 11/2001 and 12/2007 – 6/2009.

These three criteria, every single of them with two alternative scenarios, provide us with eight possible outcomes, meaning eight optimal equity portfolios. In general, short sales have been allowed.

4   Empirical results

Average monthly return of wide market S&P 500 index varies over different periods of time. The lowest mean return was reached over 30 years period 0.70 % ± 2 basic points (bp) dependent on whether crisis has been included or not. On the ten-year period overall stock market was much more profitable as stocks have rallied well during recent decade after greatest financial crisis since the Great Depression. In tables below there are author's Microsoft Excel calculations for all assets under different selection of criteria. There are published monthly mean returns, risks (standard deviation), variances, betas and Sharpe ratios. In total four tables are always followed by two charts presenting eight optimal low risky diversified equity portfolio structures (two charts per table for whether market S&P 500 index may or may not be added into portfolio).

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[10] The benchmark index is a standard against which the performance of a security, mutual fund or investment manager can be measured. Generally, broad market and market-segment stock and bond indices are used for this purpose (Chan, 2017)

[11] EMH was issued in the book „Efficient Capital Markets" by Eugene F. Fama (*1939), Nobel Prize laureate in 2013. Fama insisted that consistent „beating the market" is impossible because stock prices walk up and down randomly. All past, present and future information is in his opinion already included in the current stock prices which makes it difficult to predict the stocks' next step. The first perfect market assumption was already built by Irving Fisher in 1930.

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Table 1. Individual assets ex-post monthly mean performance (30 years incl. crisis)

30year period included crisis	S&P 500 INDEX	Consumer Staples	Consumer Discretionary	Information technology	Energy	Financials	Health Care	Utilities	Telecommunications	Industrial	Materials	Real estates
RETURN	0.68%	0.72%	0.82%	1.05%	0.65%	0.67%	0.89%	0.40%	0.28%	0.72%	0.58%	0.61%
RISK	4.06%	3.72%	4.97%	6.96%	5.28%	6.08%	4.41%	4.23%	5.38%	4.86%	5.58%	6.41%
VARIANCE	0.16%	0.14%	0.25%	0.48%	0.28%	0.37%	0.19%	0.18%	0.29%	0.24%	0.31%	0.41%
Beta	1	0,58	1,09	1,37	0,79	1,25	0,74	0,42	0,82	1,08	1,08	1,07
Sharpe ratio	**0,17**	0,19	0,16	0,15	0,12	0,11	0,20	0,09	0,05	0,15	0,10	0,10

Source: own calculations

Consumer staples and Health Care sectors seem to be winners by risk-return Sharpe ratio on 30-year period with no possibility of correct market timing. Second portfolio without S&P 500 index has higher return 0.66 % (compared to 0.58 %) with similar risk. Even though both portfolios have slightly lower returns than market itself, they have significantly lower volatility. Their Sharpe ratios are 0.19 and 0.21.

Chart 1. Optimal structure of equity portfolio (30 years incl. crisis while variable S&P 500 index)

Source: own calculations

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Table 2. Individual assets ex-post monthly mean performance (30 years excl. crisis)

30year period excluded crisis	*S&P 500 INDEX*	*Consumer Staples*	*Consumer Discretionary*	*Information technology*	*Energy*	*Financials*	*Health Care*	*Utilities*	*Telecommunications*	*Industrial*	*Materials*	*Real estates*
RETURN	0,72%	0,74%	0,83%	1,07%	0,73%	0,70%	0,88%	0,53%	0,39%	0,80%	0,55%	0,58%
RISK	3,88%	3,67%	4,59%	6,66%	5,24%	5,49%	4,32%	4,13%	5,37%	4,45%	5,41%	5,56%
VARIANCE	0,15%	0,13%	0,21%	0,44%	0,27%	0,30%	0,19%	0,17%	0,29%	0,20%	0,29%	0,31%
Beta	1	0,59	1,05	1,38	0,82	1,18	0,75	0,41	0,89	1,03	1,07	0,95
Sharpe ratio	**0,19**	0,20	0,18	0,16	0,14	0,13	0,20	0,13	0,07	0,18	0,10	0,11

Source: own calculations

Consumer staples and Health Care sectors have been also winners by risk-return ratio on 30-year period with correct market timing, meaning with no crisis period involved. Second portfolio without S&P 500 index has higher return 0.74 % (compared to 0.66 %) with similar risk, but this time higher return than market index 0.72 % while significantly lower volatility 3.03 % (compared to 3.00 % and 3.88 % of index itself) so would be better again not to invest even partly into S&P 500 index, but into sectors only. Their Sharpe ratios are 0.22 and 0.24. In the long-term period that is visible that market-timing theory would be mostly beneficial.

Chart 2. Optimal structure of equity portfolio (30 years excl. crisis while variable S&P 500 index)

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Table 3. Individual assets ex-post monthly mean performance (10 years incl. crisis)

10year period included crisis	*S&P 500 INDEX*	*Consumer Staples*	*Consumer Discretionary*	*Information technology*	*Energy*	*Financials*	*Health Care*	*Utilities*	*Telecommunications*	*Industrial*	*Materials*	*Real estates*
RETURN	1,20%	0,91%	1,67%	1,57%	0,48%	1,42%	1,28%	0,74%	0,46%	1,32%	1,07%	1,39%
RISK	3,59%	2,96%	4,51%	4,56%	5,41%	5,47%	3,55%	3,48%	4,05%	4,71%	5,53%	5,50%
VARIANCE	0,13%	0,09%	0,20%	0,21%	0,29%	0,30%	0,12%	0,12%	0,16%	0,22%	0,30%	0,30%
Beta	1	0,55	1,15	1,12	1,10	1,32	0,76	0,27	0,50	1,22	1,37	0,99
Sharpe ratio	**0,33**	0,31	0,37	0,35	0,09	0,26	0,36	0,21	0,11	0,28	0,19	0,25

Source: own calculations

Consumer discretionary and Health Care sectors have been winners by Sharpe ratio on 10-year period with no possibility to correctly time the market. Both portfolios have the same level or risk 2.56 % (lower compared to 3.59 % S&P 500 volatility), but on the other hand both have expressly lower returns 0.88 % and 0.91 % next to 1.20 % market profitability, their Sharpe ratios are in both cases 0.35 (compared to market's 0.33). Investor would have been better paid-off by investing passively into market index only or into US sectors only with lower risk but the same return.

Chart 3. Optimal structure of equity portfolio (10 years incl. crisis while variable S&P 500 index)

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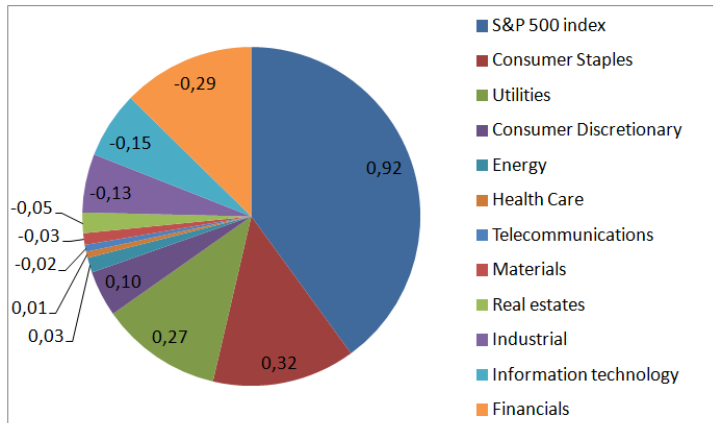**Table 4. Individual assets ex-post monthly mean performance (10 years excl. crisis)**

10year period excluded crisis	S&P 500 INDEX	Consumer Staples	Consumer Discretionary	Information technology	Energy	Financials	Health Care	Utilities	Telecommunications	Industrial	Materials	Real estates
RETURN	0,98%	0,78%	1,39%	1,29%	0,34%	0,95%	1,16%	0,64%	0,38%	1,05%	0,73%	1,06%
RISK	3,43%	2,94%	4,13%	4,37%	5,39%	4,79%	3,52%	3,51%	4,08%	4,40%	5,14%	4,50%
VARIANCE	0,12%	0,09%	0,17%	0,19%	0,29%	0,23%	0,12%	0,12%	0,17%	0,19%	0,26%	0,20%
Beta	1	0,55	1,11	1,11	1,15	1,19	0,81	0,29	0,52	1,19	1,31	0,86
Sharpe ratio	**0,29**	0,27	0,34	0,30	0,06	0,20	0,33	0,18	0,09	0,24	0,14	0,23

Source: own calculations

Consumer discretionary and Health Care sectors have been winners by Sharpe ratio on 10-year period again, this time with correct market timing strategy. Both portfolios have the same level of risk 2.50 % (lower compared to 3.43 % S&P 500 volatility), but on the other hand both have significantly lower returns 0.77 % and 0.74 % next to 0.98 % market profitability. Their Sharpe ratios are 0.31 and 0.30 (compared to market's 0.29).

Chart 4. Optimal structure of equity portfolio (10 years excl. crisis while variable S&P 500 index)

Source: own calculations

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There has been one surprising finding in the table 1. On 30year time period correctly market-timed portfolios have had higher monthly returns as expected but opposite to 10year period ones. Portfolio returns are expected to be certainly higher if investor sold out his positions right before crisis, however on the ten-year time range with market index those returns were actually lower 0.77 % compared to 0.88 % (with crisis included) and without market index also lower 0.74 % (compared to 0.91 %). The explanation is because even though economic crisis ended in 6/2009, stock markets lived a severe boom in stock prices already since 3/2009. That's why the crisis-excluded portfolio since 7/2009 missed a few highly profitable months.

Portfolios created of US sectors only have been mostly beating those with benchmark market index included in terms of higher Sharpe ratios, but have been for more risky averse investors as lower risks and returns too.

Recent decade has been considered as the longest economical rally since 1950s, that's why ten-year portfolios generated higher returns m-o-m than those in 30 years period.

5   Conclusion

Main goal of this paper was reached as all eight equity portfolios have had higher Sharpe ratios meaning higher returns per a risk unit than wide market S&P 500 index itself. Most of equity portfolios have had lower returns, but all of them been significantly less volatile measured by their standard deviations. To conclude, an attempt to create optimal effective equity portfolio on Markowitz' MPT have led to better risk-return investments ex-post under all selected scenarios. These are proper for more risky averse investors while passive investment into whole stock market would lead to higher returns matched with higher risks. Passive investing is generally considered to be less risky as portfolio managers do not attempt to "beat the market" for overperformance. This paper's MPT "active sector picking" is however resulting in lower returns followed by lower risks, but beating the market with their Sharpe ratios.

In terms of first criteria 10 or 30 years investment length, the recent decade was typical for higher mean monthly returns and low volatility too. Secondly, regarding to the market timing hypothesis portfolios with correct market cycles timing are supposed to have higher returns, however in this paper that was not the case because stock markets usually lead the economical conditions already a few quarters in advance. And because it's been a decade now since the Great Recession, the crisis-excluded portfolio since July 2009 missed some highly profitable months compared to the portfolio evaluated since February 2009.

Thirdly, in most cases this strategy has better paid off by creating portfolio from US sectors only, not including wide market index. Health Care has been one of two best sectors always with consumer staples or consumer discretionary. Health care sector is being however usually more expensive in its valuation. The issue with locating Retail industry is about current online-shopping trends that press on retailers' margins and their struggle to invite customers in person into their stores.

The usual problem is to identify the best sectors ex-ante. Even through mathematical calculation of efficient non-systemic risk-diversified portfolio, there is no guarantee of profits for investors and equity managers due to the systemic risk. Plus, there are investment strategies like Value investing not following MPT as past performance is never a guarantee of future results and any risky situation might have represented a buy or sell opportunity now. Moreover as assumed, MPT is based on symmetric distribution and based on efficient market hypothesis. Else what, with ever-growing stock markets, unconventional monetary policies worldwide, strong globalisation of financial sector, computers interconnection and artificial intelligence with algorithm trading there may be no safe heaven with potential upcoming financial crisis to strike. For these and more else reasons it is reasonable to look for defensive sectors with low beta, e.g. utilities, consumer staples, health care or alternatively telecommunications.

As there has been open possibility to short assets in this paper, there is future alternative possibility to deny shorting as referred by Markowitz, or to use asymmetric returns distribution, measuring risk not based on variance, but VaR or CVaR, or to proceed data analysis in different markets too, e.g. emerging markets.

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CHINA'S ECONOMIC GROWTH THROUGH THE LENS OF COBB-DOUGLAS PRODUCTION FUNCTION - AN ARDL APPROACH

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Abstract

This study aimed to establish and explain the role of labor and capital production factors as well as international factors in China's economic growth. The analysis utilized the ARDL bounds test procedure to determine the cointegration relationship between the variables, ECM model to reveal their short-term dynamics and Granger causality test to assess predicting variables. For the purpose of predictor selection, the model took advantage of the Cobb-Douglas production function. In case of long-run estimation of growth factors, author found negative and significant relationship in case of primary sector employment, negative and insignificant relationship with total investment share in GDP, positive and significant relationship with FDI inflows and positive and significant relationship with international trade flows share in GDP. Total investment has a positive short-term relationship with growth, but it cannot be used as a predictive indicator of GDP per capita in China. Author therefore strongly advises against China's involvement in a global trade war because domestic investment is an insufficient source of long-term growth.

Keywords
Total factor productivity, Economic growth, Trade openness, China's economy.

JEL Classification
F43, O47.

1   Introduction

The astonishing opening of Chinese economy is a fundamental variable in economic globalization today, and one can assume even the next half-century. It is the second largest economy in the world when we consider GDP at nominal prices; in 2017, China accounted for 15.2% of the global GDP (World Bank, 2018). With the population of approximately 1.42 billion, it accounts for approximately 18.5% of human population (World Population Review, 2018). The per capita income is still relatively low (only 26% of the US purchasing power parity) and the supply of cheap and productive labor is enormous (World Bank, 2018). This creates a potential for economic growth for decades to come.

International trade, as the main factor of economic openness, has constituted a significant portion of China's economic expansion. Both foreign trade and national income have experienced rapid growth, which has forced the country's supply to focus on the world and its market. Discussions on the role of international trade, particularly in promoting economic growth and productivity, have been going on for several decades. The main findings from extensive literature show that internationally active countries tend to be more productive than those that produce only for the domestic market. Studies on the impact of international trade on economic growth are of great importance in today's globalized era. They help political representatives in determining appropriate policies by identifying the source of productivity growth with regard to international trade.

2   Literature Review

The first major modern empirical studies looking for a systemic link between trade openness and economic growth were published in the early 1990s. It turned out that in the long run, openness can increase economic growth by widening the access to goods and services, achieving greater efficiency in resource allocation and improving overall factor productivity through technology dispersion and knowledge dissemination (Barro &

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Sala-Martin, 1995, Rivera-Batiz & Romer, 1991). From this perspective, developing countries can draw on the benefits of trading with technologically advanced nations. The spectacular success of East Asian economies has been partly attributed to their early opening to trade (Stiglitz, 1996). However, some authors point out that external liberalization of economy with lower quality production may tarnish its economic growth (Haussmann, Hwang, & Rodrik, 2007). In this context, another undoubtedly important factor in this *"equation"* is that Asian countries make up large share of the population of new globalizing countries, while India and China represent a majority of that population. Empirical insight into the economic processes in these economies is therefore eminently important in forecasting the next direction of the globalized world.

In addition to the economic growth itself, it is also necessary to increase the income level of the country, the primary indicator of which is the gross national product (GNP) per capita. China's GNP per capita reached $ 16,760 per capita (purchasing power parity) in 2017, which is almost a 17-fold increase since 1990. Growth in international trade flows has a bi-directional relationship with income, which means that increased trade enables higher income, and higher income brings more international trade (Bhagwati, 1988). Grossman and Helpman (1991), Wörz (2005) and Jiyang and Wen (2009) also revealed a potential causal relationship. Increased international fragmentation of global value chains opens new opportunities for the realization of individual competitive advantages of economies with incomes below their potential through higher degree of specialization.

Following the growth of exports, curbing labor-intensive production in export portfolio is another step that encourages economic expansion and strengthens international position of a country. The notion that technological sophistication and complexity of production and exports are the results of "climbing the production ladder" (accentuated, for example, by the flying geese paradigm) is quite widespread and there is a wealth of empirical literature supporting a close association of technology and development. The Prebisch-Singer hypothesis points out that concentrating on primary commodity production is not consistent with the goal of many developing countries to lift their global economic status, as primary commodity prices have a long-term negative correlation with industrial goods prices and this would deteriorate terms of trade. Through extensive diversification of accumulated capital into higher productivity industries, China is able to produce goods that do not match its income level. Naudé and Rossouw (2010) have determined that the relationship between GNP per capita of China and its export specialization has *U*-shape on scatter plot. This means that the growing income in the country is first accompanied by the diversification of exports to new industries and consequently, after reaching a certain level of income, the export basket is increasingly concentrated in a smaller number of production categories.

Arora and Vamvakidis (2004) pointed out that advanced industrialized countries benefit from trading with developing countries that are growing at a rapid pace, while developing countries benefit from trading with developed countries that possess relatively high levels of income and progressive technologies. Zhu (2007) analyzed China's trade with 26 members of the OECD and found that both intra-industry trade and inter-industry trade are crucial in China's international trade flows. Kwan and Kwok (1995) confirmed the validity of the exports-based growth hypothesis, which assumes that exports expansion is one of the main determinants of Chinese economic growth. The study reported that exports are an exogenous production function. Herreias and Orte (2010) investigated the empirical relationship between exports, investment and production growth. Their study identified evidence of economic growth based on exports as well as economic growth based on investment.

Yao (2006) examined the relationship between exports, foreign direct investment and economic growth in the period of 1978-2000. He found that both exports and FDI had a strong and positive impact on China's economic growth. Similarly, Liu, Burridge and Sinclair (2010) examined the causal link between trade, economic growth and foreign direct investment in China at an aggregated level. Long-term two-way causality between these variables has been identified. In their opinion, economic growth, exports and foreign direct investment seem to be mutually reinforcing under the open door policy. This study will attempt to estimate whether external economic factors have two-way, one-way or no causal relationship with economic growth on a more recent dataset. This will answer the question whether China's economic model underwent a shift in favor of capital-intensive productivity.

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2.1 Estimation of the impact of selected factors on the growth of the Chinese economy

For the purpose of examining the impact of trade openness on economic growth, the model utilizes the Cobb-Douglas production function (Cobb and Douglas, 1928). The general production function's formulation is as follows:

$$Y = f(A, L, K) \tag{1}$$

Where Y represents GDP, L is employment (i.e. labor force) and K is the volume of capital. A is aggregate factor productivity, which includes other than factor determinants L and K. According to Kohpaiboon (2003) and Rizavi et al. (2010), openness of the economy and foreign direct investment can represent A. Therefore, the simplified linear model, from which we'll derive the autoregressive distributed lag model, looks like this:

$$Y_t = \alpha_0 + \alpha_1 L_t + \alpha_2 K_t + \alpha_3 F_t + \alpha_4 T_t + \varepsilon_t \tag{2}$$

Where:

α_0 is a constant

F are foreign direct investment flows

T is openness of the economy

ε_t is white noise

3 Methodology and Data

The data used for the estimation has annual frequency from 1982 until 2017, providing enough observations - 36. Time series data has been transformed into natural logarithms for a number of practical reasons. In the first place, it allows to interpret the resulting coefficients directly as percentage changes of the variables. The transformation transforms the exponential growth pattern into a linear growth pattern, and at the same time converts proportional variance into constant variance, thereby minimizing the risk of heteroskedasticity.

The data for the dependent variable, China's GDP per capita, was drawn from the UNCTAD database in nominal prices. The labor factor is expressed by the number of persons employed in the primary sector. The data was drawn from the National Bureau of Statistics of China (NBS). Author assumes a negative relationship between this variable and the dependent variable. The factor of capital will be represented by the share of total investment in GDP, and this was taken from the *World Economic Outlook Database, October 2018* publication of the International Monetary Fund. As the first external variable, author chose the net inflows of foreign direct investment from the Balance of Payments database of the International Monetary Fund. Foreign direct investment refers to flows of direct investment in assets of the reporting economy. This is the sum of equity, reinvestment of returns and other capital. Direct investment is a category of cross-border investment associated with a resident in one country that controls or has a significant impact on the management of an enterprise that resides in another country. Ownership of 10% or more of ordinary shares with a voting power is the criterion for determining the existence of a direct investment. The openness of the economy was calculated as the sum of exports and imports divided by GDP (UNCTAD database). Author used shares of investment and trade in GDP as exogeneous variables and GDP per capita as endogeneous variable to minimize the possible problem of endogeneity. The results will thus not show the impact of absolute values of GDP components but rather their (lower or higher) rates of growth in comparison to GDP.

ARDL bounds testing approach (Pesaran et al. 2001) is well suited for testing the existence of a long-term relationship between economic time series, while also allowing for evaluation of time series with lower number of observations (usually, this is tolerated when using annual data). The ARDL specification of the function identified by Cobb and Douglas (1928) and amended by Kohpaiboon (2003) and Rizavi et al. (2010) is as follows:

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$$\Delta logGDP_t = \alpha_0 + \sum_{i=1}^{n_0} \sigma_i \Delta logGDP_{t-i} + \sum_{i=0}^{n_1} \tau_i \Delta logEMP_{t-i} + \sum_{i=0}^{n_2} \varphi_i \Delta logINV_{t-i}$$
$$+ \sum_{i=0}^{n_3} \omega_i \Delta logFDI_{t-i} + \sum_{i=0}^{n_4} \xi_i \Delta logOPN_{t-i} + \lambda_1 logGDP_{t-1}$$
$$+ \lambda_2 logEMP_{t-1} + \lambda_3 logINV_{t-1} + \lambda_4 logFDI_{t-1} + \lambda_5 logOPN_{t-1}$$
$$+ \epsilon_t \tag{3}$$

The first part of the equation with the coefficients σ_i, τ_i, φ_i, ω_i and ξ_i expresses the short-term dynamics of the model and the parameters λ_1, λ_2, λ_3, λ_4 and λ_5 express the long-term equillibrium relationship. The null hypothesis of the model is as follows:

$$\text{H}_0: \quad \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = 0 \text{ (no long-term relationship)} \tag{4}$$

$$\text{H}_1: \quad \lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq 0 \text{ (long-term relationship)} \tag{5}$$

If there is evidence of a long-term relationship (cointegration) between variables, following long-term model is estimated:

$$logGDP_t = \alpha_1 + \sum_{i=1}^{n} \sigma_i logGDP_{t-i} + \sum_{i=0}^{n} \tau_i logEMP_{t-i} + \sum_{i=0}^{n} \varphi_i logINV_{t-i}$$
$$+ \sum_{i=0}^{n} \omega_i logFDI_{t-i} + \sum_{i=0}^{n} \xi_i logOPN_{t-i} + \epsilon_t \tag{6}$$

If there is evidence of a long-term relationship, author will estimate the Error Correction Model (ECM), which shows the rate of return to the long-term equilibrium after a short-term imbalance. The standard ECM model includes an estimate of the following equation:

$$\Delta logGDP_t = \mu_1 + \sum_{i=1}^{n_0} \zeta_i \Delta logGDP_{t-i} + \sum_{i=0}^{n_1} \eta_i \Delta logEMP_{t-i} + \sum_{i=0}^{n_2} \theta_i \Delta logINV_{t-i}$$
$$+ \sum_{i=0}^{n_3} \iota_i \Delta logFDI_{t-i} + \sum_{i=0}^{n_4} \upsilon_i \Delta logOPN_{t-i} + \gamma ECM_{t-1} + \epsilon_t \tag{7}$$

4   Empirical Results

4.1   Unit root test

One of the first steps in econometric analysis is the testing of time series for unit roots. For the purpose of this study, a standard version of the ADF test (Dickey and Fuller, 1979) is used to verify the assumption of non-stationarity. Author performed ADF test on both original and first-differenced variables to determine whether they are *I(0)*, *I(1)*, or differenced of higher order. Trend was also included in the test statistics. The choice of optimal lag was determined automatically by the Schwarz information criterion. The results are shown in Table 1. Since all variables are *I(1)*, it is appropriate to use them for ARDL model testing.

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Table 1. Unit root test

Original variable	p-value	t-statistics	First-defferenced variable	p-value for first-differenced variable	t-statistics for first-differenced variable	Type
LOGGDP	0,3974	-2,3507	**D(LOGGDP)**	0,0033	-4,6958	I(1)
LOGEMP	0,9226	-1,0517	**D(LOGEMP)**	0,0158	-4,0614	I(1)
LOGINV	0,0771	-3,3390	**D(LOGINV)**	0,0110	-4,2151	I(1)
LOGFDI	0,8053	-1,5129	**D(LOGFDI)**	0,0079	-4,3492	I(1)
LOGOPN	0,9168	-1,0884	**D(LOGOPN)**	0,0005	-5,4477	I(1)

Source: Author's calculations.

4.2 Bounds test

The Akaike information criterion was used to select the best model among the ones evaluated. The number of regressors in the model is four, therefore K = 4. All critical values of the lower and upper limits are obtained from the publication of Pesaran et al. (2001). The calculated Wald F-statistic is 7.788227 and is greater than the critical value of the lower limit of 3.74 and the critical value of the upper limit of 5.6 at the level of 1% of significance. Author rejects the null hypothesis of no long-term relationship. Therefore, this model of growth of GDP per capita contains a cointegration or a long-term relationship among the variables. It is possible to continue to estimate the long-term relationship between the variables.

4.3 Long-run and short-run estimates

Table 2 summarizes the results of the long-term form of ARDL model of GDP per capita growth. The choice of optimal lags in explanatory variables was tested and determined by the Akaike information criterion. Primary sector employment is statistically significant in the model at 1% level of significance. The coefficient is -3.45, therefore a 1% increase in employment in the primary sector is associated with a 3.45% decline in GDP per capita over the long term. On the contrary, the drop in employment in the primary sector has a positive relationship with the growth of the People's Republic of China. This outcome shows an expected and highly elastic effect. The share of total investment in GDP has no long-term statistically significant impact on GDP per capita. However, FDI inflows have a positive and statistically significant relationship with GDP per capita at 1% significance level. With a 1% increase in FDI inflows, China's GDP grows by 0.33%, which indicates low elasticity of GDP levels to the changes of FDI inflows. The last variable is the openness of the economy, and author found that at 2.5% significance level, GDP has a positive and elastic response to the increase in foreign trade. 1% growth in the share of exports and imports in GDP is associated with a 1.4% increase in GDP per capita. Therefore, characterization of the PRC as an export-oriented economy still holds true.

Table 2. Long run coefficients

Variable	Coefficient	Standard deviation	t-statistics	p-value
LOGEMP	-3.453634	0.683929	-5.049698	0.0000
LOGINV	-0.856030	1.198136	-0.714468	0.4818
LOGFDI	0.332015	0.078876	4.209327	0.0003
LOGOPN	1.397793	0.510645	2.737311	0.0115
C	39.836497	11.939547	3.336517	0.0028

Source: Author's calculations.

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Table 3 shows the short-term coefficients of error correction model for the GDP per capita growth of the PRC. In the short term, a 1% increase in the labor force in the primary sector has a statistically significant impact, resulting in a fall in GDP of 0.62%. In the long run, investment to GDP ratio is not estimated to have an impact on GDP, but in the short term, its growth by 1% goes hand-in-hand with an immediate 0.49% growth of GDP per capita (at 10% of the significance level). Investment to GDP ratio growth therefore encourages economic activity in the year in which it was initiated, but has no measurable effect on GDP over the long term. This may be caused by a non-market decision-making when allocating new investment and subsequent weak or unstable returns. Foreign investment also has a positive and statistically significant impact on GDP, but not to the extent of total investment to GDP ratio. Its 1% increase will lead to an increase in GDP by 0.14% in the same year. Unlike overall investment to GDP ratio, FDI inflows have a positive impact on the economy in the long run, indicating a long-lasting "spillover" effect and a beneficial effect of technological adoption and the involvement of the economy in international distribution and value chains. The share of international trade in GDP does not have a statistically significant short-term association with GDP per capita. The error correction factor is negative and significant (-0.1786), confirming the long-term relationship between the variables, hence after each short-term shock in the model, there is a 17.9% year-on-year correction towards the long-term equilibrium. The shocks are therefore corrected after approximately five and a half years (which is an inverted absolute value of the error correction term).

Table 3. ECM estimation results

Variable	Coefficient	Standard deviation	t-statistics	p-value
D(LOGEMP)	-0.616870	0.194844	-3.165962	0.0042
D(LOGINV)	0.488946	0.255829	1.911226	0.0680
D(LOGFDI)	0.143562	0.045616	3.147148	0.0044
D(LOGFDI(-1))	-0.052731	0.043468	-1.213124	0.2369
D(LOGOPN)	-0.153716	0.099400	-1.546445	0.1351
CointEq(-1)	-0.178615	0.051002	-3.502122	0.0018

Source: Author's calculations.

4.4 Granger causality test

Granger causality test adds to the previous section, which estimated the cointegration relationship between variables, by estimating their causal relationships. Claims on a causal relationship need to be interpreted as *Granger causality*, hence relationships with a rejected null hypothesis indicate that the first variable has predictive ability in relation to the other variable. The results showed that there is a bilateral causal relationship between labor force in the primary sector and GDP per capita. Changes in one variable therefore affect the other, and its changes revert to the first one. The openness of the economy, as well as the inflows of FDI, have a predictive power in relation to GDP (at 10% of the significance level), which coincides with author's assumptions in the long-term model. FDI inflows also affect the employment rate in the primary sector. The author assumes that this could be a negative relationship, but the model does not examine the primary sector as an endogenous variable. The number of workers in primary sector is also a result of the openness of the Chinese economy. The GDP per capita growth of the PRC has an impact on the share of investment in GDP. Therefore, it is possible to assume that the period of economic optimism is manifested by an increase in the volume of investments.

4.5 Diagnostic and stability tests

The validity of these econometric findings depends on the suitability and the stability of the model used. Therefore, in this section the results of the diagnostic tests necessary for ARDL modelling are summarized: stability tests (CUSUM and CUSUMSQ), heteroskedasticity test (Breusch-Pagan-Godfrey test), autocorrelation test (Breusch-Godfrey LM test), model misspecification test (Ramsey's Reset test) and normal distribution test (Jarque-Bera test).

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The PRC's GDP per capita growth model was first tested by CUSUM and CUSUMSQ. These indicate that the residuals do not deviate significantly from the mean values and thus do not cross the two critical lines at the 5% significance level. Therefore, the null hypothesis of the stability of all coefficients in this regression can not be rejected.

The Ramsey's Reset Test shows an F-statistic of 0.739 and a p-value of 0.489. The resulting nonlinear combinations of fitted endogenous variable values (in this case $\hat{y}_t^2$ and $\hat{y}_t^3$) in the modified econometric model are not statistically significant when describing a dependent variable. Therefore, the null hypothesis of no model misspecification can not be rejected. The Breusch-Pagan-Godfrey test of heteroskedasticity calculated the value of F-statistic at 1.5 and a p-value at 0.1797. Therefore, the test can not reject the null hypothesis of homoskedasticity. Therefore, the model does not suffer from heteroskedasticity of residuals, as confirmed by the supplementary White's test. The Breusch-Godfrey LM autocorrelation test calculated the F-statistic and ita value is 0.518 and the p-value is 0.6029. Residual covariance is therefore zero for all lags. Since residuals with different latencies do not correlate with each other, the null hypothesis that the model does not contain autocorrelation can not be rejected. Author also tested the presence of autocorrelation with the Ljung-Box test (Q-statistics) with the number of lags set at 16. Since all of the resulting p-values are above the 5% level of significance, it is also not possible to reject the null hypothesis of no autocorrelation. Finally, author determined whether the model has a normal residual distribution using Jarque-Bera test. The resulting p-value is above 5% significance level, thus the null hypothesis that the residuals have a normal distribution can not be rejected.

5   Conclusion

This study aimed to explain China's massive economic growth by labor and capital production factors as well as factors of economic internationalization (FDI inflows and trade openness). The analysis utilized the ARDL bounds test procedure to determine the cointegration relationship and the ECM model to reveal the short-term dynamics between the variables. Predictors were selected based on the Cobb-Douglas production function. Nominal GDP per capita was chosen as a dependent variable. In case of long-run estimation, author found negative and significant relationship in case of primary sector employment, negative and insignificant relationship with total investment share in GDP, positive and significant relationship with FDI inflows and positive and significant relationship with international trade flows share in GDP. Short-run coefficients point to negative and significant relationship with primary sector employment, positive and significant relationship with total investment share in GDP, positive and significant relationship with FDI inflows and negative and insignificant relationship with international trade flows share in GDP. Based on Granger causality test, the predicting capability of FDI inflows, trade openness and primary sector employment with regards to China's GDP per capita growth can be confirmed. Total investment cannot be used as a predictive indicator of GDP per capita in China. Author therefore strongly advises against China's involvement in a global trade war because domestic investment is an insufficient source of long-term growth. Hence, China's government should focus on restructuring its export basket in favor of goods and industries with lower demand elasticities that would shield its exporters from volatility of export earnings and look for other, mainly domestic sources of growth. China is well on its way to reducing the role of simple industries which are shown to reduce country's growth prospects. This paper found that FDI is a crucial force in China's economic growth even today, after significant industrialization. China's government should therefore continue to introduce cautious foreign investment deregulation measures, even in industries dominated by state-owned enterprises.

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HIGH-SKILLED LABOUR ON THE MOVE: EFFECT OF THE 'BRAIN GAIN' IN EUROPEAN DESTINATION COUNTRIES

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Abstract

This paper assesses the impact of skilled immigration on economic growth in European countries. The 'brain drain' phenomenon is becoming a more dominant trend on international labour markets, and there are increasing concerns about the effects of distribution in terms of migration not only within destination and origin countries but also between them. The relationship between skilled immigration and economic growth is modelled in two stages. Firstly, the propose model that analyses the potential determinants of immigration and is inspired by gravity models. Second stage follows adjusted Solow growth model with human capital. In this stage we distinguish between foreign and national skilled labour force, the former being estimated with a panel regression in the first stage. The estimated coefficient of skilled immigration is positive and statistically significant.

Keywords
Brain drain, Brain gain, International Migration, Labour Migration, Labour Mobility.

JEL Classification
F22, J61.

1   Introduction

Over the span of the last 30 years, countries of Central and East Europe (CEE) have undergone considerable changes. The transition from socialist regime to capitalism and democracy has seen the birth of new generation with more opportunities than any generation before. Ability to enter foreign markets, trading production factors without major difficulties, increased level and speed of implemented innovations, or technological progress are only a fragment of the most notable differences. For the ordinary citizen, access to higher education and training might seem as one of the biggest advantages. Alongside with growing availability of information and opening up of intra-European borders, the structure of labor markets substantially reformed. Globalization allowed international employers to provide employment for any worker regardless of his/her country of origin. Increased mobility of high skilled workers is not an unfamiliar concept for several decades. However, over the past few years this phenomenon is gaining more attention. The outflow of high skilled and educated workers seeking more quality and more attractive working environment is constantly increasing. The general direction of this migration flow is from less to more developed countries.

There are several approaches to analyze labor mobility. In this paper we use simplified model only inspired by the gravity approach. We do not observe direct bilateral relationships, though the ratio to the sample averages is used. To observe the determinants, e.g., we omit the distance or language variables. Labor mobility, however, should not be recognized only as a dependent variable. High skilled labor migration has significant effects on the quality of employment and human capital, which consequently should affect economic growth in the country. Therefore the second part of the analysis consists of estimated skilled immigration acting as an explanatory variable of the GDP per capita growth.

Economically, is it important to support high skilled migration? What factors are important for educated workers in the migration decision making process? The question is, whether or not there is a relationship between labor mobility and economic growth. Is it favorable for the developing countries to adjust their policies so that they become more attractive for skilled foreigners?

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This paper is structured as follows. Section 2 provides literature overview related to brain drain phenomenon in terms of theory and empirical evidence accompanied by some stylized facts about current situation and historical comparison. Section 3 describes used data and applied methodology. Empirical results from the two models are presented in Section 4. Lastly, Section 5 concludes results and the most important findings of the paper.

2   Literature Review

One of the dominant patterns in international migration is the emigration of skilled employment from developing to developed countries. Current globalization makes the distribution of human capital more unevenly distributed, contributing to already existing inequality between countries (Docquier and Rapoport, 2012). The growing tendency of the last decades to brain drain should be assessed in terms of its effects on both sending and receiving countries. In economic theory, mobility of labor is one of the adjustment mechanisms that are crucial in an optimum currency area. Since the European Union sets one of its objectives to build an effective currency union, this should be observed more closely. What is more important, care should be taken to mitigate the brain drain from countries of Central and East Europe and to establish balanced ratios of highly educated and high skilled workers between European countries (Nedeljkovic, 2014).

Causes of the brain drain could be explained by observing the so called 'push' and 'pull' factors (Nedeljkovic, 2014). First observed factors and consequent dangers of non-returning skilled employment in CEEC have been addressed already at the end of the last millennium (Vizi, 1993). What remained unchanged throughout the time are lower wages, education expenditures, or GDP per capita as the 'push' factors, and better quality of life, better work opportunities, or even greater number of available job positions as the 'pull' factors. In analyzing determinants of high-skilled emigration, poor performance of an economy and its correlates are all significant factors of emigration, especially of high-skilled workers. Besides, brain drain should be treated as an exogenous variable in models of economic performance (Docquier and Rapoport, 2012).

Bhagwati and Hamada (1974) built their model of educated migration on assumptions of rigid wages and resulting unemployment. Ultimately, in contrast with traditional neoclassical models, emigration of high-skilled population could lead to adverse effects on national income as well as income per capita, and on the unemployment. Paper of Mountford and Rapoport (2009) develops a model combining evolution of the world distribution of per-capita income and the world distribution of population. Accounting for brain drain, this pattern of international migration is likely to reduce inequality in the short run as a consequence of an increase in GDP per capita in developing countries. The long-term effects, however, may present themselves as a rise in inequality since the loss (or gain) of skilled and educated workers could have significant impact on the level of human capital and the population in general. This is somewhat in a contradiction with Mountford (1997), where the model led to the conclusion that brain drain may actually increase the long run income level and reduce income inequality in a small open economy. In the theoretical model Grossmann and Stadelmann (2011) imply that brain drain is intensified if there is a decline in mobility costs, especially in already suffering countries. Furthermore, they come to the conclusion that the effort of the EU to attract high-skilled workers may have detrimental effects even for skilled workers in developing countries.

Beine et al. (2001) divided the brain drain into two, and distinguish between the 'brain effect' and the 'drain effect'. The former possible impact accounts for benefits of higher expected returns whereas the latter has rather detrimental impact and describes the outflow of educated and skilled employees. They conclude that the overall effect depends on which of these prevails over the other.

On the positive side, there are some arguments that skilled migration might have beneficial effects for sending country such as additional income in form of remittances, encouragement to increase the level of education or training or even a return migration after increasing ones' skills (Docquier and Rapoport, 2009). What is more, extensive outflow of high skilled could provide an incentive for the remaining workers to invest more in human capital, and therefore, in accordance to the theory, contribute to the economic growth of the country. In this scenario, in spite of the brain drain, it might actually cause the opposite – a brain gain (Beine et al., 2008; Mayr and Peri, 2008; Beine et al, 2011). Nowadays, more and more papers support the hypothesis of the 'beneficial brain drain'. In a cross-section of 50 developing countries Beine et al. (2003) show that migration prospects on an aggregate level yield a positive effect on formation of the human capital. Additionally, economies with combination of low levels of human capital with low emigration rates of high-skilled workers are positively

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affected by the brain drain. On the contrary, the brain drain seems to have negative effects on growth if there is migration rate of the high-skilled greater than 20% or alternatively, where the proportion of high-skilled in the total population exceeds 5%.

Empirically, migration is significantly driven by wage differentials. Negative significant relationship is observed between migration and the population size, indicating that decisions to migrate are taken under uncertainty regarding effective migration opportunities (Beine et al., 2001). In attempt to measure the brain drain from Italy, Becker et al. (2004) derived three indices describing this phenomenon founded on theory of human resources and two indices based on college graduates. Results confirmed the increasing tendency of graduates moving out of the country during 1990's, the number increased fourfold.

A major issue in assessing macroeconomic effects of brain drain stems from insufficient quality of available data. An improvement is required in several aspects and dimensions such as frequency of time series, further disaggregation of education levels, age and gender decomposition. Moreover, current migration flow is measured as a change in the stock of foreign citizens over a given period of time with no respect or additional information about the background of such attritions. Other than that, relationships between high-skilled migration and economic growth are analyzed as unidirectional despite the fact that this is a two-way link (Docquier and Rapoport, 2012).

2.1 Stylized facts

European citizens have a fundamental right of free mobility within the EU. While there are no longer any administrative barriers of migration to another country, Europe is a very heterogeneous area in terms of culture, language, or education and work standards. This, however, should not greatly affect high-skilled workers, for whom working opportunities in the EU shall by easier to find (Nedeljkovic, 2014).

There are some consistent observations in migration trends. In general, the number of foreigners in European countries is constantly growing. The distribution of immigrants, however, remains unchanged. This is shown in Figure 1., where the higher intensity of color represents higher number of citizens born in a different country. The recent development and financial crisis did little to nothing to this distribution. Most attractive countries are Germany, France and the UK. Popularity of Italy increased in the last 10 years, though this may be caused by the most recent more open immigration policy and significant inflow of migrants coming from other than European countries from the South.

Figure 1. Total number of non-residents in European countries
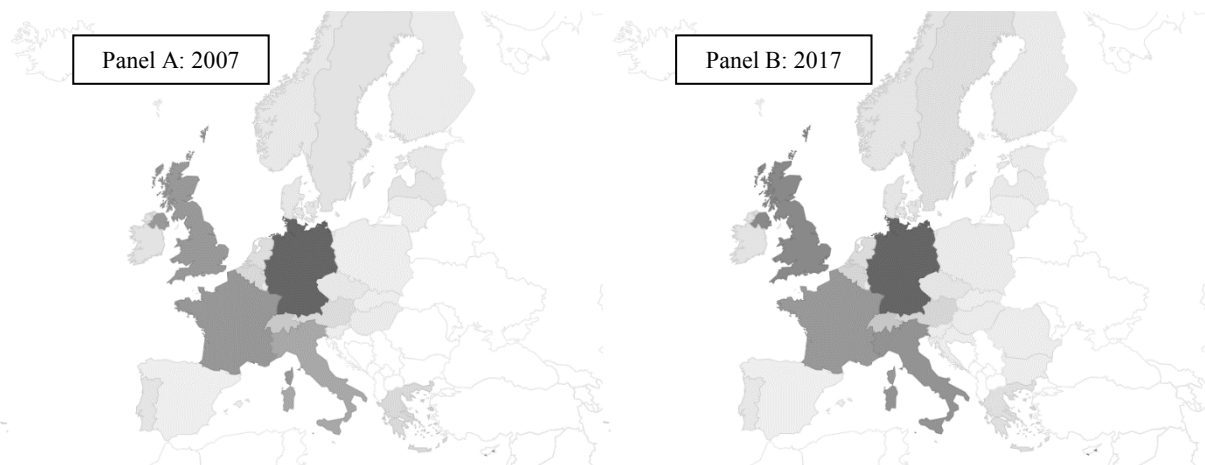
Source: EUROSTAT data on population by citizenship, extracted in December 2018

If information about total number of foreigners were transformed to relative variables, i.e. share of migrants on total population (See Figure 2.), the distribution across Europe is visibly different. The diaspora is more even and the imaginary leadership belongs to Luxembourg and Switzerland. Scandinavian countries inhabit also greater shares of immigrants while this is slowly decreasing in Baltic States.

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Figure 2. Share of foreigners on total population in European countries

Panel A: 2007

Panel B: 2017
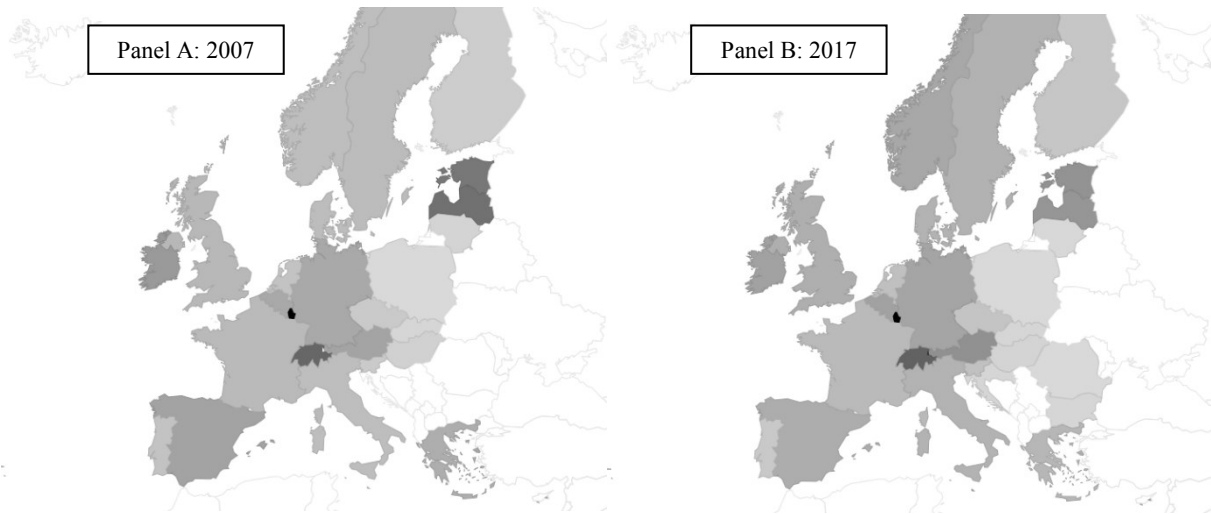
Source: EUROSTAT data on population by citizenship, extracted in December 2018

Significant majority of all active movers within the EU-28 are from Romania, Poland, Italy, and Portugal. Together with the UK, Germany and Spain these countries rank among the economies with the largest outflow of their nationals. The growing trend of emigration continues in Estonia, Croatia, Hungary and Slovenia. The newest EU member countries, mostly countries of Central and East Europe, commonly face above average emigration rates – approximately up to three times higher than the EU cross-country average in Lithuania, Latvia and Romania (European Commission, 2018).

In general, majority of the mobility flows comes from Europe itself. Participation of migrants from third countries is much lower. If specified to labor mobility, the number of active European movers is increasing. Based on the *Labour Force Survey* (LFS) the majority of movers have medium or high level of education. Interestingly, overall mobility of men is higher, yet in the group of highly educated women in the migration flows represents a greater share (see Table 1). Unfortunately, females are also more often over-qualified in comparison to males (European Commission, 2018).

Table 1. also shows share of active movers across the EU-28 in 2007 and 2017 by education levels. In general, the education attainment of EU citizens increased over the last decade. The most obvious changes are in groups of foreigners with low and high education, share of migrants with secondary education has changed only marginally.

Table 2. Education levels among active foreign (EU) population – EU28

	Low (0-2)		Medium (3-4)		High (5-8)	
	2007	2017	2007	2017	2007	2017
Total	37.5	32.3	40.7	38.2	21.8	29.6
Female	38.5	31.8	39.5	37.2	22.0	31.0
Male	36.6	32.8	41.8	39.1	21.6	28.0

Notes: ISCED 2011 classification: Low – less than primary, primary, lower secondary education; Medium – upper secondary, post-secondary and non-tertiary education; High – tertiary education.

Source: EUROSTAT, LFS, extracted in December 2018

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Empirically, the relationship between stock of immigrants and the growth of GDP per capita is negative. The intuition behind this might be that increased level of legal immigrants improves the overall population level and therefore the ratio of GDP per capita decreases. Over time, this connection weakens (See Figure 3.).

Figure 3. Relationship between Economic Growth and Immigration (Scatter plot)
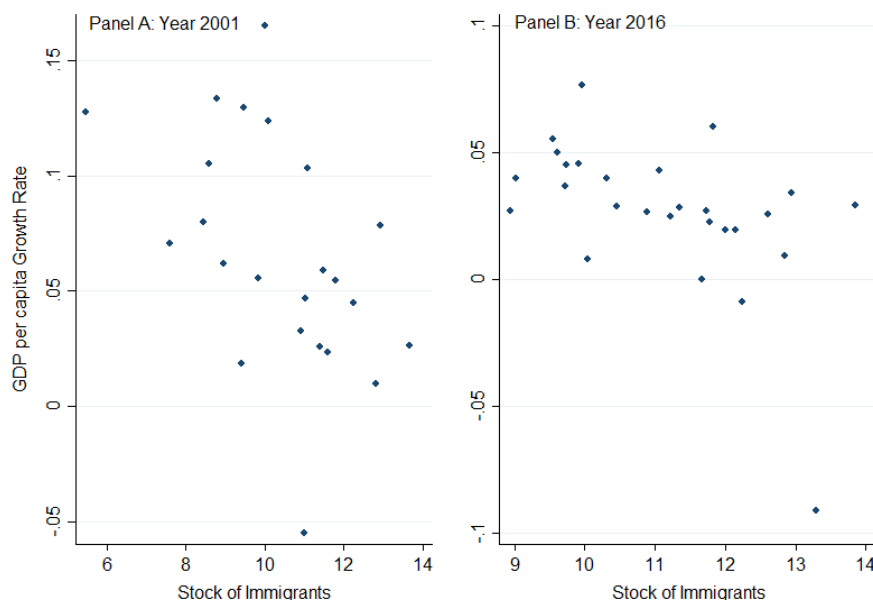
Notes: Expressed in logarithms, Growth calculated as log-difference.

Source: EUROSTAT, Author

3 Methodology and Data

In the analysis we apply a macroeconomic approach to estimate the effect of brain drain on economic growth. We use the panel data methodology in two stages, in which we first estimate the immigrated human capital variable. In the second stage we then use these fitted values in order to quantify its effect on economic growth. This section provides an insight into the methodology used in the paper as well as overview of used data.

3.1 Data

All observed variables are presented in Table 2. along with their descriptive statistics. The observed period is from 2000 to 2017, and the sample consists of the EU27 countries.

Table 3. Descriptive Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Number of immigrants	423	133848	204248.8	35	1543848
GDP per capita	484	23467.98	16239.87	1800	92600
Gross fixed capital formation	486	96106.56	140129.6	780.3	665722
Population in destination country	486	1.85e+07	2.28e+07	390087	8.27e+07
Productivity of labor	486	97.92675	10.41216	56.1	141.5
Unemployment	486	8.995885	4.347795	1.9	27.5
Human Development Index (HDI)	486	.8538498	.048328	.709	.938
Index of Economic Freedom	486	67.8821	6.785718	47.3	82.6
Net income	362	16137.97	6658.837	3671	33365
Foreign skilled labor force (ter. ed.)	323	38464.19	60385.37	448.2	348909.7
National skilled labor force (ter. ed.)	480	4717268	6429032	21064.7	2.83e+07

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Source: EUROSTAT, LFS, extracted in December 2018

Moreover, in the second stage of analysis there is a dummy variable CRISIS that is equal 1 in year 2008 to control for the financial crisis. The next section shows how data were transformed before entering the model.

3.2 Model

According to the neoclassical theory, the reason for international migration stems from existing differentials between individual countries. By the Keynesian theory, the driver for migration is the level of unemployment in receiving country. The most popular approach to describing mobility and migration flows are gravity models. Because of the data availability and demanding data preparation process, we only use fractions of classical gravity models of international migration, e.g. we do not follow direct bilateral relationships, therefore the distance variable is omitted. Nevertheless, we use information about population size, unemployment and GDP per capita (all expressed relatively to the EU mean for given year). As control variables, stock of immigrants in the destination country, human development index, and index of economic freedom are added to the model.

Therefore, in the first stage we propose following model:

$$
\begin{aligned}
\log(Skilled\ immigration_{i,t}) \\
= \beta_0 + \beta_1 log\left(\frac{population_{i,t}}{population_{EU}}\right) + \beta_2 log\left(\frac{unemployment_{i,t}}{unemployment_{EU}}\right) \\
+ \beta_3 \log(stock\ of\ immigrants_{i,t}) + \beta_4 HDI_{i,t} \\
+ \beta_5 \log(economic\ freedom_{i,t}) + error\ term
\end{aligned}
\tag{1}
$$

In the model of economic growth, we follow the Solow model of economic growth with human capital (Benhabib, Spiegel, 1994). We propose a modified model with labor divided into two separate variables: foreign labor force and national labor force, former being estimated in the first stage. Since the main focus is on skilled workers, both variables are only workers with tertiary education. Capital is approximated by observations of the gross fixed capital formation; proxy for human capital is the real labor productivity (per person). Intercept of the model should represent the technology aspect of the growth model.

In the second stage we estimate the effect of the net migration rate on economic growth using model:

$$
\begin{aligned}
D.(GDP\ per\ cap_{i,t}) \\
= \gamma_0 + \gamma_1 D(Skilled\ \widehat{immigration_{i,t}}) \\
+ \gamma_2 D(Skilled\ national\ workers_{i,t}) + \gamma_3 D(Productivity_{i,t}) \\
+ \gamma_4 D(Gross\ Fixed\ Capital\ Formation_{i,t}) + error\ term
\end{aligned}
\tag{2}
$$

Where D represents the differential and γ_0 is the difference in technological level.

4 Empirical Results

4.1 First Stage

Results of the regression in the first regression analysis are presented in Table 3.

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Table 4. First stage estimation results

Dependent variable: **Skilled immigration**			
Population	-.6561847	(.6141724)	
Unemployment	-.378233	(.0843891)	***
GDP per cap	-.4193606	(.2244562)	*
Imm. Stock	.8267141	(.0425051)	***
HDI	8.667415	(1.283422)	***
Econ. freedom	-1.113205	(.6426284)	*
Cons	-2.836673	(2.684677)	

R-squared:	Within:	0.7338
	Between:	0.4867
	Overall:	0.5045

*Notes: *, **, *** represents 10%, 5% and 1% significance levels respectively, Fixed Effect model based on Hausmann test. Standard errors are presented in parentheses.*

Source: Author

Based on these results, majority of estimated coefficient are corresponding with our expectations. Population is not a significant factor as well as the constant term. In terms of unemployment, an increase in unemployment rate above the EU average causes the level of skilled immigrants to decrease, meaning that a country is less popular and migrants might expect increased difficulties with finding a job. The most controversial is the negative relationship between GDP per capita (relative to the EU average) and immigration, yet it supports the empirical observations presented in the Scatterplot in Section 2.1. Positive and significant impact is observed in the current stock of immigrants and HDI. This may imply that existing social, cultural and language networks are important in the decision making process. At the same time, high skilled workers are seeking more developed countries and environments.

Predicted stock of skilled immigration is used in the second stage of the analysis in the next chapter.

4.2 Second Stage

Results of the regression in the first stage of the 2SLS analysis are presented in Table 4.

Table 5. Second stage estimation results

Dependent variable: **D(GDP per capita)**			
D(Skilled Foreign Labor Force)	.0115107	(.0069707)	*
D(Skilled National Labor Force)	.0042958	(.0347439)	
D(Productivity)	.005902	(.0007457)	***
D(Gross Fixed Capital Formation)	.3125601	(.0161035)	***
Crisis	.0169061	(.0069351)	**
Cons	.0182982	(.0023723)	***

R-squared:	Within:	0.7214
	Between:	0.7974
	Overall:	0.7213

*Notes: *, **, *** represents 10%, 5% and 1% significance levels respectively, Fixed Effect model based on Hausmann test. Standard errors are presented in parentheses.*

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Source: Author

In the second regression we attempted to quantify the relationship between high skilled labor force inflow and economic growth (GDP per capita). For that reason, we observe the most important first coefficient, which is significantly positive, meaning that with an increase in the stock of skilled immigrants an increase in GDP could be expected. In contrast to this, added value of national skilled workers does not proved itself as statistically significant driver of economic growth. Productivity and Gross fixed capital formation are also positively influencing, ceteris paribus, economic growth. In our model, it is assumed that constant represents technological growth which has also positive significant impact. Proposed model explains the variation between and within panels at a satisfactory level of approximately 72%.

5   Conclusion

The increased mobility of labor is a strong trend in Europe. Opening borders to its citizens, workers have currently more opportunities than ever. However, this also represents an incentive for highly educated and skilled labor force to seek these opportunities outside their birth country. Many countries are suffering from the particular trend in international migration – brain drain. On the other hand, destination countries are profiting from this phenomenon.

In this paper we attempted to derive the effect of labor migration on the economic growth in European countries. At first we build a model of skilled immigration inspired by gravity models of international migration. Fitted values were then used in the analysis of the economic growth. Second model was derived from adjusted Solow model with human capital. In our case we differentiate between foreign and national labor force, focusing specifically on tertiary educated workers. Based on our results we came to the conclusion that brain drain is beneficial for destination countries. This may be a signal for policy makers that improving the attractiveness of the country and supporting inflow of skilled and educated foreigners might prove as a significant driver of the economic growth.

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CORPORATE SOCIAL RESPONSIBILITY IN THE SMES' SECTOR IN THE CONTEXT OF NETWORKING

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Abstract

Corporate social responsibility (CSR) is actually often in the center of attention. Human rights, labor standards, environmental protection or ethical market rules are becoming very actual issue in business. Large companies create special strategies to implement these ideas. The SMEs' sector is considered as less prepared to realize these goals. The aim of this article is to point out, that in some SMEs this problem is resolved. When the small or medium-sized enterprise is a member of a network, then the CSR strategy is creating by a leader of an organization. SMEs can just realize a ready program. The case study method is used to analyze an example of such situation. The research shows, how is realized the action *The safe way to school* and other educational activities by members of Polish business network Grupa Polskie Składy Budowlane.

1   Introduction

Corporate social responsibility is the relatively new concept. The approach to CSR was changing in time. After the period, when egoistic motives and earning money were the main aim of companies, during the last few decades from philanthropic activities, through marketing approach and management of CSR we came to innovative approach to CSR (Rojek-Nowosielska, 2017). Nowadays companies try to see the long-term benefits of implementing the CSR concept and begin to build business models based on the idea of social responsibility. In large companies CSR is actually usually a part of the business strategy (Czapla, 2018). They take into account human rights, labour standards, environmental protection and ethical market rules.

But when we are talking about CSR strategy, we are thinking about large companies. The SMEs' sector is considered as less prepared to realize CSR policy. In small and medium-sized enterprises the approach to CSR is different. Personal motivation for taking socially responsible initiatives is more important than marketing, public relations or strategic approaches. They realize many philanthropic initiatives and various local actions. It is difficult to find an example of CSR strategy in a small company because of the law knowledge of the term CSR, limited financial and human resources, lack of CSR departments, officers, policies.

On the other hand small and medium-sized enterprises (SMEs) play a key role in national economies around the world. In developed countries about 99% of all firms are SMEs, they generate around 70% of total employment and between 50% and 60% of value added (OECD, 2017).

The aim of this article is to point out that when the small or medium-sized enterprise is a member of a business network then the CSR strategy is creating by a leader of an organization. SMEs can just realize a ready program.

As an example of such situation Grupa Polskie Składy Budowlane (PSB) was analyzed. A case study method was used to point out, that many small or medium-sized enterprises – members of this Group realize CSR strategy prepared by the leader of this business network.

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Initially only the action *The safe way to school* has been taken into account, but it turned out soon, that this single activity is not enough to build a CSR strategy. So another educational actions were included in the research.

2 Literature Review

2.1 CSR Strategy

There has never been a single and definite definition of *strategy* (Mainardes et al., 2014). We can understand strategy as the pattern of decisions that guide the organization in its relationship with the environment, affect the processes and internal structures, as well as influencing the performance of organizations (Hambrick, 1980), as a set of plans or decisions made in an effort to help organizations achieve their objectives (Miller and Dess, 1996) or as performing different activities to those performed by rivals or performing the same activities differently (Porter, 1996). Mainardes (2014) quotes about forty various definitions of this term and additionally twelve understandings of strategy expressed by managers.

The same situation is with the term *corporate social responsibility*. The approach to CSR was changing in time, so it was difficult to define CSR. We can easy find about forty various definitions, for instance: a company's management of its influence on and relationships with the rest of society (Marsden, 2000) or actions that appear to further some social good, beyond the interest of the firm and that which is required by law (McWilliams and Siegel, 2001). It should be highlighted, that one of them is very special - social responsibility was defined in 2010 by International Organization for Standardization in *ISO 26000 Guidance on Social Responsibility*. This definition was a result of work of 450 experts, 210 observers from 99 countries and 42 organizations (Rojek-Nowosielska, 2017). They agreed, that the *social responsibility* is a responsibility of an organization for the impacts of its decisions and activities on society and the environment, through transparent and ethical behaviour that:
- contributes to sustainable development, including health and the welfare of society,
- takes into account the expectations of stakeholders,
- is in compliance with applicable law and consistent with international norms of behavior,
- is integrated throughout the organization and practiced in its relationships (ISO 26000, 2010).

Moratis (2016) analyzes many others definitions.

It means, that it is really difficult to define CSR strategy. But it is clear that the idea of CSR can't be understood as some single activities such as sponsoring, educational events, environment protection projects etc. (Książkiewicz, 2017).

2.2 CSR in SMEs

Studies into corporate social responsibility in small and medium-sized enterprises suggest that small businesses are different to the large companies in this topic (Preuss and Perschke, 2010). Surveys indicate that the level of knowledge of the term CSR in SMEs moves around half of the surveyed companies (Ubrežiová and Moravčíková, 2017). Integration of corporate social responsibility to the organization's strategy is a challenge for small and medium-sized enterprises as they usually have limited financial and human resources (Salciuviene et al., 2016). SMEs are also less likely to have CSR departments, officers, policies, or partake in social and environmental reporting, or sign up to CSR agreements (Amaeshi et al., 2016).

CSR in SMEs is often characterised in the literature as unstructured, informal and ad hoc discretionary philanthropic activities (Amaeshi et al., 2016). Usually, small and medium-sized enterprises initiate different philanthropic programs targeting local societies (Salciuviene et al., 2016). Small businesses are usually run by individuals who both own and manage the organization and react ad hoc to social needs (Spence, 2007).

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2.3   CSR in Networks

In literature there are many studies of networks in the context of CSR, for instance Lubańska (2016) describes the conception of corporate social responsibility applied in retailers with analysis of good practices and CSR activities in the two networks Tesco and Biedronka, Reformat and Reformat (2017) analyze implementation of CSR in three retail networks, Dziwiński et al. (2015) compare the role of CSR in building competitiveness and innovativeness of the company on the example of the Spanish and Polish network companies, Maciąg (2015) researches implementation of CSR in the tourist networks. However this publications focus on the networks as a whole structure (Czapla, 2018).

3   Methodology and Data

3.1   Research Methods

The case study method was used to analyze Polish business network Grupa Polskie Składy Budowlane . The research shows, how is realized the action *The safe way to school* and another educational activities by members of this Group. Survey research, interviews, document studies and observations were used.

The survey was carried out during the conference of PSB network members in November 2018. It was a meeting of owners and managers of trading companies operating under this structure. The Group has about 400 members, about a half of them participated in the conference. Most companies were represented by few persons. So questionnaires not only were filled in by competitive persons but additionally in most cases one paper was completed by few managers of the same company. As a result 50 questionnaires were correctly completed. The sample is not representative, nevertheless results of this survey have a great value.

Following the questionnaire, some interviewees were requested to tell more about CSR strategy in their companies. It was to supplement the numerical data. Opinions, comments and impressions complement the knowledge from the survey.

Document studies and observations are the important part of this research. Summary reports, publications, post-conference materials were studied. Additionally reports from educational actions organized by PSB members were observed.

3.2   Choice of the Case

PSB Group is the largest and fastest growing network of building materials wholesales and stores "home and garden" type in Poland. At the end of 2017 PSB consisted of 382 trade companies: 315 wholesales, 269 PSB-Mrówka DIY markets and 53 PSB-Profi specialist shopping centers for constractors operating throughout country. The warehouses and Mrówka shops employ a total of about 13000 people. Cumulated revenue of PSB network from construction materials' sales at the end of 2017 exceeded 6.24 billion PLN. The total income of the entire PSB network is over 1 billion PLN higher and it is from other activities led by most of PSB members (Grupa PSB, 2017).

The structure of this business network is very simple. The leader of this group is PSB central office – big company. PSB members are usually SMEs. They are independent enterprises and on the other hand they are the shareholders of PSB central office.

This business network was chosen to this research because of same important reasons:
1. The size of this network is huge, so it is easier to observe occurring phenomena.
2. Previous observations suggested, that CSR strategy can be realized by PSB partners.
3. Some data is available.
4. Some research was possible to be carried out in short time.
5. Professional experience of the author in this branch allowed to better estimate the situation.
6. Simple structure of this network makes it easier to formulate conclusions.
7. Simple structure and huge size allowed to try generalizations.

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4   Research Results

4.1   Corporate Social Responsibility in PSB

Let's consider the corporate social responsibility in PSB in terms of the leader's activity (PSB central office). PSB for many years has had a patronage over cultural events, it supports financially numerous educational institutions, children's homes, hospitals, foundations, associations and aggrieved families. The total expenditures in 1998-2014 on the above-mentioned purposes have reached almost 2,5 million PLN but for instance only in 2015 – exceeded 2,5 million PLN.

In 2014, Grupa PSB received the "Economic prize of Polish Republic President of 2014" in the category "Corporative order and social business responsibility".

Actually in every summary report of Grupa PSB we can find a separate chapter dedicated to CSR. However we cannot read about *CSR strategy* in these reports. Leader of the Group does not use this term. It doesn't mean, that PSB central office does not realize such strategy. It takes part in huge number of activities addressed to stakeholders in order to make a positive impact on society. PSB takes into account human rights, labour standards, environmental protection, ethical market rules.

There is a large number of activities, which are described in another chapter of the summary report, but they are unquestionably related to CSR strategy. This chapter applies to trainings.

4.2   Educational actions in PSB

PSB central office organizes a large number of educational actions, for instance:

1. PSB Academy – the project has been realized for years by Grupa PSB as different trainings for various participants. Totally in 2017, over 8,000 listeners took part in trainings within PSB Academy. It was, undoubtedly, the biggest educational project in construction branch in Poland. The expenditures for these trainings incurred by Suppliers estimated over 600,000 PLN and by PSB Partners – 450,000 PLN.

2. PSB School of Good Building – the biggest training program for constructors – the customers of PSB's points of sale.

3. PSB central office, throughout its own specialists as well as their Suppliers' realizes different series of trainings for network employees:

-   technical trainings – their purpose is to increase the knowledge about Suppliers' products and technologies among the sales employees from retail and wholesale branch offices.
-   trainings about service procedures and standards in Mrówka outlets
-   soft skills trainings for managers and sellers (sale, customer service and management).
-   Mini-MBA of Grupa PSB – there was the fourth edition of eight two-day sessions for managing staff and owners about management, team creation, negotiations, finance and logistics in 2017.

4. Grupa PSB prepared on-line training calendar and e-learning platform to amend and coordinate all training types for the whole network (Grupa PSB, 2017).

5. The safe way to school – action organized together with police officers and schools. During this meetings children learn about the rules of safe participation in the road movement and receive reflective elements.

6. The educative campaign "Dom Nowoczesny" ("Modern House") to promote modern building.

4.3   CSR in SMEs – members of PSB business network

A different point of view on the implementation of CSR strategy is to consider the activity of SMEs – members of PSB business network. It is the purpose of this study.

Fifty companies from all over Poland took part in the survey. In terms of the number of employees: 17 of them are medium-sized (50-249 employees), 30 of them are small (10-49 employees) and 3 of them are micro (0-9

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employees). In terms of the type of business: 25 of them run a construction warehouses, 36 of them run retail DIY stores - Mrówka, 10 of them run specialist shops for contractors – Profi (some of them several types).

82% of respondents know the term *corporate social responsibility*. The same number of companies financially support local initiatives. It is not enough to talk about CSR strategy.

98% of them know the action *The safe way to school,* but only half of them take part in this action. The reason for this is the fact, that this program is dedicated for Mrówka shops. For some partners it was only one-off activity. Only few companies showed great interest in this action. Though respondents declared a total of over 100 trainings and over 5000 trained children as a part of this action, however it is still not enough to consider this activity as a CSR strategy.

The situation is changing, when whole companies' educational activity is analyzed. Members of PSB organize a huge number of various trainings both for employees and customers. The number of enterprises involved in particular educational activities shows figure 1.

Figure 1. Participation in Educational Activities
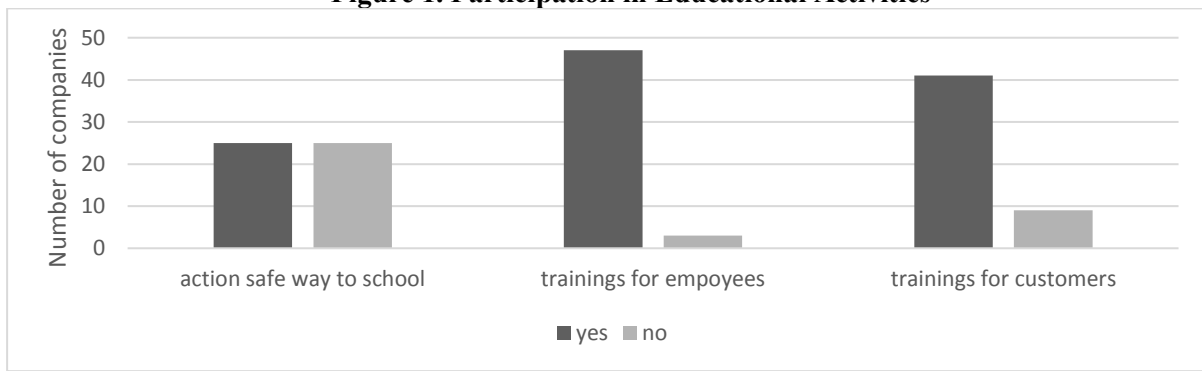
Source: own elaboration

What is surprising, almost all enterprises organize trainings for employees and 82% of them train customers. Even though in the case of the first one we may have doubts, if it is connected with CSR, however regular trainings for customers are certainly a part of CSR strategy.

To analyse this phenomenon, percentage of companies participating in educational activities in particular types of business has been calculated (figure 2).

Figure 2. Percentage of Companies Participating in Educational Activities in Particular Types of Business

Source: own elaboration

All Profi shops and almost all wholesales declare organizing training for customers. The number of such initiatives during last year was around 300 and the number of participants around 5000. Trainings for employees were prepared by all wholesales and Profi shops and more than 91% of retail markets Mrówka. The number of this actions was about 270 and the number of participants was greater than 1300.

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Of course the above data does not allow us to suppose, that all PSB partners realize CSR strategy. Some of them are not engaged in CSR actions, others realise educational activities occasionally. In such cases we cannot talk about implementation of the strategy. However the majority of SMEs – members of PSB network realize educational CSR strategy.

5   Conclusion

Nowadays managers and owners of companies are aware, that their decisions influence not only the enterprise and its employees, but also environment and local society. So corporate social responsibility is actually one of the most important issues. Human rights, labor standards, environmental protection or ethical market rules should be in the middle of attention both in large companies and small and medium-sized enterprises. But SMEs are less prepared to implement the idea of CSR (Czapla, 2018).

The most important conclusion of this research is that this problem can be resolved. The chance to change this situation is in networking. When the small or medium-sized enterprise is a member of a network, then the CSR strategy is creating by a leader of an organization. SMEs can just realize a ready program.

It should also be noted, that implementing CSR strategy is possible also in the situation, where this strategy is not defined. In the above case study most of educational activities was not even included to CSR and the leader of the network did not use the term CSR strategy.

This study has limitations, because only one business network was analyzed and the number of respondents was too small to generalize. The article just underlines, that we can find examples of such situation. However we don't know the scale of this phenomenon.

Future research should relate to another examples of CSR strategies in SMEs, so case study method is recommended. Then should be explored haw business network leaders can help SMEs in implementing CSR strategy.

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EVALUATION OF INNOVATION ACTIVITIES REALIZED BY THE SELECTED SIZE OF ENTERPRISES IN THE MANUFACTURING INDUSTRY

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Abstract

Implementation of innovation through well-planned activities allows enterprises to confront an increasingly dynamic business environment and also to achieve and maintain a competitive advantage with the assumption of long-term development. In the process of innovation fulfillment in the company, a proper system of managing innovation plays a key role. The aim of the paper is to evaluate the realization of innovative activities in the manufacturing industry in the enterprises based in the Czech Republic. This evaluation is realized for the period 2014-2016 on the basis of the data published by the Czech Statistical Office. Concerning the number of employees, in this paper small and medium-sized enterprises with up to 249 employees and large enterprises with 250 and more employees are considered. The evaluation takes into account specific factors, primarily the kind of implemented innovation, the way of its development, implementation process and results of technical innovations, the novelty of product innovations. The research results were evaluated using statistical software SPSS 21 individually for the group of small and medium-sized enterprises and large enterprises. For valuation purposes, regression analysis and descriptive statistics were used. The results expand the knowledge base by the findings from the realization of innovative activities of small and medium-sized enterprises and large enterprises based in the Czech Republic in the manufacturing industry.

Keywords
Innovation activities, innovative companies, manufacturing industry, regression analysis, descriptive statistics.

JEL Classification
M10, O31, O32

1 Introduction

At present, companies are forced to face the challenges of a competitive business environment. According to Tidd and Bessant (2016), it is important to monitor market trends and look for opportunities that need to be used in the future. At the same time, Tidd and Bessant (2016) recommend the implementation of innovation to acquire and maintain a significant market position. In business practice, management and owners draw inspiration from the knowledge gained from tracking the best practices of successful companies that are often handled in the form of general procedures, rules, and useful, innovative methods. However, Peterková and Ludvík (2015) point to the fact that it is necessary to find their way of transferring the innovative idea into practice, thus avoiding the copying of others. Innovation then becomes a prerequisite for a successful business. As Peterková and Wozniaková (2015) emphasize, innovation should not be an end in itself but should lead to more advanced performance, better outputs, a higher level of efficiency. Tidd and Bessant (2016) complement this with wellspring for national economic growth.

The difference between innovators and other companies lies in the ability to set up an enterprise system so that it can support continuous development and subsequent implementation of innovations. According to Isaksen and Tidd (2006), the main factor of success is the person who can translate the concept into reality by finding a mechanism that demonstrates and reinforces the sense of management involvement, commitment,

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enthusiasm, and support. This personality can be a founder of a company, a senior manager or an R&D manager. Peterková and Ludvík (2015) add that it is necessary to understand the needs of customers, knowledge of innovative methods and trends, new technologies and materials, but also the courage to experiment. Zelený (2012) maintains that in the Czech Republic the production type companies dominate. These are subcontractors who carry out production, storage or assembly activities at a contractual price for foreign owners. This type of production is efficient but has a low added value. The subcontracting company does not own the design and development department, as innovations are undesirable in this case: the foreign owner must approve all changes.

The results of the statistical survey on innovation activities for the period 2014-2016 show that 46.3% of enterprises in the Czech Republic carry out innovation activities, which is a 4% increase compared to the previous period 2012-2014 (ČSÚ, 2018). In this area, the most active enterprises are in the manufacturing industry and provide 57.7% of innovative activities within the Czech business environment. At the same time, in the monitored period, innovation activities were recorded in 51.7% of firms operating in the manufacturing enterprise. These are both technical and non-technical innovations, but technical innovations are more often implemented in this case. Companies often carry out both types of innovation activities at the same time. Concerning enterprise size, in the manufacturing industry, innovations are more intensively implemented by SMEs (49 %) than the large enterprises (80 %). Regarding international comparisons in innovation activities within the EU Member States, companies in the Czech Republic were below the average in the period 2012-2014. However, a slight improvement in the position (ČSÚ, 2018) can be expected with the increase in shares of innovative companies over the period 2014-2016.

In domestic and foreign literature are defined the characteristics of the concept of innovations, differences concerning the different types of innovation, ways of their development. The question, therefore, arises as to how these factors are fulfilled in the corporate practice of enterprises operating in the manufacturing industry in the Czech Republic.

The aim of the paper is to evaluate the realization of innovative activities in the manufacturing industry in the Czech Republic in the period 2014-2016. In the evaluation, the type of implemented innovation, the way of its development, the implementation process and the results of technical innovations, the novelty of product innovations are investigated. The research results are analyzed using the statistical program IBM SPSS Statistics 21. Statistical analysis is performed through correlation analysis, descriptive statistics and hierarchical regression analysis.

2   Literature Review

In domestic and foreign literature there are different approaches to defining the concept of innovation. Nevertheless, most authors emphasize the form of innovation as news or changes towards something new. Already Drucker (1985) spoke about the specific tools of entrepreneurs by which they exploit change as an opportunity for a different business or service. Three factors are crucial: able to be presented as a discipline, competent of being learned, capable of being practiced. Galla's definition (2011) points to a new way of working, the result of which is a change in the positive character. The definition of the OECD (2018) speaks of the introduction of a new or significantly improved product, and the use of a new or significantly improved process in the internal environment of the production company. Tidd and Bessant (2016) emphasize that innovation has to be more than just getting good ideas, it has to be the process of developing them into practical use. An invention as an idea is therefore only seen as an initial impulse, but in isolation, it is insufficient to create and implement innovation. The invention must be commercially exploited in order to be able to become innovation (Herzog, 2011). Valenta (2001), followed by Mlčoch (2002) or Dytrt and Stříteská (2009) continue their reflections on the depth of innovation. They explain the extent of innovation, respectively the degree of consistency and the severity of the impacts of innovation together with their influence. It reflects the relationship of innovation to the environment and is reflected in changes in suppliers, customers, consumers or the public.

The basis is the ability to identify the opportunity for change, to create new ways of using it. Opportunities can be seen in the area of new possibilities in the form of radical technological breakthroughs, as well as in the field of new outlets or new ways of providing services in a more stable market (Peterková and Ludvík, 2015). As Bessant and Tidd (2016) emphasize, recognizing the need for change is a tough task, which companies

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often solve too late. This problem is reflected in the declining level of business life in companies, regardless of their size. Based on a survey of 500 companies, Kosturiak and Chal' (2008) found that this business life is currently the 20 years, whereas before the World War II the age of life reached values of 60 to 100 years.

Authors Bessant and Tidd (2016) further argue that although large businesses have a resource advantage, they are often lagging with innovation activities because of certain rigidity and conviction of their size. On the other hand, small and medium-sized enterprises, although affected by a lack of resources (information, financial, personal), can quickly respond to a rapidly changing business environment and adapt to a certain extent. New players on the market also have the advantage, entering the competitive battle with the knowledge of contemporary conditions and new solutions.

The pioneering concept of innovation as a continuous change has already come from Schumpeter (1987), who at the time recognized only absolute innovation. He included the launching of a new product or existing product with new features, the introduction of a new production process, the opening of a new market, the use of new raw materials or the creation of a new production organization. For practical reasons, however, the notion of innovation has to be extended to changes of all kinds, which are new internally, for a particular business. Valenta (2001) here speaks of relative innovation and introduces the distance of a new product or other new factors from the original state before innovation. These are nine innovation codes that fall into three groups: rationalization, qualitative innovation, and a technological breakthrough.

For benchmarking within EU countries, innovations are monitored through a statistical sampling survey, which is governed by the international Oslo Manual (OECD, 2018). The OECD gave the initiative for its elaboration. Here is a basic breakdown of technical and non-technical innovations. Innovations of technical nature include product and process innovation. In the first case, it is the introduction of new or significantly improved products or services, given their characteristics or their intended use. Process innovation involves the introduction of new or significantly improved production or even delivery methods. Non-technical innovations include marketing and organizational innovations. Marketing innovations focus on introducing a new marketing method that includes significant changes in product design or packaging, product placement, product support, or valuation. Organizational innovations are focused on introducing a new organizational method in corporate business practices, job organization, or on external relationships. According to Eurostat (2014), an enterprise is considered to be an innovative company when it introduced one of the above innovations, i.e., product, process, marketing and organizational, during the period.

Bessant et al (2012) emphasize the importance of creating an innovation network for cooperation. There is a collective efficiency when networking can provide a way of getting access to different resources through a shared exchange process. Also, collective learning offers exchange experiences, challenging models and practices. Partners support each other with new insights and ideas that lead to common experimentation. Collective risk-taking and an intersection of different knowledge sets are other significant benefits of innovation networking. Collaboration can work with other businesses within a group, with suppliers, customers, but also with competitors from the same industry. Partners may also be consultants in the field of research and development, universities, public research institutions or private research organizations (Birkinshaw et al, 2007).

It follows from the above that there is not only one approach to defining the concept of innovation. Innovation is broadly understood as a change, in any area of social life. When it comes to innovation in business practice, it is advisable to prefer a narrower definition of the concept, with innovation seen not just a change in products and services but also a change in the circumstances and ways in which they get and keep on the market.

3 Methodology and Data

The necessary data for evaluating the innovation activity of enterprises in the Czech Republic was obtained from the Czech Statistical Office, which, at two-year intervals, conducts a statistical survey on innovation activities of enterprises respecting the OECD methodological principles in the Oslo Manual. Based on the combination of field (large enterprises) and sample surveys (SMEs), a sample of 10,473 innovating enterprises operating in the Czech Republic was created. A sample of 6,039 enterprises operating in the manufacturing industry was selected for sample analysis, as this is the largest category concerning CZ-NACE sections. The net return rate was 85%.

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The research aimed to evaluate the realization of innovative activities in the manufacturing industry in small and medium-sized and large enterprises based in the Czech Republic. Descriptive statistics were used to describe essential relationships. Based on the literature and the aim of the paper, the following hypotheses were defined:

- *Hypothesis 1:* There is a dependency between the realization of technical innovation (product and process innovation) and the way of self-directed development.

- *Hypothesis 2*: There is a dependence between the absolute novelty of the product and self-directed development.

- *Hypothesis 3:* Increasing market share as a result of the introduction of innovation is related to the relative novelty of the product (new for the enterprise only).

Defined hypotheses were evaluated in IBM SPSS Statistics Software by using regression analysis. The results were surveyed for small and medium-sized enterprises with up to 249 employees and large enterprises with 250 and more employees. The primary tool was a questionnaire with the leading innovative indicators: data on the innovations carried out according to innovative types, the knowledge base of the enterprises, the way of technical innovation development, the results of the introduction of technical innovations, the novelty of the product innovations, cooperation on innovation activities. The sample examined includes 88.8% of small and medium-sized enterprises and 11.2% of large enterprises. In 76% of these cases, it was domestic enterprises while only in 24% of the cases the foreign companies appeared.

The research results were analyzed using the statistical program IBM SPSS Statistics 21. Statistical analysis of data was initiated by performing descriptive statistics.

Table 6. Descriptive Statistics

	Minimum	*Maximum*	*Mean*	*SD*
Absolute innovation	310,00	995,00	629,33	344,84
Relative innovation	412,00	1462,00	944,33	525,15
Product	516,00	1953,00	1210,33	719,72
Process	509,00	2166,00	1289,00	832,75
Marketing	347,00	1864,00	1078,00	759,99
Organizational	357,00	1076,00	704,00	360,15
Patents	172,00	240,00	214,66	37,17
Articles	387,00	1153,00	795,33	385,50
Cooperation	405,00	828,00	647,00	217,99
Quality improvement	428,00	1475,00	955,33	523,54
Market share	374,00	1129,00	756,00	377,58
Offer	374,00	1129,00	756,00	377,58
Self-managed	293,00	1481,00	848,00	597,82
Group	88,00	266,00	202,00	98,97
Out of group	104,00	195,00	146,66	45,76
University	130,00	215,00	168,00	43,20
Adaptation	46,00	132,00	84,00	43,86

Source: own research based on ČSÚ (2018)

The data in Table 1 shows major factors for evaluation innovation activities. Results from a more profound analysis of visible relationships are adduced in the next section where a regression analysis was also performed.

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4 Empirical Results

The most innovative branch of the manufacturing industry is the petrochemical and chemical industry, with the share of innovative enterprises reaching 71.6%. In both monitored groups, small and medium-sized and large enterprises, technical innovations over non-technical innovations prevail. In the group of small and medium-sized enterprises as well as in the group of large enterprises, the situation when the company implements both innovation type at the same time is most often. The values in each group are shown in Figure 1.

Figure 4. Implementation of Innovation in Terms of Type and Size of Companies (%)
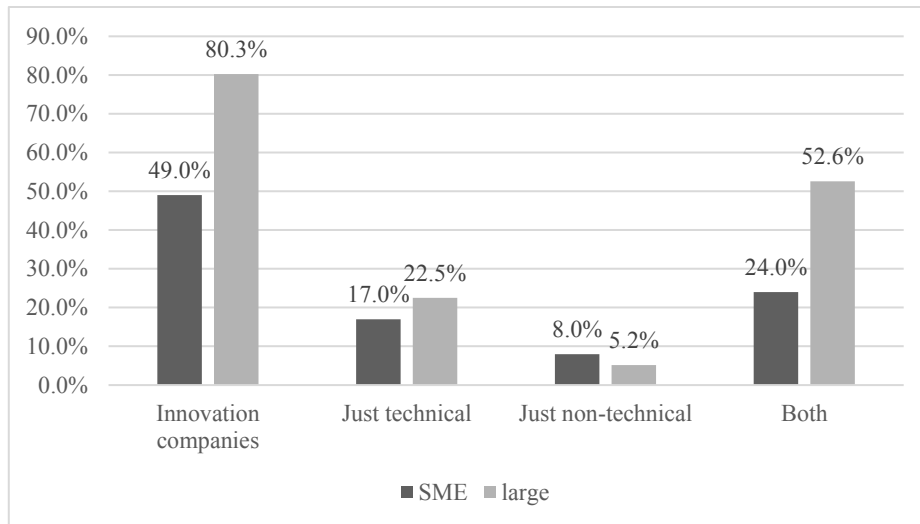
Notes: Share in the total number of enterprises in a given group.

Source: own research based on ČSÚ (2018)

In the case of small and medium-sized companies, process innovation is most often implemented. Large businesses focus on product innovation within technical innovation. The results correspond to perceptions of innovation primarily as technical changes and improvements. In SMEs, marketing innovations are more often realized, on the contrary, large companies deal with both marketing and organizational innovations (see Table 2).

Table 2. Innovative enterprises in the Czech Republic in the manufacturing industry by type of innovation introduced in 2014-2016

	Product		Process		Marketing		Organizational	
	% [1]	% [2]	% [1]	% [2]	% [1]	% [2]	% [1]	% [2]
SME	28.7	58.1	31.0	62.6	26.6	53.9	16.2	32.7
Large companies	61.2	76.2	60.5	75.3	41.2	51.2	42.3	52.7

Notes: [1] Share in the total number of enterprises in a given group, [2] share in the total number of enterprises with innovative activities in the given group.

Source: own research based on ČSÚ (2018)

In the paper, the author further focuses on technical innovations that dominate the field. It was found that both groups of companies are implementing self-managed innovations. For small and medium-sized enterprises, however, this dominance is more noticeable (63%) than for large enterprises (30%). The least companies use the opportunities for the development from a university or a research institution. As part of the activities necessary for the development and implementation of technical innovations, companies most often acquire machinery, equipment, software, and buildings, as well as in-house research and development. On the third

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place are education and coaching. The order of activities is the same for small and medium and large enterprises. Companies are the least interested in acquiring external knowledge from other sources.

Again, both groups of companies launched innovative products that were new to their company only. That means not an absolute innovation, but only relative innovation. Small and medium-sized enterprises launched absolute innovation in 39.5% of cases, large enterprises achieved the value of 43%. Small and medium and large companies gain input information in professional and scientific articles and journals. SMEs use the search for patents in only 19% of cases, and large enterprises in 30.7% of cases. In large enterprises, the knowledge base is most often made up of 10% - 24% of employees with completed higher professional or university education (43%). 30% of small and medium-sized enterprises build a knowledge base on 1% - 4% of employees with completed higher professional or university education.

The analysis of cooperation showed that up to 59.9% of large companies preferred to engage in innovation activities other institutions or entities. Most of them are domestic partners (81%), where the most valuable partners are companies from the same business group (40.8%), suppliers of equipment, materials, components or SW (17,8 %). As far as small and medium-sized enterprises are concerned, only 29% of them have decided to cooperate, with the Czech Republic (65.9%) being the most important partner, but most believe in their suppliers (38.5%) and their private clients' sector (22.4%).

Verification of hypothesis 1

During the analysis of relationships in the environment of innovating companies in the Czech Republic a question emerged about the way of the realization of technical innovations in enterprises. Hypothesis 1 assumes that there is a dependence between the implementation of technical innovation (product or process type) on the self-managed way of development (independent research, without the cooperation of other entities). To determine the dependence of these variables, statistical testing was performed using hierarchical regression analysis. As a dependent variable, the realization of technical innovation was chosen, the independent variable is the self-managed way of developing.

Multicollinearity in variables was investigated using the Pearson correlation coefficient, the tolerance values and mean values of VIF. Multicollinearity was not confirmed. Based on the Durbin-Watson test values (2,974), the assumption of error independence was confirmed. Dependence was confirmed by $\beta = 1.202$; $p < 0.05$ for product innovation and $\beta = 1.393$; $p < 0.05$ for process innovation.

Verification of hypothesis 2

Further considerations led to the question of the absolute novelty of the product, a product that is new for the whole market, not just for the company and its dependence on the way in which product innovation evolves, specifically self-managed type. Hypothesis 2 assumes just such a dependency. Again, hierarchical regression analysis was used to determine the dependence of these two variables when the dependent variable was the absolute novelty of the product. Based on the result, we can state that multicollinearity through VIF values was not detected. Based on the Durbin-Watson test values (2,974), the assumption of error independence was confirmed. By performing statistical testing by regression analysis, it was found that this dependence exists ($\beta = 0.577$, $p < 0.05$)

Verification of hypothesis 3

Hypothesis 3 focuses on the dependence of the result of the introduction of product innovation, namely the increase of the market share, on the selection of relative innovation, a new product only for the enterprise. The dependent variable, in this case, was an increase in market share as a result of the implementation of product innovation. When testing the hierarchical regression, multicollinearity was not detected through the VIF pointer. At the same time, the Durbin-Watson test values (2,974) confirmed the assumption of error independence. The values of the β coefficient reached 0.719 at $p < 0.05$, thus confirming hypothesis 3.

5   Conclusion

The evaluation of innovative activities was focused on innovative enterprises operating in the Czech Republic in the manufacturing industry. According to Eurostat, such a label is used by companies that have implemented

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one of the four types of innovation, namely product, process, marketing, or organizational, over the reference period.

A sample of 6,039 enterprises operating in the manufacturing industry was selected for sample analyzes, as this is the largest category concerning CZ-NACE sections. Critical factors for analysis were selected from the primary data, and data of a small and then medium-sized enterprise group was summed up and next analyzed using the IBM SPSS Statistics 21 program, both for small and medium-sized and large enterprises, in particular, and in aggregate. The hierarchical regression analysis was used to verify the three hypotheses.

Data analysis has shown that companies prefer to implement technological innovations before non-technical innovations, regardless of their size. In the case of small and medium-sized companies, process innovation is most often implemented. Large enterprises focus on product innovation within technical innovation. Both groups of companies implement innovation through the self-managed way of development. The least companies use for these purposes a university or a research institution. These findings confirm the view that enterprises perceive inventions and their subsequent transformation into a comprehensive innovation marketed as sensitive know-how.

At the same time, in the group of small and medium-sized enterprises as well as in the group of large enterprises, the number of units, which perform both technical and non-technical innovations, increased. These findings support the idea that innovation is perceived first as a change of a technical nature, but business success is increasing if the risk is split into several incoherent innovations. These resolutions are a confirmation of the conclusions of Zelený (2012), Kiernan (1997), who states that in a growing competition, businesses are retreating from a cost-cutting strategy and focusing on implementation of an innovation strategy that not only allows them to survive, but also maintains a specific position in the market. At the same time, these findings are in line with the theory (Bessant and Tidd, 2016) that marketing and organizational innovations support the success of hard innovations of a technical nature.

Companies in the manufacturing industry, regardless of their size, focus on the development and subsequent sale of products that are new to the business only, not to the market. It means a relative innovation. This finding supports the assumption that, given the accelerating competitive environment and the speed of change in society and business practice, it is severe and very costly to develop an absolute novelty. At the same time, this novelty due to customer mistrust may not be profitable in the future. This step is very hazardous. Companies in the manufacturing industry in the Czech Republic use the possibilities of cooperation, especially with domestic partners. For small and medium-sized enterprises, suppliers and clients from the private sector are the most valuable partners, and for large enterprises, the most valuable partners are companies in the same group.

Data analysis also showed that there is not only a strong link between the implementation of technical innovation and its overhead of development but also the connection of an absolutely new product to the market and its development direction. Although, as mentioned above, companies operating in the manufacturing industry are more likely to report products which are new to the enterprise alone, the result of a self-managed way of innovation development supported by a strong knowledge base is very often an absolute market novelty (confirmation of hypothesis 2).

The assessment of the available data on innovation activities in the Czech Republic shows that the development and successful sale of relative novelty (a new product only in an enterprise environment) affect increasing market share. Higher market share is the fundamental factor of survival and maintaining a healthy and stable position for future business development (hypothesis 3).

The analysis of data of innovative enterprises in the manufacturing industry in the Czech Republic has shown that small and medium-sized and large companies differ mainly in the possibilities of creating a knowledge base of the enterprise, access to cooperating partners and possibilities by implementing some particular activities necessary for the successful implementation of innovation. At the same time, research has been limited by the nature of available data, which is very sensitive.

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INFORMATION ASYMMETRY IN RESIDENTIAL SOCIAL SERVICES

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Abstract
The study focuses on assessing the availability of information on residential social services (homes for the elderly seniors) provided by ecclesiastical organizations. In the Czech Republic from 1st November 2018 there are 153 ecclesiastical non-profit organizations that provide outpatient, outreach and residential social services through their facilities. In total, church services provide 269 social services, of which 59 are residential services. The aim of the thesis is to evaluate the level of online information availability of selected seniors' homes according to selected criteria. Evaluation of online information availability is realized using the method of multicriteria decision making – the TOPSIS method. The subject of multicriteria analysis is the official website of selected homes for the elderly of religious organizations. On the basis of 18 criteria and their evaluation parameters incl. weighing the extent to which information for social service seekers is available on individual websites.

Keywords
Ecclesiastical non-profit organizations, social services, seniors' homes, information availability.

JEL Classification
D82, J14, L31.

1   Introduction

The solution of efficient and transparent providing of public services and thus also social services despite the type of provider is their availibility which gains not only spatial, institutional, temporal but also informational shape, (Vrabková, Vaňková, 2015).

This paper focuses on assessing the availability of information on residential social services (homes for the elderly seniors) provided by ecclesiastical organizations. Social sector has to deal with the existence of a problem information asymmetry. It is the matter of a situation, where one side of the barter has more information than the other side. The informed side, however, does not feel the need to share said information with the other side and at the same time gaining such information can be extremely costly for the other side. Social services, however, is not the only sector dealing with such problem. It affects banking as well as public health and other participants in the market. The existence of information asymmetry in social services will be observed via ecclesiastical legal bodies, which represent one of the forms of non-profit organizations providing social services.

As of 1st November 2018 there are in total of 153 ecclesiastical non-profit organizations in the Czech Republic which provide outpatient, field and long-stay social services to people who are socially disadvantaged. The main attention is given to the organizations whose provided residential social services are directed on one targeted group - seniors. The aim of this paper is to evaluate the online access of information from the perspective of a user of a website (prospective clien of the service) of a particular charity. The websites present a first step in contacting prospective clients of the given organization and it is necessary that not only the websites were user-friendly but most of all that the prospective clients could learn as much information as possible about the provided service. Such information is then determinative for their next economical decision and behaviour.

In order to achieve a set goal, a method of multicriteria decision-making called TOPSIS was used. By means of said method, 55 official websites of seniors´ homes provided by ecclesiastical organizations were assessed using 18 criteria and their parameters including the weight.

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2 Literature Review

The availibility can be characterized as an ability of a certain service to be available for a client when they request it and preferably at the given time. The problem, however, occurs with the availability of perfect, or rather complete information which is required for providing given service. In most cases, the market deals with so-called imperfect information. Imperfect information presents one type or cause of market failure. Market failure happens when holdings and services are ineffectively provided to consumers on the market. Imperfect information emerge when one participant on the market does not have enough reliable information about the market´s offers, about the properties of the products or service they are buying, their prices etcetera. The other participant in the market does have said information, however, does not feel the need to share them (either for profit or for their own enrichment). The imperfect information can also be labelled as uncertain or asymmetrical (Boyes, Melvin, 1991).

The existence of information asymmetry is being shown among a patient/a potential patient and a provider/social service distributor. The prospective client is not able, due to lack of knowledge and experience, to judge their health conditions or newly emerged social situation and the solution of thereof. That is why they turn with faith to abilities of providers to act in their interest and secure them quality social service. Aspects of service quality stated by a provider are relevant for the client and it should be able to verify if they reached such qualities. If that was not the case, it would create a relationship called principal-agent problem among stated participants- the informed subject reduces the benefit of all uniformed subjects while maximizing their benefit. (O´Neill, Largey, 1998)

Knowledgeability can also be weakened in case they will assume that politicians and clerks already reduced imperfect information. They can be confirmed for example via political propaganda which broadcasts incorrect information. That is how moral hazard emerges. One cannot assume that a politician can orientate perfectly in the area of social service and that they understand the needs of different target groups (seniors, disabled ones, drug addicts, families with children and others.) and therefore are able to suggest actions leading to elimination of information asymmetry. (Salvatore, 2003)

In the process of providing social services- alternatively their arranging, it is necessary that the particular patient does not hold out any essential information from the provider such as their health condition, social problems in their family, traumatic events etcetera. Suppressing these substantial facts will then lead to an incomplete solution to a newly emerged and adressed social situation, which will have a negative impact on a particular service user. (Knapp, 1984)

There are also other cases when a social worker must deal with another type of information asymmetry which complicates their job. The issue is misusing social services by those who do not need them. Such situations are when the illnesses, troubles or social situations are faked and also are hard to detect and hard to prove, even though the individual goes through medical examination or local investigation by a social worker. The solving of the problem of information asymmetry with regard to misusing social services can be for example via larger knowledge of the local environment and decentralization, alternatively offering non-monetary help, even though they are usually much more expensive. (Matoušek, 2012)

The level of awareness of social services is among Czech inhabitants is varied - mostly among social service users and among the public. Generally, the awareness increases with respect to currently dealt with social situation in which the particular person or their related ones is in or is threatened by such situation. Legislative norms and potential changes, opportunities to help, types and forms of provided social services, a summary of their providers, etcetera creates so-called information level in which even social workers can get lost, which makes it almost impossible for the general public.

3 Methodology and Data

When solving decision-making problems it often comes down to situations when an optimal decision must suit more than one criterion. The stated criteria can have qualitative and quantitative character. The methods of multi-criteria evaluation of variants generally do not provide just one solution and the final one is influenced by the selection of weights and the chosen method. Because of the general character and independence of the content of the decision-making, these methods are acceptable to use in different areas. There are many types of multi-criteria evaluation of variants. Some of them are easy computing-wise

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and some of them are more difficult. The subjunctive method, disjunctive method, lexicographical method, method of order, point method, a method of a weighted total, method AHP and method TOPSIS rank among those. The TOPSIS method (Technique for Order Preference by Similarity to Ideal Solution) is one of the methods used for multi-criteria evaluation of variants. It ranks among the representatives of methods, which specializes in a principle of minimalizing the distance from the ideal variant.

The aim of this method is the selection of a variant, which is placed the closest to the ideal variant represented by a vector (H1, H2,…,Hk), and contrarily is the furthest from the basal variant, which is represented by a vector (D1, D2,….,Dk).

The idea variant can be characterized by a vector of the best criteria values, which is also the furthest from the basal variant. The basal variant is a flow variant, which is represented by a vector of the worst criteria values. It is essential to assume that all criteria are of maximizing type. A minimizing criterion can be transformed into a maximizing one in a way that the new criterion will present the difference within the highest criteria value. For example, if one picks price as a criterion, it is possible to carry out a transfer into a new criterion which states a difference in comparison with the highest price, which is the most expensive variant. In this case, such criterion becomes a maximizing one. For calculation of this method, it is necessary to state values of all criteria for each variant and at the same time weights for each criterion. Criteria values of each variant are arranged in a criteria matrix $Y = (y_{ij})$.

The TOPSIS method can be described in few steps:

1. Transformation of criteria– transformation of minimizing criteria into maximizing criteria:
$$y_{ij} = -y_{ij}$$

2. The construction of normalized criterial matrix $R = (r_{ij})$ in accordance to the relation:
$$r_{ij} = \frac{y_{ij}}{\sqrt{\sum_{i=1}^{n} y_{ij}^2}} \qquad i=1,2,...,n, \; j=1,2,...,k \tag{1}$$

    The matrix R columns are vectors of identity length.

3. The calculation of normalized weighted criterial matrix $W = w_{ij}$ in accordance to the relation:
$$w_{ij} = v_j \cdot r_{ij} \tag{2}$$

    Where v_j equals the weight of j criterion

4. With regard to values of matrix W an ideal variant H is chosen from individual elements with criterial values *(H1, H2,....Hk)* and basal variant D with values *(D1, D2,....,Dk)*, where $H_j = \max_i (w_{ij})$ and $D_j = \min_i (w_{ij})$, $j = 1,2,....k$.

5. The calculation of the distance of variants from the ideal and basal variants in accordance with the relations:

$$d_i^+ = \sqrt{\sum_{j=1}^{p} (w_{ij} - H_j)^2} \qquad ,i= 1,2,....n \tag{3}$$

$$d_i^- = \sqrt{\sum_{j=1}^{p} (w_{ij} - D_j)^2} \qquad ,i= 1,2,....n \tag{4}$$

6. The calculation of CC_i relative indicators of distance of individual variants from the basal one in accordance to the relation:

(5)

$$CC_i = \frac{d_i^-}{d_i^- + d_i^+}, \qquad i= 1,2,....n \tag{5}$$

    The values CC_i gain values from intervals <0, 1>, where the basal variant has a value 0 and ideal variant has value 1

7.   Ranking of the variants according to the indicator CC_i coming from the highest to the lowest. In compliance with the needed amount of variants, the ones with highest value are then chosen.

Method TOPSIS can be easily evaluated in the system SANNA, which is a standard addition of MS Excel (Fiala a kol., 1997).

These days, the websites play a crucial role when it comes to getting information. It does not matter if the websites are private or public. Via them, the prospective clients and also donors or competition can learn about the organizations and about their activities. The websites should be constructed in a way so they are user-friendly and most importantly they included all essential information. (Bachman, 2014)

This paper deals with information availability from the official website (portal) user point of view of an individual, chosen ecclesiastical legal bodies providing residential social services to seniors. The number of registered corporate bodies in the Czech Republic is 55 (see appendix 1). For the evaluation of the websites of ecclesiastical corporate bodies, there were set criteria giving evidence about the information availability.The individual websites were observed via set 18 criteria, which were divided into three groups. Each criterion was also given a weight according to their importance for the users themselves, see Table 1. The term weight can be defined as the relative importance of each criterion. That means the more important the deliberative criterion is the bigger is its weight.

Table 1. Criteria for Web site evaluations of ecclesiastical corporate bodies

Criteria			Weight
Information for prospective clients of residental social service	**Key criteria**	Type of the provided service	7
		Description of the provided service	7
		Mission of the senior home	7
		Criteria of acceptance	7
		Application/Request or the needed steps to request placement	7
		Price list	7
	Related criteria	The quality standard of social services	6
		Interactive electronic reference on communication (direct form for communication)	6
		Laws and responsibilities of the user/ a client of the services at the home	6
		Protection of personal information	6
		Mobilization of the seniors at the home	6
		Photo gallery	6
		Virtual tour	6
		Contacts (e-mail, phone number, address)	6
Information about the organization´s activities		Annual report of the organization	3
		Organizational structure	3
		Open days	3
Up-to-dateness of the website		Updates/News	1

Source: Own processing.

The collection of data was realized via searching and recording the extent of information availability on websites with regards to three parameters, see Table 2. The criteria were assessed using the time orientation for the search of the information by website user, scale of availability and corresponding point evaluation (max. 10 p., min. 0 p.).

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Table 2. Parameters of evaluation criteria

Evaluation	Time orientation	Points
Easy orientation	within 20 seconds	10 – 8
Worsen orientation	20 sec. – 1 min.	7 – 5
Bad orientation	1 min – 5 min.	4 – 1
Not found	> 5 min.	0

Source: Own processing.

3.1 Established results according to the TOPSIS method

A method TOPSIS was chosen to assess information availability of the 55 ecclesiastical organizations. The TOPSIS method is not comparable with the standard point system. This difference in placings is set by weights of individual criteria, which were not taken into account in standard pint system. Figure 3 shows result values of indicators CC_i of particular observed centres and their portals. Value CC_i expressed relative distance to the best variant extending to value one – that means centre and its website with highest value CC_i is considered to be structured the best as far as information is considered. The picture shows a clear variety of established results.

At first sight, one can notice that the range of the values of indicators CC_i move only at intervals <0, 2 – 0, 5>. None of the centres, therefore, got close to the ideal value of one which already gives evidence of lack of information availability of all observed websites.

Figure 3. Results of indicator values CC_i according to TOPSIS method in observed centres
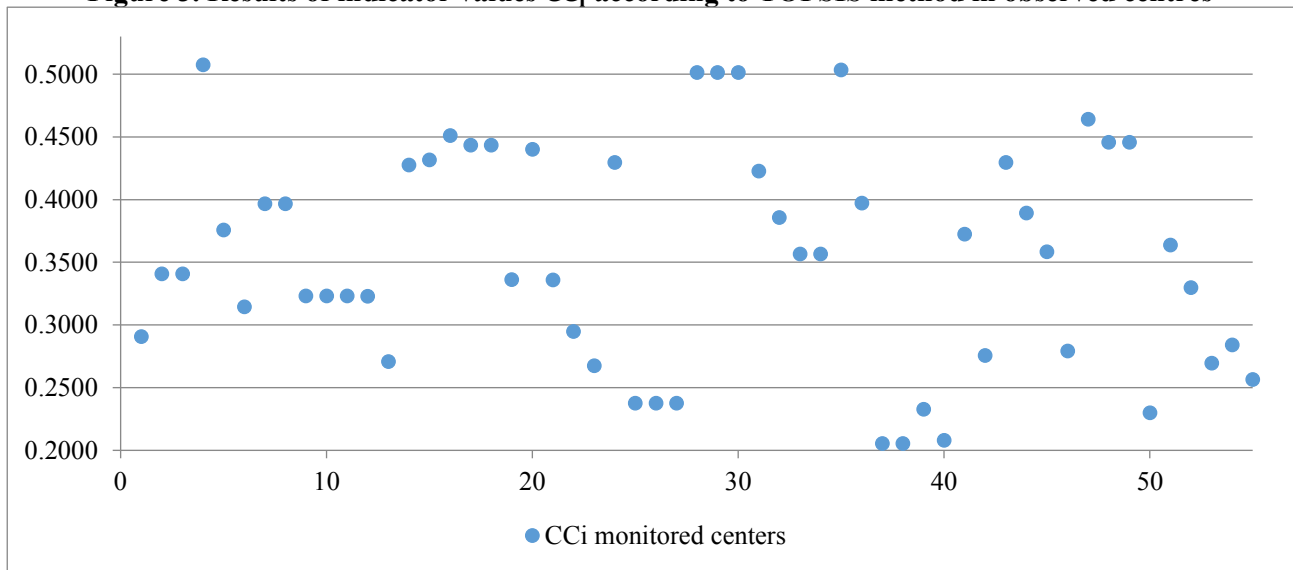
Source: Software SANNA. Own processing.

The first place according to TOPSIS method belongs to STR4 (Charity Hlučín – Charity Home sv. Mikuláš) with value CC_i (0, 5073). The website is user-friendly and a crushing majority of essential information is easily available. Among things that were lacking was the absence of information regarding the criteria for acceptance, service providing according to quality standards or virtual guide. The website lacks an online form for direct contact with the home, the option of a virtual guide and information about open days. The content of the portal can be assessed as decent and relatively also organized. The second highest value CC_i (0, 5033) was reached in STR35 (Regional charity Červený Kostelec - Anežka Česká hospice). Prospective clients of the service had all key information including a downloadable application form available on the opening page. The up-to-date price list for accommodation and meal was much harder to find. The option of a virtual guide is something that can be highlighted because such an option is otherwise

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very rare in other centres. The website user does not have access to additional information regarding the stay at the home (for example house rules, leisure activities, GDPR), which can be considered insufficient.

With minimal distance, three centres were placed third - STR28, STR29 and STR30 with the value CC_i (0, 5013). These centres have the same provider which is Diakonie ČCE, which from content point of view provides the same amount of information for the website users within every type of provided social service. The websites of these centres include all essential information about the provided social service and they were structured in such a way so they are user-friendly as far as orientation is considered. Direct forms for communication with the home are, however, not available and virtual guide and information regarding the organizational structure is also harder to find. From the observed samples, STR37 a STR38 (Seniors´ Home Libice n. Cidlinou and Seniors´ Home Kostelec n. Černými lesy) took the last place with value CC_i (0,2054), whose provider is Diakonie ČCE. The only available information on the website were the type of provided social service and their brief description, a photo documentation, contacts and a summary of news. The attached downloadable form was harder to find. It was also rather difficult to find annual reports or information regarding GDPR. From the above-mentioned information it is not possible for a prospective client to learn all that they need to know, particularly key information. The websites, however, do make a good impression on the user since they are user-friendly and relatively organized. Nevertheless, that is not their job description.

Next to the last place but with only small difference belongs to STR40 (Archdiocesan charity Praha – A home with a special regime). All available information (type, description of the service, price list, photo gallery, news, and contacts) were available only on one site of the portal.

4   Empirical Results

There was a scale created within the overall evaluation gathered by the TOPSIS method expressing the levels of information availability on the official websites of the ecclesiastical organizations going from excellent to insufficient.

The Figure 4 shows that it is obvious that no seniors´ home website achieves excellent or very good information availability according to the chosen method. This result shows as rather surprising because it is the websites that should serve as the second best source for the prospective clients of the service. The issue is a visible shortage from the residential social services provider´s and particularly corresponding administrators of the corresponding website´s portals. The best way of getting informed is directly at the particular home nevertheless, one cannot assume that every prospective client is willing to personally visit every center. There are only four ecclesiastical organisations websites that achieved sufficient results - STR4 from Moravian-Silesian Region, STR35 from Hradec Kralove Region and STR28, STR29 from Vysočina Region. This is the highest possible placement nevertheless one cannot say that the good information availability should be considered the best for the prospective clients. Sufficient information level was assessed in 33 centres, which represents 60 % of the observed sample. Among the information that is available on the websites are primarily: the type of service provided, the description of the service, annual reports, contacts, photo gallery, alternatively downloadable application, and an up-to-date price list. When it comes to the 17 centres, the situations is the absolute worst, the level of their information availability was insufficient. The potential client, therefore, is in no way able to search for all basic information and necessities regarding the placement into a seniors´ home.

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Figure 4. Evaluation of the information availability according to the results of the TOPSIS method
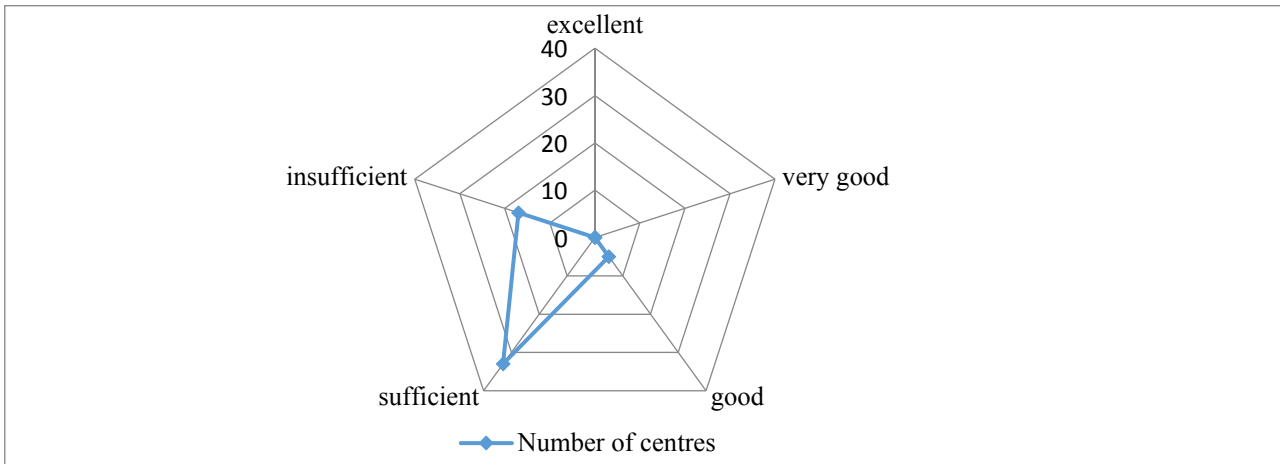
Source: Own processing.

Among the strong points of the ecclesiastical organizations 'websites are mainly their up-to-dateness. Because of up-to-date news and information concerning future events, a prospective client can make a picture about each organization and their activities. From the observed sample, 34,5 % of organizations had an interactive electronic link to direct communication with the home. Because of this offered service, it is possible to contact the home directly and therefore there is no need to email them on the numerous number of email addresses. Part of every website should be information about the type and description of social service, the mission of the home and mainly up-to-date price list of accommodation and meals (89 % of organizations had that available).

One of the weak points that should be mentioned is the fact that some of the websites were oversaturated with information and thus they become extremely confusing to the user. Another weak point of the portals was their chaotic arrangement, the time it took to find information and the lack thereof. It is mainly concerning the information about quality standards of social services, rights, and responsibilities of the clients, the safety of private information or important criteria for being accepted into the facility.

It is recommended to the providers of given social service to focus as much as they can on their websites and enhance the information availability about the provided service which are and can be important to a prospective client. The contribution can also be seen in making websites in such a way that they would be much more user-friendly (i.e. Capital letters, voice reading, etcetera).

5   Conclusion

Information presents a valuable source which is rare and also very expensive to obtain. That is why it is common that participants on the market come together with very different knowledge. In an ideal world which is characterized by all conditions of perfect competition, there is no such thing as information asymmetry because it comes out from assumptions of perfect knowledgeability of the participants of market transactions. In the case of violating these conditions due to imperfect information, processes occur which lead to a reduction of profit. Cruz and Hinck (1996) define them as quality effect and quantity effect. Quality effect presents a reduction of social benefit caused by the absence of transactions which were beneficial for both participating sides because the firms can gain more by selling low-quality holdings/services which the consumer does not distinguish from the quality ones. Quantity effect can be characterized by using other than an optimal amount of holding by a consumer because they were given a wrong value due to wrong information.

The issue of information asymmetry also does not avoid the area of social services. The issue is a situation where the clients are not informed about the quality of the provided service be it a field, in-patient or a residential form. Existing clients of social services can judge the quality only from subjective feelings, from the position of a client v. social worker, individual approach or from references on a particular social service provider. (Kašlíková and col., 2008)

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A prospective applicant has their orientation worsened. In case that no one from their surroundings such as family or friends used the said service, they are thrown back on a reference or an annual report of a provider. The main issue is that not everyone has enough knowledge of where to find such information and how to acquire them at their disposal. The aim of this paper was to assess the availability of information from the point of view of a user (prospective applicants) of official websites of non-profit ecclesiastical organizations from the area of residential social services in the Czech Republic. In total, 55 official websites of seniors´ homes ran by ecclesiastical organizations were assessed. To achieve the goal, a method called TOPSIS was used which is suitable for solving multi-criteria problems.

By carrying out the analysis by the TOPSIS method it was concluded, that the level of information availability on the websites of the 55 tracked ecclesiastical law bodies can be considered good up to sufficient. However, in some cases insufficient. The websites are from a processing viewpoint user-friendly and well organized nevertheless, from the content viewpoint there were many deficiencies. The basic information about the provided social service, that is the label of the type of the service, its description alternatively the mission of the home were stated on the main page of the portals of all tracked organization. Finding the actual forms/applications and finding a price list for accommodation, meals, cleaning etcetera was, however, rather time-consuming. Particularly the summary of payment for the accommodation and meal is crucial for the prospective clients because they are covered by old-age pension and thus they have to be able to pay it monthly. At the same time act on social services appoints the obligation of a balance of 15 % out of the overall monthly income (pension) for each user of the service. A so-called reduced payment will be given to the social service users who don't extend to the full payment. Applicant should be immediately informed about these issues of fact and potential options of the amount to be paid and they should become a part of every price list.

Information regarding basic criteria, which an applicant has to fulfill in order to be accepted into a home, was almost never available. Due to this, the applicant does not know if they even have a chance to get into a home or what they have to do in order to get in one. The offer of direct communication with the home via interactive electronic link can be assessed positively. One of the major shortages are almost zero knowledge of the social services offers in accordance with quality standards of social services provided by law, by which every provider has to be guided. Via given standards, a prospective client learns what a quality social service should look like and it also works as a manual to show how a provided service works. Because of this, there is a major reduction of information asymmetry from the prospective client of the service.

The declined information availability was established even in the case of the commitment of the organization to protect and respect private information of prospective clients of the service, the clients of the home but also those who left said place or died. This fact should these days be stated on all websites given the due date of General data protection regulation also known as GDPR, which considerably increases the protection of personal data of citizens as well as increasing the obligation of institutions and firms to protect said data. With some websites, there was a possibility to download house rules with the statement of fundamental rights and obligations of a client and a survey of leisure activities. This information allows prospective clients to have some kind of an idea of how it works at a given seniors´ home and what to expect a based on that knowledge if they will request placement or not. General survey about the organizations and its activities including contacts and updates were available at almost all observed ecclesiastical organizations.

From the observed sample of 55 ecclesiastical corporate bodies, it was the website STR4 (Charity Hlučín - Charity home sv. Mikuláš) that placed best according to the TOPSIS method. According to established weights of each criterion, said method assessed the informational availability of given home at $CC_i = 0,5073$ when the maximum value was 1,00. STR37 a STR38 (Diakonie ČCE – Senior´s home Libice n. Cidlinou and Seniors´ home Kostelec n. Černými lesy) from the observed sample were placed the worst according to the method TOPSIS ($CC_i = 0,2054$).

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Appendix

Appendix 1: An overview of 55 church corporate bodies analyzed

Region	Center	Abbreviation
MSK	Česká provincie Kongregace Dcer Božské Lásky	STR1
	Diakonie ČCE - středisko Rýmařov - Domov pro seniory	STR2
	Diakonie ČCE - středisko Rýmařov - Domov pro seniory se zvláštním režimem	STR3
	Charita Hlučín - Charitní domov sv. Mikuláše	STR4
	Charita Studénka - Domov sv. Anny	STR5
	Konvent sester alžbětinek v Jablunkově - Domov sv. Alžběty	STR6
	Slezská diakonie - SAREPTA Komorní Lhotka - Domov pro seniory	STR7
	Slezská diakonie - SILOE Ostrava - Domov pro seniory se zvláštním režimem	STR8
	Charitní dům Salvator Krnov	STR9
	Charitní dům sv. Alžběty	STR10
	Charitní dům sv. Václava	STR11
	Hospic sv. Lukáše	STR12
JHM	Diakonie ČCE - středisko Brno - Chráněné bydlení Nosislav	STR13
	Diecézní charita Brno - Domov pokojného stáří Kamenná	STR14
	Diecézní charita Brno - Chráněné bydlení sv. Anežky	STR15
	Domov sv. Alžběty	STR16
ZLK	Diakonie ČCE - středisko Vsetín - Domov Harmonie	STR17
	Diakonie ČCE - středisko Vsetín - Domov Jabloňová	STR18
	Diakonie ČCE - hospic CITADELA - Domov se zvláštním režimem	STR19
	Charita sv. Anežky - Charitní domov Otrokovice	STR20
	Charita Svaté rodiny Nový Hrozenkov - Dům pokojného stáří	STR21
	Charita Valašské Meziříčí - Charitní dům Valašská Bystřice	STR22
	Oblastní charita Kroměříž - Charitní dům pokojného stáří	STR23

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	Oblastní charita Uherské Hradiště - Domov pokojného stáří Boršice	STR24
OLK	Charita Javorník - Charitní dům sv. Anežky	STR25
	Charita Javorník - Domov pokojného stáří sv. Hedviky	STR26
	Charita Javorník - Domov pokojného stáří sv. Františka	STR27
VYS	Diakonie ČCE - středisko v Myslibořicích - Domov pro seniory	STR28
	Diakonie ČCE - středisko v Myslibořicích - Domov se zvláštním režimem	STR29
	Diakonie ČCE - středisko v Myslibořicích - Domov pro seniory s postižením	STR30
	Domov blahoslavené Bronislavy	STR31
	Dům sv. Antonína	STR32
KHK	Diakonie ČCE - Dvůr Králové nad Labem - Domov pro seniory	STR33
	Diakonie ČCE - Dvůr Králové nad Labem - Domov se zvláštním režimem	STR34
	Oblastní charita Červený Kostelec - Hospic Anežky České	STR35
	Oblastní charita Červený Kostelec - Domov sv. Josefa	STR36
STC	Diakonie ČCE - Domov pro seniory Libice n. Cidlinou	STR37
	Diakonie ČCE - Domov pro seniory Kostelec n. Černými lesy	STR38
PHA	Arcidiecézní charita Praha - Domov pro seniory kardinála Berana	STR39
	Arcidiecézní charita Praha - Domov se zvláštním režimem	STR40
	Diakonie církve bratrské - Domov pro seniory Bethesda	STR41
	Horizont - penzion	STR42
JHC	Diakonie ČCE - Blanka u Písku - Domov pro seniory Domovinky	STR43
	Diakonie ČCE - Blanka u Písku - Domov se zvl. režimem Vážka	STR44
	Oblastní charita Strakonice - Dům klidného stáří sv. Anny	STR45
LBK	Domov U Spasitele	STR46
	Oblastní charita Liberec - Domov sv. Vavřince	STR47
ÚLK	Oblastní charita Ústí nad Labem - Domov pro seniory	STR48
	Oblastní charita Ústí nad Labem - Domov se zvláštním režimem	STR49
PLK	Diecézní charita Plzeň - Domov pokojného stáří bl. Hroznaty	STR50
	Diecézní charita Plzeň - Domov pokojného stáří sv. Alžběty	STR51
	Diecézní charita Plzeň - Domov pro seniory Bor	STR52
	Diecézní charita Plzeň - Domov pokojného stáří Naší Paní	STR53
	Farní charita Stříbro - Domov pro seniory sv. Pavla II	STR54
	Městská charita Plzeň - Domov pro seniory sv. Jiří	STR55

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CREDIT RISK MANAGEMENT AND FINANCIAL PERFORMANCE OF SELECTED COMMERCIAL BANKS IN THE CZECH REPUBLIC

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Abstract
This paper is concentrating on credit risk management in financial institutions. The aim of this paper is to study the performance of credit risk management reflected on profitability ratio of selected commercial banks in the Czech Republic. We apply the panel data regression analysis to figure out the influence of selected credit risk management associated variables on the financial performance variables. This analysis is based on valid data from annual report of the 12 commercial banks in the Czech Republic from 2013 to 2017, joint with the secondary database Helgi Library. Under pooled OLS model, we examine the Non-performing Loan ratio (NPLR), Provision ratio (PR), Capital Adequacy Ratio (CAR) and Loan ratio (LOAN) have negative relationship with Return on Asset (ROA), while Provision of total loan Ratio (PTL) and staff cost to total cost ratio (SCTC) are positively related to ROA. Furthermore PTL, SCTC and LOAN are negatively related to ROE, but NPLR and CAR has positive impact.

Keywords
Credit risk management, Profitability, Performance, Commercial banks.

JEL Classification
C33, C51, G21.

1   Introduction

BCBS (2000) stated that for most banks the major risk is credit risk. Generally, credit risk is associated with the traditional lending activity of banks and it is simply described as the risk of a loan not being repaid in part or in full. Banks basically make money from lending activity. Therefore, banks are more aware of the risks they are taking, that is the reason for credit risk management and regulation.

A number of financial institutions have collapsed or experienced financial problems due to inefficient credit risk management systems. Njanike (2009) has investigated that the failure to effectively manage credit risk contributed to a greater extent to the banking crisis, the research was based on the inefficient credit risk management create the crisis of Zimbabwe's banks.

In Dec.2017, about ten years since 2008 global financial crisis, the Basel Committee's oversight body, the Group of Central Bank Governors and Heads of Supervision (GHOS), endorses the outstanding Basel III post-crisis regulatory reforms ("Basel IV"), which seeks to restore credibility in the calculation of risk-weighted assets (RWAs) and improve the comparability of banks' capital ratios (BCBS, 2017). With the introduction of Basel IV, there are several revisions concerning credit risk management, one is amendment to the Standard Approach (SA) for credit risk, enhancing its robustness and risk sensitivity, and the other one is setting a new SA for credit valuation adjustment (CVA) risk. Furthermore, setting constraints on the use of the internal ratings-based approach (IRB) for credit risk. Mckinsey&Company (2017) has forecasted the Basel IV may lead European banking experience a decline of return on equity, which may create new challenges of credit risk management and financial performance.

The aim of this paper is to study the performance of credit risk management reflected on profitability ratio of selected commercial banks in the Czech Republic. In this study, we will construct the panel regression model, then analyze the coefficient and the relationship between dependent variables and independent variables. This

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paper is divided into five parts. The first part starts with introduction and the last part ends with the conclusion. The second part includes the literature reviews, the third part is description of methods and data collection. In the fourth part, empirical result will be discussed.

2   Literature Review

In this part, we will provide a review of the previous studies concentrated in credit risk management and financial performance. Some studies started from the determinants of bank profitability, the most frequency used dependent variables are Return on Equity (ROE) and Return on Asset (ROA), the independent variable in previous studies have examined from macroeconomic variables, industry-specific variables and also bank-specific variables.

Horsna et al (2009) has investigated the relationship between credit risk management and profitability of four commercial banks in Sweden, ROE was defined as profitability indicator, at the same time, NPLR and CAR as the credit risk management indicators. In this study, NPLR has a significant impact than CAR in Sweden, while they only choose small sample banks, which may not have the representative effect of whole Swdedish banking industry, though, the result is reasonable. Furthermore, they construct model in each sample bank, then compared with all four samples to see the different performances in selected Swedish banking.

Kolapo et al (2012) also use panel data regression for investigating quantitative effect of credit risk on the performance of commercial banks in Nigeria, in their study, they found out NPLR has negative impact on ROA, same sign as PTL, the increase of PTL will decrease the bank profitability. The new variables they examine is the loan to debt ratio, which shows a positive relationship with bank profitability.

Hamza (2017) used the pooled regression to determine the impact of credit risk management on two performance indicators, which are ROE and ROA. The findings also revealed the fact that credit risk management is inversely associated with bank performance. In the analysis of ROA, PTL, liquidity ratio (LR) and NPLR shows a negative impact in bank performance, while CAR and LAR has positive impact, the paper also used SIZE of bank as a credit risk management indicator, which has positive relationship with ROA. In relation to return on equity, the CAR, LAR and PTL variables have significant impact on ROE. Furthermore, PTL, NPLR and LR variables have negative and CAR, LAR and SIZE variables have positive impact on the ROE. Similar as the Horsna et al (2009), the sample size is not credible enough to extend the results to all commercial banks and other financial institutions.

Musyoki and Kadubo (2012) use regression and correlation to analyze the various parameters pertinent to credit risk management as it affects banks' financial performance. The study used default rate, bad debts costs and cost per loan asset as credit management parameters, then the result shows all parameter has inverse impact on banks performance. Moreover, as the most predicted indicator, the study suggest bank measure the strategy on it to enhance profitability.

Orzubuma (2016) has examined the impact of NPL on the performance of selected commercial banks in Nigeria. Similar as Kolapo et al (2012) and Hamza (2017), these studies were analysed using ordinary least square method, the independent variables are non-performing loans, provision for loan loss and loans and advances and the dependent variables are ROE and ROA. Furthermore, the finding stressed on the NPL, which has negative impact on performance and should not to be underestimated.

3   Methodology and Data

There are 18 commercial banks except branches of foreign banks, in which 12 commercial banks be selected, included the large size such as Česká spořitelna, Čsob; Medium size such as MONETA money bank, Equa bank; Small size such as PPF bank, Air Bank. We collect data from annual report of each bank, with secondary data from Helgilibrary. In the data set, twelves banks are observed over five years (2013-2017), create 60 observations, because the data is cross-sectional, which can be also estimated equation as balanced panel. Hence, we will use E-views 7 software to build panel regression through panel least squares. Then we will discuss the result based on the regression result. In this research, Return on Equity and Return on Asset are the parameters of financial performance of banks, then, there has several bank-specific variables

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as independent variables.

Two models can be specified as:

$$ROE = \beta_0 + \beta_1 \frac{NPL}{TL} + \beta_2 \frac{P}{NPL} + \beta_3 \frac{P}{TL} + \beta_4 CAR + \beta_5 \frac{SC}{TC} + \beta_6 \frac{TL}{TA} + \mu, \tag{1}$$

$$ROA = \beta_0 + \beta_1 \frac{NPL}{TL} + \beta_2 \frac{P}{NPL} + \beta_3 \frac{P}{TL} + \beta_4 CAR + \beta_5 \frac{SC}{TC} + \beta_6 \frac{TL}{TA} + \mu, \tag{2}$$

where:

ROE represents Return on Equity, which is the dependent variable in model 1.

ROA represents Return on Assets, which is the dependent variables in model 2.

β_0 stands for intercept parameter.

β_i ($i = 1,2,3,4,5,6$) are coefficients of independent variables.

μ stands for random error term.

$\frac{NPL}{TL}$ represents the ratio of non-performing loan to total loan, which records as NPLR in model. The NPL ratio measures the effectiveness of a bank in receiving repayments on its loans. The lower the proportion of non-performing loans, the higher the asset quality of commercial banks, the higher the level of credit risk control. At the same time, it reflects the liquidity of assets and high profitability of commercial banks.

$\frac{P}{NPL}$ represents the ratio of provision and non-performing loan, which records as PR in model. Provision ratio is primarily to reflect commercial Banks' ability to compensate for loan losses and to protect against credit risk.

$\frac{P}{TL}$ represents the ratio of provision and total loans, which records as PTL in model. The provision of total loan ratio provides a measure of possibility of future risk. The higher the ratio of the indicators, the stronger the ability of banks to write off bad debts, but it may also indicate a decline of assets quality.

CAR is capital adequacy ratio. The CAR is an international standard that measures a bank's risk of insolvency from excessive losses. Currently, the minimum acceptable ratio is 8%. Maintaining an acceptable CAR protects bank depositors and the financial system as a whole.

$\frac{SC}{TC}$ stands for the ratio of staff costs and total costs, which records as $SCTC$.

$\frac{TL}{TA}$ stands for the ratio of total loan and total assets, which records as $LOAN$.

In terms of the version in E-views 7, two models can be expressed as:

$$ROE = \beta_0 + \beta_1 NPLR + \beta_2 PC + \beta_3 PTL + \beta_4 CAR + \beta_5 SCTC + \beta_6 LOAN + \mu, \tag{3}$$

$$ROA = \beta_0 + \beta_1 NPLR + \beta_2 PC + \beta_3 PTL + \beta_4 CAR + \beta_5 SCTC + \beta_6 LOAN + \mu. \tag{4}$$

Corresponding to the theoretical knowledge, we expect $\beta_1, \beta_5 < 0, \beta_2, \beta_3, \beta_4, \beta_6 > 0$.

In next section we will show the empirical result from regression model.

4   Empirical Results

We can see from Table 1, which shows the coefficient of each variable. The value of R-squared is 0.968703, which indicates there is about 97% of the total variation ROA explained by the regression model, almost perfect fit.

We can first discuss the NPLR, which has negative sign in the value, means the negative relationship with ROA. Lower NPL ratio can increase asset quality of bank, which also bring high profitability. Similar result

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as Kolapo et al (2012). If NPLR increases 100% then will leads ROA decreasing 16.4%. Furthremore, NPLR shows a high statistically significant level impact on performance indicator, at which the p-value is 0.0027.

Table 7. Regression resule of ROA

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NPLR	-0.163873	0.052054	-3.148126	0.0027
PC	-0.007795	0.005514	-1.413711	0.1632
PTL	0.937997	0.046315	20.25238	0.0000
CAR	-0.088592	0.092181	-0.961067	0.3408
SCTC	0.081753	0.030625	2.669513	0.0100
LOAN	-0.035407	0.013009	-2.721677	0.0087
R-squared	0.967803	Durbin-Watson stat		1.654315
Adjusted R-squared	0.964822			
S.E. of regression	0.021106			
Sum squared resid	0.024056			
Log likelihood	149.5155			
Durbin-Watson stat	1.654315			

Sources: E-views 7 regression output

Next, we can process to PR, p-value is 0.1632 and higher than 0.005, means these indicators may not have enough significant impact to the ROA. We expect PR to be positively related to ROA, because more provisions could cover the NPL, bank can meet their shortage immediately when risks occur. While in this case, provisions are collected from total liabilities included foreign currencies and Czech Koruna, which can be the reason of less significant impact on ROA. Meanwhile the regression result shows a negative relationship with ROA, which means when increasing 100% of provision ratio will cause declining of ROA about 0.78%.

The ratio of PTL has p-value less than 0.05, statistically significant, even has the most significant impact on the dependent variable. The regression coefficient result is positive, it indicates PTL is positively related to ROA. This result means more provisions used to cover loan loss, profitability of the bank will increase, which shows a different result than Hamaz (2017), it is reasonable that there will be different results in different markets, moreover, the sample data in our study, not only the significant banks, but it also included the small size, or lower profitable banks, this may be the reason why the result shows different.

CAR ratio has a negative sign on regression coefficient result, which means the negative relationship between CAR and ROE, when CAR increase 100%, the value of ROA will correspond decrease 8.8%. The value of probability is 0.3408, it shows CAR has not enough significant impact on ROA. When bank has higher CAR, in other words, has more capital for absorbing the risk may occur, may lead lower profitability. This result shows a different sign with previous studies, as we mentioned before, the sample of the data is from large-size bank to small-size bank, the data has large range, moreover, banks can decide the methods of calculating the RWAs. As the analysis about bank size and risk-taking under Basel II, Hakenes and Schnabel (2011) found out although bank can choose between SA and IRB, while the difference makes larger banks to a competitive advantage and pushes smaller banks to take higher risks. This may even lead to higher aggregate risk-taking.

The ratio of SCTC shows positive value of coefficient result and p-value is 0.0100, it can be said SCTC has positive relationship with ROA. When bank put in more cost on staff, no matter when staff measuring the risk or manage the risk, can help bank increase their profitability. The result similar to the finding of Wanjohi and Baimwera (2016).

Loan ratio has probability value at 0.0087, which is statistically significant. Simultaneously, it has a negative value of coefficient result, which means the relationship between Loan ratio and ROA is negative.

Through Durbin-Watson Significance Tables, we can find the observations at 60 and 6 beta coefficients corresponding to the $dL = 1.214, dU = 1.639$. The result of our test is 1.654, which means there is no autocorrelation between disturbances.

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Table 8. Regression resule of ROE

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NPLR	0.081558	0.201523	0.404709	0.6873
PC	0.027658	0.021346	1.295689	0.2006
PTL	-0.661628	0.179305	-3.689958	0.0005
CAR	1.492266	0.356870	4.181542	0.0001
SCTC	-0.242281	0.118560	-2.043527	0.0459
LOAN	-0.070112	0.050364	-1.392097	0.1696
R-squared	0.221774	Durbin-Watson stat		1.258817
Adjusted R-squared	0.149716			
S.E. of regression	0.081711			
Sum squared resid	0.360539			
Log likelihood	68.29871			

Sources: E-views 7 regression output

Table 2 shows the regression result of ROE. The value of R-squared is 0.221774, which indicates there is only 22% of the total variation ROE explained by the regression model, however, we can not expect the reality data being nice-looking, but it is still reasonable.

First, we can look at NPLR, which has no statistically significant, but positively related to ROE. Totally inverse result than relationship with ROA. The reason can be the sample data differential, while in extremely cases, without prudential regulation, bank may face huge non-performing loan while earn high profit. When facing higher default risk borrower, bank will provide higher loan rate, which create the high profitability for bank.

Second indicators, provision ratio, which has statistically significant, regression result shows a positive relationship with ROE, which means when increasing 100% of PCR ratio will cause declining of ROE about 2.76%. More provisions are covering non-performing loan, asset quality will be higher, so does profitability.

The ratio of PTL has p-value at 0.0005, less than 0.05, statistically significant. The regression coefficient result is negative, it indicates PTL is negative related to ROE. This result keep consistency with the result of, Ozurumba (2016) and Hamaz (2017), more provisions used to cover loan loss, less profitability of the bank.

CAR ratio has a positive sign on regression coefficient result, which means the positive relationship between CAR and ROE, when CAR increase 100%, the value of ROE will correspond increase 149.22%. The value of probability is 0.0001, it shows CAR has significant impact on ROE. When bank has higher CAR, in other word, has more capital to absorb the risk may occur, can create high profitability.

The coefficient result of SCTC shows negative value and p-value is 0.0459, it can be said SCTC is negatively related to ROE. When bank put in more cost on staff, may lead bank decrease their profitability. In the relationship of cost and profitability, the result is reasonable.

Loan ratio has probability value at 0.1696, which has statistically significant. It can be said to be the least significant variable to dependent variables. While it has a negative value of coefficient result, which means the relationship between Loan ratio and ROE is negative.

Through Durbin-Watson Significance Tables, we can find the observations at 60 and 6 beta coefficients corresponding to the $dL = 1.214, dU = 1.639$. The result of our test is 1.258, which means there is a zone of no decision.

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5   Conclusion

Commercial banks basically make money from lending activity, which may include different kinds of risks during their daily operating, especially credit risk. Proper management of bank credit risk can reduce or avoid economic losses when risks occur. Managing credit risk of commercial banks is not only related to the survival and development of commercial banks, but also to the stability of the entire financial market and the healthy development of the economy. Otherwise, it may not only lead to bankruptcy, but also bring serious consequences of the entire national economy. There has been 10 years since 2008 global financial crisis, with the technology development of measuring credit risk and management, banks should have more prudential regulation and strong ability to absorb credit risk.

The aim of this paper is to study the performance of credit risk management reflected on profitability ratio of commercial banks in the Czech Republic. The sample data is 12 commercial banks, sample still cannot be representative for whole Czech Republic, while for more accurate analysis, we will proceed in future study.

Through their annual report and secondary data from Helgilibarary, we collect Return on Equity (ROE) and Return on Asset (ROA) as the dependent variables, Non-performing Loan ratio (NPLR), Provision to total loan Ratio (PTL), Provision ratio (PR), Capital Adequacy Ratio (CAR), staff cost to total cost ratio (SCTC) and Loan ratio (LOAN) as the independent variables. In the analysis of ROA, under panel data regression analysis, processing with the E-views 7, we examine the NPLR, PR, CAR and LOAN have negative relationship with the performance indicator, while PTL and SCTC are positively related to ROA. Among the independent variables, PTL has the most significant impact to profitability, as well as NPLR. In the analysis of ROE, the result shows PTL, SCTC and LOAN are negatively related to ROE, NPLR and CAR has positive impact. Although there exists difference between two profitability ratios due to the sample data, we can still conclude the credit risk management has significant impact on the financial performance of the commercial banks.

Hence, bank should strengthen credit risk management through prudential credit risk identification, credit risk assessment, credit risk assessment to reduce or avoid economic losses. Furthermore, pay more attention to manage the non-performing loan and loan loss provision coverage ratio, which have significant enough impact on financial performance.

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CIRCULAR ECONOMY CONCEPT FROM THE PERSPECTIVE OF MANUFACTURING INDUSTRY

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Abstract
The paper presents an overview of circular economy concept and convergence of it with the lean manufacturing approach. Within the paper, the waste perception has been characterized from both manufacturing and circular economy standpoint. The authors have described five identified circular economy business models applied to manufacturing. Presented models have been supported by real-life examples implemented by the industry. Additionally, the research has been carried out in order to compare the environmental impact of a plastic chair under the circular supplies model with the reference scenario representing a typical life cycle pattern. LCA methodology has been applied. Normalization results indicate that the circular approach increases significantly the environmental performance of the product. The indicators have been respectively 22 and 1,9 times lower for impact categories of human health and ecosystem quality. In case of resources endpoint, the positive environmental impact has been recorded.

Keywords
circular economy, lean manufacturing, waste, plastic, case study.

JEL Classification
L60, O44, Q01.

1. Introduction

Throughout the years manufacturing industry was changing. On the beginning human crafted goods in small quantities, now we are living in the mass production period. In the pursuit of the advancement and profit, it is often forgotten what environmental cost is associated with the human climb. The effects of global warming are increasingly being felt (IPCC, 2018) and the threat of depletion of natural resources is more frequently being mentioned (Malczewski, 2018). As a response to this challenge, the circular economy concept is often introduced. The question naturally emerges: is this concept beneficial for manufacturing industry? The paper provides the answer for priorly asked question. In the paper, circular economy concept and nowadays manufacturing has been described. Waste concept from both perspectives has been identified. Real life example of circular economy and five business models has been recognized. The paper has been supported with the research investigating environmental impact of both traditional and circular manufacturing approach.

2. Waste concept in nowadays manufacturing

For the purpose of this paper, the lean manufacturing approach will be adopted as main manufacturing philosophy. Nowadays almost in every large business' shopfloor it is easy to find some of the techniques used in lean manufacturing. This concept was based on management methods created in Toyota Motor Company which all combine formed Toyota Production System. Due to application of its methods Toyota became one of the largest car manufacturer gaining an advantage over competitors and now the company is regarded by the majority of the industry as the most efficient and highest quality car manufacturer

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in the world (Womak, 2007). In short words, Toyota production philosophy can be summarized as: make only what you need, in the quantities you need, when you need it (Ohno, 1988). Toyota focuses on eliminating *Muda, Muri* and *Mura* which mean many types of waste. Therefore the core idea of lean manufacturing is to maximize customer value while minimizing waste. In other words, delivering better satisfying product to the customer, using fewest possible resources. In this approach minimising use of resources and efficient utilization of it is the key factor in proper operation of the industry. The three types of waste called *Muda, Muri and Mura* collectively describe the waste concept in lean manufacturing (Emiliani, 2007). *Mura* refers to unevenness and irregularity in the production process. It concerns wastage resulting from the organization of work. *Muri* refers to overloading employees or equipment and everything that results from it. *Muri* concerns on work division and work standardisation. The last type of waste named *Muda* refers to not adding value activities and may be split into 7 categories: over-production, unnecessary inventory, transport, over-processing, defects, waiting and unnecessary motion (Carreira, 2004). Over-production - occurs when more products are produced than is needed. This type of overproduction is called "quantitative". When products are produced earlier than are needed, this kind of overproduction is called "early". Unnecessary inventory – in means such as raw materials, work-in-progress or finished goods which bring no value to the final customer. Transport – unnecessary movement of the product from one place or process to another. Over-processing – not adding value actions, which are unnecessary when delivering the product for example rework or remake. It also includes higher quality products than expected. Defects – refers to both reject and rework products and waste related to it. Waiting – a period of idle time when the work could be done to the product but for some reason is not. Unnecessary motion, in comparison to transport, the category refers to unnecessary motion performed by human or machine while processing the product. Some additionally distinguish the eighth type of waste which is "waste of untapped human potential". This one refers to not utilizing the full employees' potential by the organization. Defining sources of waste and eliminating it is the main principle followed by business entity trying to gain the edge over its competitors. Eliminating waste is crucial in lean approach but something vital is missing. Waste refers mostly to shopfloor production, and many areas from the borderline of production not mentioned.

3. Circular economy and waste concept

Circular economy (CE) concept got into the mainstream and becomes more and more popular among many milieus. Nowadays it is easier than ever before to find an event or conference concerning this matter. Many businesses around the world found this idea worthy of interest. Ikea (Ikea, 2014), Procter & Gamble (Procter & Gamble, 2017), Philips (Philips, 2018) are some corporations of many which started implementing sustainability goals, consistent with CE principles, to their operating strategy. European policymakers follow this same path setting sustainability goals, like municipal waste recycling target: 44 % today, 55% by 2025, 65% by 2035 or no more than 10% landfilling by 2035 (European Parliament, 2018). European Commission announced an action plan for the implementation of the Circular Economy Strategy in the European Union in 2018 (European Commission, 2018). The circular revolution began and it will influence every aspect of our life by redefining relationships between market, customer and natural resources. The question naturally emerges: What is the circular economy? The concept has been first introduced by British environmental economists David W. Pearce and Kerry R. Turner in 1989 (Pearce, 1989). The core of the circular economy is the circular (closed) flow of materials. The concept is based on the concept that nothing in nature becomes waste and superfluous material for one, becomes "food" for another (McDonough, 2002). It is a kind of rebellion against the traditional linear approach to economics: take-make-dispose and proposes a more rational approach to the use of resources: take-make-remake. It aims to maintain materials and resources in the economy for as long as possible and reduces inevitable waste generation to a minimum. Materials and resources not needed in one industry may be profitably used in another. The circular economy is perceived as well as "decoupling of economic growth from the extraction and consumption of constrained natural resources like fossil fuel or hard-to-recycle materials" (Lacy, 2013). It is especially useful perception nowadays. Ellen MacArthur Foundation on basis of Michael Braungart and William McDonough work depicted "Butterfly diagram", which describes the continuous flow of material in circular economy (Ellen MacArthur Foundation, 2018).

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Figure1. Butterfly Diagram
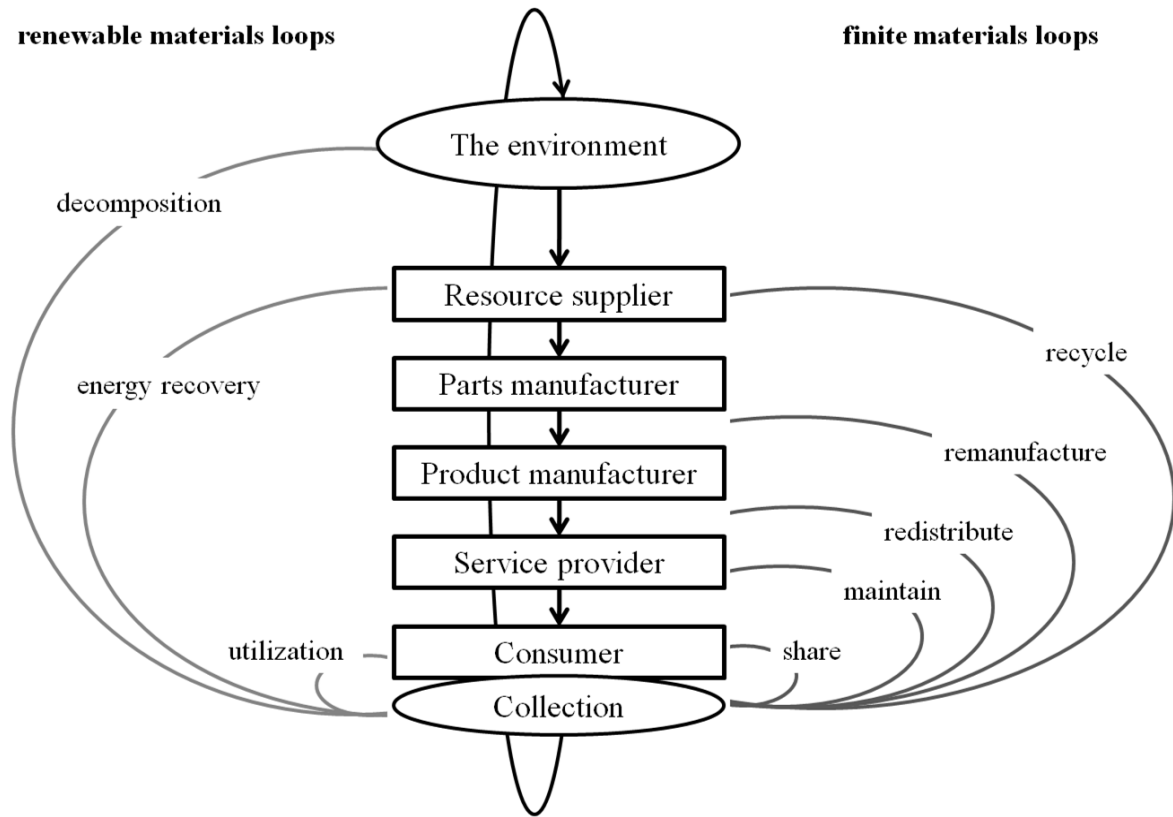
Source: Own elaboration on basis of "Butterfly Diagram" Ellen MacArthur Foundation.

The diagram divides the flow of the material into two cycles: biological cycle on the left-hand side which portrays renewable materials flow and technical cycle on the right-hand side which pictures non-renewable materials flow. The cycles which are the closest to the collection hold of the most economical value for the customer and are preferable actions in circular approach (Jamsin, 2014). Every product should go through as many circles as it physically is able to. From the circular perspective, the waste concept does not exist since everything can be reused, reprocessed or decomposed and products itself are designed for disassembly and reuse (Kobilarev, 2018). The idea started to be considered by many as a tool for solving current and future resources depletion problem. It has also reasonable potential on micro economical scale. Ellen MacArthur Foundation estimates that circular economy results in net material cost saving opportunity of USD 340 to 380 billion at European Union level (Ellen MacArthur Foundation, 2013). Other sources (McKinsey, 2014) assesses that there is a yearly 80% of unrecovered materials from the $3.2 trillion worth that are used in consumer goods. Estimates leave broad field for action for every concept, that proposes profitable solution for manage waste and resource problem.

4. Five circular business models and real-life examples

In these times, many examples of circular economy being implemented to manufacturing can be seen. Accenture consulting based on analysis of more than 120 companies' business models, has identified five circular business models which could be employed in circular approach: circular supplies, resource recovery, product life extension, sharing platforms and product as a service (Accenture, 2014). The main focus of this chapter has been five identified circular business models.

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4.1. The circular supplies

The first mentioned circular business model named circular supplies refers to the change of linear resource approach in utilising resources during production processes. It guides to use fully renewable, recyclable or biodegradable materials and renewable energy (Lacy, 2013). The resources recommended may be used infinitely, without the threat of future scarcity. The strategy is particularly beneficial for companies dealing with scarce commodities or ones with a major environmental footprint (Accenture, 2014). Many companies across the world started implementing sustainable supply chain model to its functioning by setting ambitious goals to be fully powered by renewable energy in the near future. RE100 is a collaborative, global initiative uniting more than 100 influential businesses committed to 100% renewable electricity (RE100, 2018). On its list, there are already over 150 companies including Ikea, Apple, BMW Group, Danone, GM, Nestle, Nike, P&G, Tata Motors, Unilever, SAP, most of whom committed to achieving the goal by 2030 or earlier. On the market, there are already available companies which offer fully sustainable resource solutions. As an example may serve CRAiLAR Technologies which offer sustainable natural fibre (CRAiLAR FTI, 2018) and NatureWorks which offers biopolymers made from 100% renewable resources (NatureWork, 2018). Ecovative Design is another example of a company which propose a sustainable solution by producing the mushroom replacement for styrofoam packaging (Ecovative Design, 2018). Some firms took it even further and have created an infinite resource supply loop by designing products which at the end of its life are taken back from their customers and reprocessed into new products. A good example might be Desso Group carpet manufacturer, which takes back worn out carpets, thanks to reverse logistics and remaking it into new (Desso Group, 2018). Another example is Herman Miller furniture manufacturer which produces easy to disassembly products which are made from fully recyclable materials (Herman Miller, 2018). A closing the loop like that is known as Cradle to Cradle approach and is becoming increasingly applied (McDonough, 2002). The sustainable supply chain model has economic sense since it limits supply chain disruptions and fluctuation of materials price that are needed for production. Thanks to application this business model companies may gain more stable market position and can establish a long-term relationship with their customers.

4.2. The resource recovery

The resource recovery model portrays a system in which everything that used to be considered as waste is revived for further use. It captures previously mentioned circular economy principle, that waste for one can be "food" for another. In current times, many businesses across the world declared the ambitious goal of "zero waste to landfill". Companies across the world are trying to decrease environmental impact by reducing, reusing, recycling resources and energy savings. P&G has committed that all their manufacturing sites will send zero manufacturing waste to landfill by 2020 (Procter & Gamble, 2017). Unilever set the same objective (Unilever, 2016). General Motors declared that by 2020 will reach 150 landfill-free sites, with currently operating in 142 landfill-free sites (General Motors, 2017). British Sugar factories implemented to its manufacturing model avoiding waste by turning process outputs into inputs for a wide range of co-products that can be used by company or others (British Sugar, 2018). Many other companies are making a similar effort (Sustainable Brands, 2018). New recycling techniques are emerging. Head & Shoulders announced shampoo bottle made of beach plastic which can be recycled endlessly thanks to PureCycle Technologies. The technology turns plastic waste into virgin like material (PureCycle Technologies, 2018). Loop™ Industries is another example of implementing innovative plastic recycling techniques. The company is able to reprocess collected plastic into virgin-quality plastic (Loop™ Industries, 2018). With the use of Loop Industries Technology, the brand of mineral water Evian declared to produce its bottles only from 100% recycled plastic by 2025 (Evian, 2018). Another innovative technique of resource recovery was presented by Apple. Company own disassembly system which is able to disassemble 1.2 million iPhone units per year (Apple, 2016). Big retailers like H&M and Marks & Spencer placed in their shops drop off bins for unwanted clothes offering in exchange shopping vouchers. The clothes collected are destined to further conversion. Adidas presented shoes made of recycled ocean plastic picked up from the beach (Adidas, 2018). The model is widely applied and has many benefits like reduction of cost related to waste management, lower demand for resources and energy, new interaction points between customer and producer and decreasing enterprise environmental footprint. Sometimes it is not so easy to distinguish between profitable deployment of the model by the company and an attempt of greenwashing public image. The resource recovery model has measurable potential.

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For example, some researchers estimate that Waste of Electrical and Electronic Equipment items contain gold in concentrations ~200 times greater than in typical gold ores (Charles, 2017). Those numbers are hard to ignore and this may be the reason why recycling nowadays becomes more and more attractive solution for business.

4.3. The product life extension

The product life extension model aims to recapture value from products at the end of its life. Goods-discarded by their users still hold considerable value, whether in operable parts or in the material itself. From the perspective of the manufacturer, worn out products can be collected and repaired, upgraded or remanufactured. A good example can be Dell and its refurbishing business (Dell, 2018). Similar actions take Apple, Samsung, HP and many other companies (Zhang, 2018). Another company which implemented remanufacturing to its practices is Caterpillar. It renews a wide range of parts from small flywheels to the largest mining trucks. As the company claims "remanufactured parts and components provide same as new performance and reliability at fraction of new costs" (Caterpillar, 2018). BMW German automaker uses remanufacturing to increase its revenue by selling remanufactured original parts which cost up to 50% less in comparison with a new component (BMW, 2018). Many examples of remanufacturing can be given since this method saves a notable portion of resources used (Merkisz-Guranowska, 2017). The method can save up a great number of resources in comparison to building a new component from scratch. By refurbishing companies can reach a wider range of customers by price reduction, their devices are longer present on the market and products are kept away from landfills. The product life extension model may be especially wide applied to mature markets where product generations do not differ much. This model is another example of a solution that is beneficial for both customer and manufacturer.

4.4. The sharing platforms

The sharing platforms model provides a platform for connecting asset or information owner with an entity that would like to use it. It is based on temporary access instead of ownership. A large amount of assets owned by businesses are not fully utilized. According to McKinsey report, even during working hours, average European office is used only for 35–40% of the time (Ellen MacArthur Foundation, 2015). Everis Benelux in his study on data sharing between companies in Europe, concludes that 60% of the companies do not share data with other companies (everis Benelux, 2018). This approach results in lost opportunity. In this model *Business-to-business* (B2B) sharing platform like Scrap Monster can be used. Scrap Monster enables business to share information about resources and connect potential seller with the potential buyer (Scrap Monster, 2018). Sedex is another platform for assets sharing among businesses. This platform contains sourcing data on supply chains, enabling businesses for sharing data (Sedex, 2018). Floow2 is a B2B solution for sharing equipment, products, waste, materials, services, facilities and even employee (Floow2, 2018). Many other B2B platforms can be easily found. A solution like this allows businesses to increase revenue and decrease cost by using the full potential of its assets or use previously not available resources. Asset sharing among manufacturers although it may raise objections about safety and privacy, it may be beneficial for sharers, especially for small entities. It may boost resource utilization and increase productivity without buying additional assets. The concept can be implemented now more easily than ever before due to the development of the internet and widespread computerization. Not many businesses actively use that kind of tools, therefore model still holds great untapped potential.

4.5. The product as a service

Product as a service is based on the idea that users are interested in performance not in owning the product itself. In this model leasing or selling services are applied. As an example may serve Philips's "Light as a Service" offer. The company offers free replacement of lightning and maintenance in return for a monthly fee which depends on the number of lumens used. The solution can save up to 44% energy used and the monthly fee for the light can be covered by the energy savings (Philips, 2018). Having good light condition in the workplace is crucial, but owning and maintaining the whole infrastructure may be unnecessary expense. Another example of a company using product as a service business model is Michelin and its "Fleet Solutions", which offers the lease of tires with payment only per mile driven

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(Michelin, 2018). It helps business to focus on the core activities without the need to deal with auxiliary activities. Advanced Systems Inc., another company, proposes "Managed Print Services" which allows users to pay only per pages printed without down payment for equipment or maintenance (Advanced Systems Inc., 2018). Many other companies present similar services, where a customer pays only for performance without paying for the cost associated with the ownership. In this business model, there is no product life cycle conflict between seller and buyer since it is more beneficial for both sides to have a product that lasts as long as possible. It also gives a more stable market position for the manufacturer because it has a constant passive income. The business model helps also with strengthening the customer brand loyalty by signing an agreement between the user and the owner. As a result of this business model, the customer gets what really needs for lower cost, and producer gains a better position on the market. It is good for the environment as well since it decreases waste generated from low-quality products.

5. Methods and data of research

As it was mentioned above, circular economy business models can provide a considerable reduction of environmental impact due to the use of recovered products instead of raw materials and avoidance of waste disposal processes. The main objective of the research was to compare the environmental impact of selected products with a typical (linear) life cycle pattern and the reference products assuming implementation of the infinite resource supply model (circular pattern). In order to estimate the environmental benefit resulting from the application of the infinite resource supply loop model, a comparative analysis was carried out. The environmental impact of plastic chairs and nylon-woollen carpet under the circular supplies model was compared with the reference scenario representing products with typical life cycle pattern (linear approach). In conducted research, life cycle assessment methodology was applied. Normalization indicators were determined by means of Eco-indicator 99 method (embedded in SimaPro software).

Life cycle assessment represents linear approach and includes numerous stages such as resources acquisition, raw materials production, materials and semi-products transport, product manufacturing, supplying products to customers, phase of product usage and waste disposal. The method consists of a sequence of procedures, namely: data collection, inventory analysis, classification, characterization, normalization. The procedures are determined by ISO 14040 and ISO 14044 standards.

The circular life cycle model assumed manufacturing of chairs and carpets using end-of-life products taken back from customers and reprocessed into new products, distribution, and use stage. The reference scenario represented a linear approach containing natural resources extraction (crude oil among others), processing (plastic granulate and wool production), chair and carpet manufacturing, distribution, products use and disposal. In case of chairs, plastic recycling was assumed; whereas in case of carpet – municipal waste scenario was assumed. The distance between natural resource extraction plant and the product manufacturer was assumed to be 200 km, and the distance from the manufacturer to the customer (in both cases) – 100 km.

6. Empirical results of LCA study of circular supplies model

Results of comparative analysis of plastic chairs representing circular and linear approach are discussed below. Figure 2 depicts LCA results for regular plastic chairs (linear model). Negative environmental impact results from production and transport (values above zero), whereas the waste scenario (recycling) indicates environmental benefit. However, the environmental burden dominates thus for all endpoint categories the resulting environmental impact is negative. Total normalization indicators are determined by adding obtained indicators within each category and rounded; amount to:

- human health: 4,80;

- ecosystem quality: 0,37;

- resources: 3,85.

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Fig. 2. Normalization indicators for plastic chair linear model
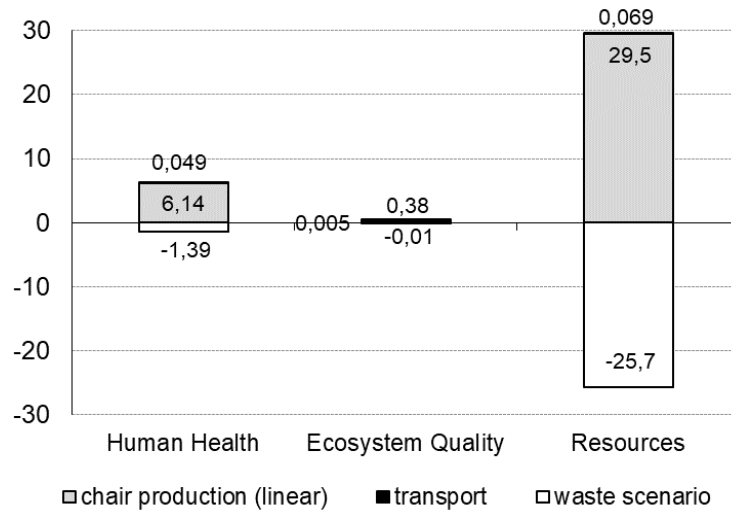
Source: Own research

The LCA results obtained for plastic chairs assuming the circular model are shown in Figure 3. Negative environmental impact is reduced due to taking back used chairs, and their utilization as raw material for manufacturing of new products. Depending on the impact category, the normalization indicators equals:

- human health: 0,22;
- ecosystem quality: 0,19;
- resources: -16,76.

In case of resources endpoint, a considerable environmental benefit is observed. It is caused by production processes assuming using waste as raw materials (avoided crude oil extraction and processing).

Fig. 3. Normalization indicators for plastic chair linear model
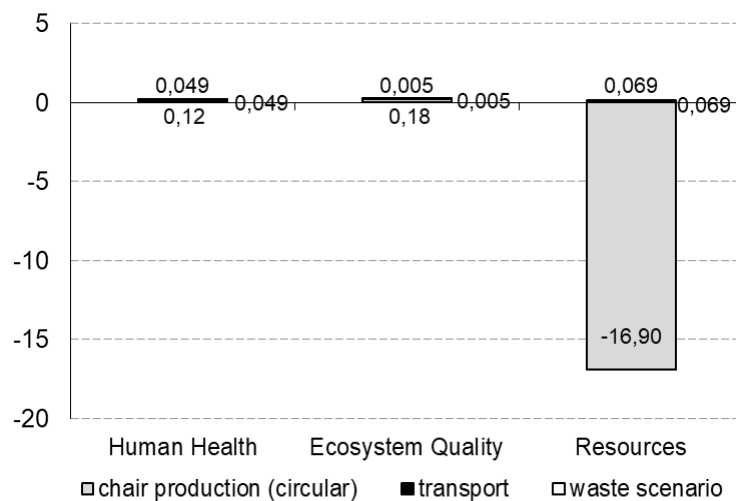
Source: Own research

It is notable that in both linear and circular models, the environmental impact of transport is insignificant. The assumptions concerning distance have therefore negligible effect on the results.

Figure 4 presents a comparison of LCA results for linear and circular model of plastic chairs. Normalization results indicate that regardless of the impact category, the application of circular approach increases significantly the environmental performance of the product. The indicators are 22 and 1,9 times lower

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for human health and ecosystem quality, respectively. In case of resources endpoint, the opposite character of environmental impact is even observed (benefit versus loss).

Fig. 4. Comparison of normalization indicators for linear and circular model
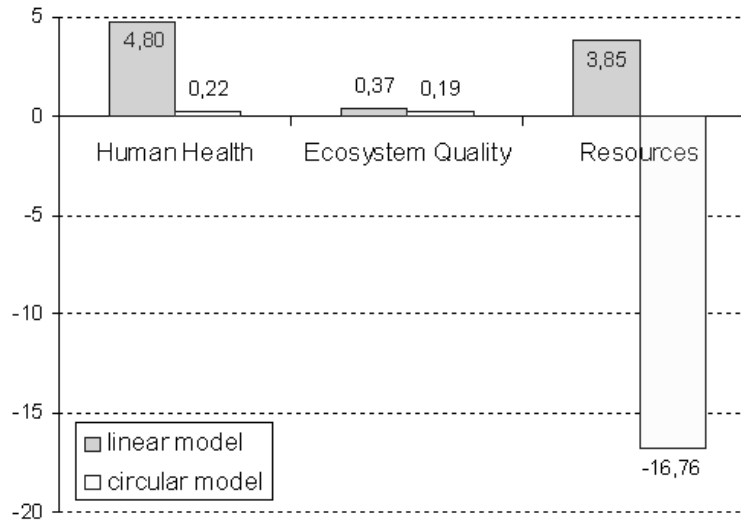
Source: Own research

Additional comparative analysis may be carried out. As the object of the research may serve carpets, which are made of wool and nylon, according to data provided by Desso Group (Desso Group, 2018). Figure 5 depicts LCA results for typically produced carpet (linear model). All components of environmental impacts are negative (values above zero). Total normalization indicators amount to:

- human health: 1,84;

- ecosystem quality: 5,09;

- resources: 1,58.

Fig. 5. Normalization indicators for carpet linear model
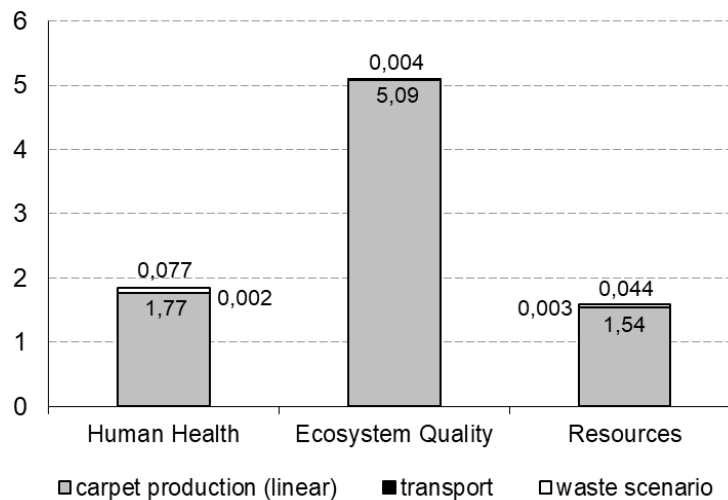
Source: Own research

The LCA results obtained for carpet assuming the circular model are shown in Figure 6. Only positive environmental impact is observed due to taking back used carpets and their utilization as raw material for new products manufacturing. Depending on the impact category, the normalization indicators are:

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- human health: -1,76;

- ecosystem quality: -5,09;

- resources: -1,52.

Fig. 6. Normalization indicators for carpet linear model
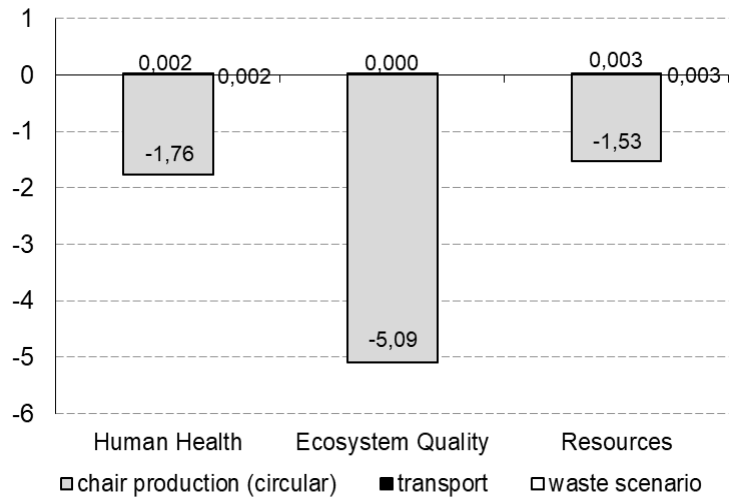
Source: Own research

Similarly, as in the case of plastic chairs, the environmental impact of transport is insignificant. The assumptions concerning distance have therefore negligible effect on the results.

Figure 7 presents a comparison of LCA results for linear and circular model of carpets. Normalization results indicate that regardless of the impact category, the application of circular approach increases significantly the environmental performance of the product (negative indicators). The opposite character of environmental impact is observed for all endpoints.

Fig. 7. Comparison of normalization indicators for linear and circular models of carpet
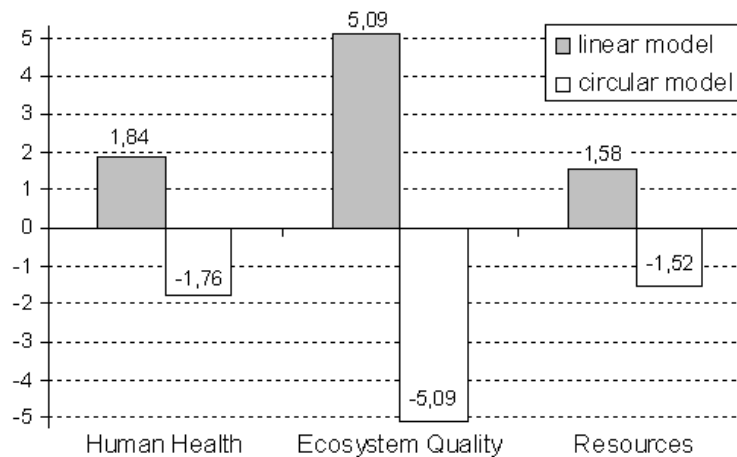
Source: Own research

7. Conclusions

The paper presents a view on circular economy concept from the perspective of manufacturing industry. Identified waste concept is portrayal from both circular economy and manufacturing industry perspectives. In circular economy concept waste concern mostly physical materials and basically does not exist.

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In lean manufacturing waste is more related to work organization and everything that is associated with deterioration of production performance. In both cases waste concept is perceived as needles and the waste notion can be complementary. In considered area, lean manufacturing and circular economy can be integrated since it has many common guidelines. Presented five circular business models are further examples of possibility of combining circular economy model with other management systems (including lean manufacturing). Nowadays more and more companies start to implement circular economy approach to its functioning strategy. Conducted research points out the benefits of the application of the infinite resource supply model. Chairs and carpets were selected as example products for comparative analysis. A comparative LCA study showed that regardless of the impact category, the application of circular approach increased significantly the environmental performance of the products. Beneficial results of the circular model have been found in human health, ecosystem quality, and resources categories. The greatest differences were observed at the production stage. The environmental impact of production has been decreased due to reduced consumption of natural resources (the raw material was supposed to be acquired from customers), and consequently, raw material processing. Which is notable, the environmental impact of transport was negligible compared to the production stage and disposal scenario. This leads to conclusion that even if the distance between product manufacturer and customers was much longer, the environmental benefit resulting from implementation of the circular model would be still substantial. In case of resources endpoint, the positive environmental impact has been recorded. The research indicates clearly pre-eminence of the circular resources approach over the traditional approach. Overall, the circular economy concept may be valuable for the manufacturing industry.

Acknowledgement

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MANAGING PROJECT USING CRITICAL PATH METHOD

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Abstract
The subject of this study is to obtain information on project management issues, specifically the critical path method (CPM). This method is one of the basic deterministic methods of network analysis. Its goal is to determine the duration of the project based on the length of the so-called critical path. As part of the time analysis, the critical activities of the project will be found in the event of non-observance of the planned implementation deadline, so the project duration will be extended. The CPM allows you to facilitate effective time coordination of partial, interdependent activities within the project. The objective of the work is to depict the critical path of the CPM at minimum total cost and to calculate the optimal duration of production of the product.

Keywords
Critical path method (CPM), Project, Network analysis.

JEL Classification
(C4):44,C12

1   Introduction

At the end of the 1950s, two methods were used to plan and monitor the development of projects that have become the basis of project management and are still used today. It was a Critical Path (CPM) method and a program evaluation and control method (PERT) whose development was mainly aimed at helping to estimate and shorten the length of project implementation and manage a large number of participants involved in the projects.

Critical Path Method (CPM) is one of the basic methods of time analysis of projects. The presume of this method is that the length of all activities carried out from which the project is composed can be accurately estimated in advance and we do not consider the possibility of changing these time characteristics - it is a deterministic method.

The Program Evaluation and Review Technique (PERT) is another important method of time analysis of projects. PERT method it assumes that the duration of each activity cannot be accurately determined and considers it a random variable defined on the interval.

The aim of the article is therefore to evaluate the possibilities and conditions of deployment of key project management methods in connection with the implementation of HR department at company. This change is part of one point of the company strategy: Keep a stable staff potencial and increase their qualifications. This point is, in my opinion, crucial to the company's management. The HR department would bring the company closer relationship to employees. It would be responsible for recruitment, control, redundancy and overall human resources management, and this would lead to more efficient work and improve the overall atmosphere of the company.

2   Methodology and Data

In as mentioned in the introduction, we use the CPM method, which is used to manage complex events that have a deterministic model. For the successful creation of the project and the subsequent implementation of the necessary methods, it is necessary to define the individual activities necessary for carrying out the whole

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process. (Shurrab, Abbasi, 2016). The activities can be divided into individual levels, thus achieving better orientation in the project. Activity lengths are then defined, i.e. when the task begins and ends, the data will be generated automatically (Čejka, 2017).

$$t_j^0 = \max(t_i^0 + y_{ij}) \tag{1}$$

The earliest possible start of performing activities that begin at node u_j is equal to the maximum of the earliest possible ends of activities that enter the node u_j (Jablonský, Maňas, Fiala, 1994).

$$t_j^1 = \min(t_j^1 - y_{ij}) \tag{2}$$

The permissible end of execution of activities ending at the node u_i is equal to the minimum of the least allowed permissible start of activities that occur from node u_i (Jablonský, Maňas, Fiala, 1994).

$$CR_{ij} = t_j^1 - t_i^0 - y_{ij} \tag{3}$$

The total time margin is the difference between the end of the permissible end, the earliest possible start and the duration of the activity (Jablonský, Maňas, Fiala, 1994).

Then we used PERT analysis to define probability of duration project. Here, the duration of each sub-activity is understood to be a random variable having a certain probability distribution. Empirically, it has been found that in practice this best describes the so-called [β] distributions that better outline the variability of operating conditions (Jablonský, Maňas, Fiala, 1994).

Beta split times are calculated based on estimates by industry experts who can estimate the risks and conditions for implementing partial activities for which they are responsible.

These estimates rely on the possibility of expression in three time characteristics:

- The optimistic estimate [α] considers the shortest duration of activity with a hypothetical frequency of 1: 100 (Hypothetical Frequency 1: 100 means that if we did 100x the same activity under the same conditions, we would manage to do the job just once).

- Modus (most probable estimate) [m] is the most probable duration of activity.

- The pessimistic estimate [β]assumes the longest duration of activity with a hypothetical frequency of 1: 100.

To determine individual estimates must always be used $0 \leq a_{ij} \leq m_{ij} \leq b_{ij}$ with the most difficult being the definition of all possible obstacles that could prevent the successful completion of the respective activity - therefore we choose a pessimistic estimate of a relatively larger.

For the creation of HR departments, it is the responsibility of the CEO of the company, although each section in the organizational structure must participate in this work, share business information, train HR staff and acquaint them with workers in individual sections.

The conversion of the model from stochastic to deterministic is done by calculating the mean durations (u_{ij}) and standard deviations (σ_{ij}) for each activity which define by Fiala (2006):

$$u_{ij} = \frac{a_{ij} + 4m_{ij} + b_{ij}}{6} \tag{4}$$

$$\sigma_{ij}^2 = \left(\frac{b_{ij} - a_{ij}}{6}^2\right) = \sigma_{ij} = \left(\frac{b_{ij} - a_{ij}}{6}\right) \tag{5}$$

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If the scheduled end date for the complete T_p task is entered, then for estimate the probability that this deadline will be met, then the following is true (Rais, 2006):

$$P\left(T \leq T_p\right) = F(\frac{T_p - T_E}{\sigma_{T_E}}) \tag{6}$$

Where T_p is planned end of the entire task, T_E is the expected date of implementation of the whole task and $F\left(\frac{T_p - T_E}{\sigma_{T_E}}\right) = F(u)$ is distribution function of the standard random variable u.

Practice shows that the probability of meeting the planned term TP in the range of 0.4 - 0.6 (40 - 60%) to a sufficient degree ensures the task is accomplished. Values exceeding 0.6 (60%) indicate surplus use, and the value below 0.4 (40%) indicates the need to better secure the activities on the way to the node (allocation of additional resources, improvement of work organization, etc.). At the 50% probability value, the same probability can be that the planned time is exceeded. Values less than 25% are very risky, and within the range of 25-60%, the risk of completing the project is timely accepted as acceptable. If the probability exceeds 60%, the prospect of meeting the scheduled term is very good (the time reserve is included in the project) by Jablonský, Maňas, Fiala (1994).

In the case of more critical paths, greater attention should be paid to the expected critical path with the greatest variance.

The PERT method is computationally more demanding than the critical path method. However, it allows qualitatively and quantitatively to estimate the probability of realizing both individual activities and the whole task (Aitchison, Brown, 1957).

Research methods should be clearly specified in a separate section. Careful description of the methods increases the credibility of results, but it (description of methods) should not become central point of the article. Particularly in case of commonly used scientific methods it is advisable to refer to the key resources related to the method. Sources of data and the description of the data should be precisely stated as well (Alexander, 2008).

3   Empirical Results

Every employee must be involved in making the change from a production laborer who has become familiar with HR employees and take them to the team up to the members of the supervisory board to reconcile the introduction of a change in the company.

In order to create the HR department and staff training (HR manager + HR specialist), we need 15 steps in the 26 day time horizon. To realize the creation of the HR Department, the total need for CZK 110,620 is given in Appendix 1. The costs include the salaries of the employees who are responsible for the action.

3.1   CPM method

You can see in the Figure 1 the sequence and interrelationship of individual activities, or more precisely, the previous activities of individual tasks. You can also see the duration of individual activities (numbered margins) and the first possible start (left at the node) and the end of individual activities. Critical path is shown in black bold line. The critical path is the longest route in the project and determines the shortest possible time to complete it, which was set at 119 hours.

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Figure 5. CPM analysis

1 / 0 0	→4 **2** / 4 4	→2 **3.1** / 6 6	→14 **3.2** / 20 20

3.3 / 25 25	→2 **3.4** / 27 27	→16 **3.5** / 43 43	→4 **4** / 47 80

(arrow 5 from 3.2 to 3.3)

5.1 / 47 47	→16 **5.2** / 63 63	→24 **5.3** / 87 87	→16 **5.4** / 103 103

(arrow 4 from 3.5 to 5.1)

5.5 / 111 111	→8 **6** / 119 119

(arrow 8 from 5.4 to 5.5; arrow 15 to 6)
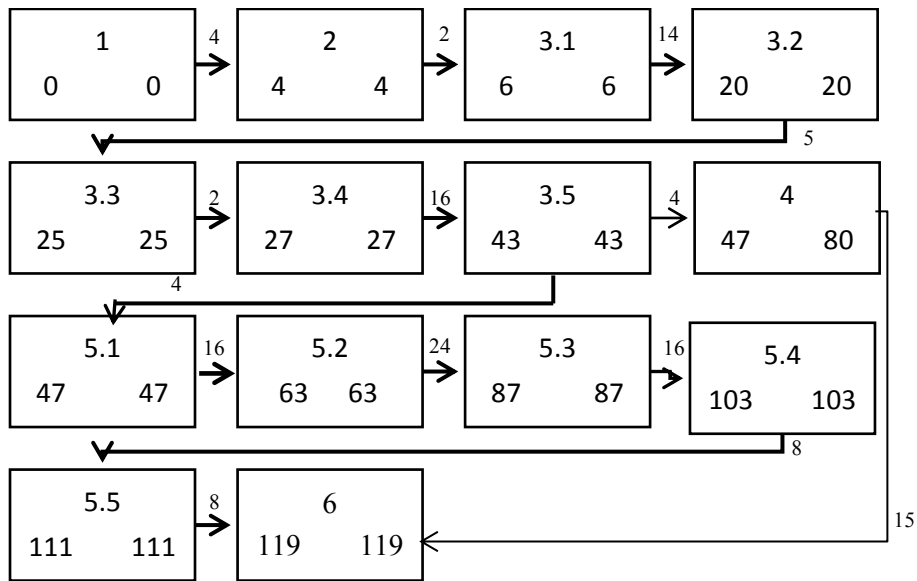
3.2 PERT method

As we mentioned in the theoretical part, there are three time characteristics: optimistic, the most probable and pessimistic in the PERT method. We can see this parameters in Table 1, which shows only the most important activities which help to calculate PERT analysis.

Table 9. Three time characteristics for calculating PERT method

Task	α	m	β	u_{ij}	σ_{ij}
Creating HR department	**16,63**	**27,13**	**54,25**	**29,90**	**6,24**
Accepting the creation of HR department	0,25	0,50	2,00	0,71	0,29
Changing organizational structure of company	0,13	0,25	0,38	0,25	0,04
Find candidates for HR department	10,63	17,38	32,00	18,69	3,56
Training of employees at the company	5,625	9	19,75	10,23	2,35

Using the PERT analysis, the expected duration of the project is 29.9 days by according formula (4) and a possible deviation from this value of 6,24 days by according formula (5). We calculated with 26 days, so we have to extend the time. Therefore, the actual duration of the project implementation should not exceed 36days.

$$\sum u_{ij} = 0,71+0,25+18,69+10,23 = 29,9 \text{ days}$$

$$\sum \sigma_{ij} = 0,29 + 0,04 + 3,56 + 2,35 = 6,24 \text{ days}$$

$$T = u_{ij} \pm \sigma_{ij} = \langle 23,66; 36,14 \rangle$$

M is modus which say how long will take the project. It is the most probable duration of activity.

The probability analysis of the project is presented in the following Table 2. This probability calculated by formula (6).

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Table 10. Probabilistic project analysis

Duration of the project	25,2	26,8	27,9	28,9	**29,9**	30	31,9	33,9	34,6
Probability	10%	20%	30%	40%	**50%**	60%	70%	80%	90%

The probability of adhering to the scheduled date of 26 working days is about 14.46%. The results show that the duration of the activity needs to be extended to 34-36 days. For better overview and time orientation you can see PERT analysis in Attachment 2.

4   Conclusion

The paper is divided into two parts - the first focuses on the theoretical determination of the given issue. During this phase I obtained the knowledge which we could apply later. The Microsoft Project 2016, was used to solve the problem. Using this program, the project consisting of individual activities in the chain was created, including the determination of the following activities, the entire sequence and durations of individual tasks. Using CPM analysis we have identified the critical path of the project. As part of the time analysis, using the Critical Path (CPM) method, it was found that the implementation of the project would take 119 hours. But when we can see in appendix 1, we calculate with 26 days. This deviation is due to activity: selection of suitable candidates, which will take secretary of company 14 hours in 14 days. Using PERT analysis we have reached the expected time of the project and the probability of reaching this time. The result of this analysis is that we have to extend the project time from 34 to 36 days. The project should be implemented in the range of 34 to 36 days.

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Attachement 1. Process of implementation HR department

Nr.	Task	Duration	Start	End	Cost (CZK)	Responsibility
	Creating HR department	26 days	4.1.2019	8.2.2019	110 620	
1	Accepting the creation of HR department	4 hours	4.1.2019	4.1.2019	5 000	Supervisory Board, CEO,PM
2	Changing organizational structure of the company.	2 hours	4.1.2019	4.1.2019	900	CEO
3	Selecting a suitable HR candidate	14,75 days	4.1.2019	25.1.2019	22 620	
3.1.	Find candidates for HR (HR Manager + HR Specialist) for example through a agency, employment office, advertisements (in newspapers, on websites), etc.	14 hours	4.1.2019	19.1.2019	1 680	Secretary
3.2.	Selection of suitable candidates.	5 hours	19.1.2019	19.1.2019	4 500	CEO,PM
3.3.	Invitation of the selected candidates to the selection procedure.	2 hours	20.1.2019	20.1.2019	240	Secretary
3.4.	Selecting a suitable HR candidate (manager + specialist).	16 hours	20.1.2019	22.1.2019	14 400	CEO,PM
3.5.	Signing a contract and agreeing to terms.	4 hours	25.1.2019	25.1.2019	1 800	CEO
4	Create a workspace in business and office facilities.	15 hours	26.1.2019	27.1.2019	13 300	Laborer,Secreta
5	Training of employees at the company.	9 days	26.1.2019	5.2.2019	68 800	
5.1.	Training of employees in the production department.	16 hours	26.1.2019	27.1.2019	16 000	CEO
5.2.	Training of employees in the economic department.	24 hours	28.1.2019	1.2.2019	24 000	PM
5.3.	Training of employees in the business section.	16 hours	2.2.2019	3.2.2019	14 400	CFO
5.4.	Training of employees in the technical department.	8 hours	4.2.2019	4.2.2019	7 200	CSO
5.5.	Creating HR department.	8 hours	5.2.2019	5.2.2019	7 200	CTO
6	Creating HR department.	0 hours	8.2.2019	8.2.2019		CEO

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Attachement 2: PERT analysis

0	0	0,71 0,3	1	0,3	0,25; 0,04	2	0,34	14,83 2,5	3.1	2,84	0,79 0,29	3.2	3,13
0	0		0,71	0,71		0,96	0,96		15,79	15,79		16,58	16,58

0,35 / 0,15

2,1 / 0,23

3.3	3,28	2 0,33	3.4	3,61	0,71 0,20	3.5	3,9	2,92 1,33	4	5,23		5.1	4,13
16,93	16,93		18,93	18,93		19,64	19,64		22,58	22,58		21,74	21,74

3,38 / 0,71

0,02 / 0,02

5.2	4,84	2 0,33	5.3	5,17	1,38 0,54	5.4	5,71	1,38 0,54	5.5	6,25	0,02 0,02	6	6,27
25,12	25,12		27,12	27,12		28,5	28,5		29,88	29,88		29,9	29,9

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EFFICIENCY AND EVALUATION OF INSURANCE INDUSTRY SUPERVISION IN CHINA

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Abstract

Chinese insurance market built a great contribution to the insurance industry in recent years. However, the insurance supervision system in the Chinese market is still not sufficiency. For the Chinese market, to get effective supervision is important. In order to judge the level of efficiency, this paper will consider three types of factors: solvency, profitability, and capacity. This paper uses SPSS software to complete the factor analysis, the data is from China Life Insurance Limited from 2010 to 2017. From the results, it can announce the insurance supervision effective is the strongest in 2013. The strength of supervision efficiency from 2014 to 2017 is increased, Chinese insurance market development is positive. Some suggestions about how to improve the insurance supervision are put forward at the last of this paper.

Keywords

Insurance supervision, SPSS, Efficiency, Factor analysis, China market.

JEL Classification

C38, G14, G22

1 Introduction

The first insurance company in China was established in 1949. However, the insurance industry in the Chinese market did not get a significant development until 1979. Allianz SE (2018) reported of the about 60 billion euros in additional premiums in life insurance, around 80 percent were attributable to the Chinese market in 2017, and China is on 35th place in the world if ranking based on the premiums per capital in Euro. Although the insurance industry develops is speediest in China, there does have some gap from the developed country. Comparing with the insurance industry in the United States, Japan, and some European Countries, Chinese insurance industry supervision system is still not enough.

An efficiency insurance market will help the insurance company to get the greatest difference between the revenues and cost. Ma (2001) stated the core of insurance supervision system is the solvency supervise of an insurance company. Tao and Xu (2012) assessed the efficiency of insurance supervision should not only by the qualitative analysis but also by quantitative analysis. How to complete the supervision system to make the more efficiency supervise become an important question for the Chinese insurance market now. This paper focuses on the quantitative analysis of insurance supervision efficiency in the Chinese market from 2010 to 2017 by using factor analysis and put forward some advice based on the results.

The paper will be processed as follows. The first part writes about the literature review of this topic. Next is the factor analysis description. The third part will give the results from the quantitative analysis model and then put forward the suggestion for insurance supervision. In the last part, will bring to the end of the paper.

2 Literature Review of Insurance Supervision Efficiency in China

For the developed market economy countries, there are three categories of the goals of insurance supervision: keep up the legitimate rights and interests of the insured; support the fair competition in the market and keep up the overall safety and stability of the insurance system. For some emerging market economy countries,

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there is one more objective, to promote the insurance industry develop, the Chinese insurance market is one of it.

Tao and Xu (2012) mention insurance supervision efficiency including two parts: the supervision efficiency of the supervision institutions themselves and the operational efficiency of the insurance companies. There are three degrees of the institutions of insurance supervision, the first level is a legislative institution, the second one is a judicial institution, and the last one is an administrative institution, this one is also the main body of supervision.

The legislative institution should clarify the supervision institution that implements the insurance supervision laws and needs to set out the statutory scope of responsibility. The judicial institution should solve the disputes between the insurers and policyholders, figures the related complaint between the insurer and insurance intermediates and to make sure the insurance law carries out, by issuing the order supporting the insurance regulator and judge the criminal liability for breach of insurance laws. Insurance supervision institution is the administrative body which performs the duties of insurance supervision according to law. The legislature institution authorized this legislature institution.

UNCTAD (1994) defined three principles to the insurance market to make sure the ideal effectiveness and efficiency of supervision. They are atomicity, transparency, and information. The World Bank (2006) found insurance supervision relies upon the policy, well-developed financial market infrastructure, and efficient financial market.

SCNPC (2015) requires the smallest registered capital for the insurance company is 0.2 billion RMB; the basic insurance clauses and premium rates for the main types of commercial insurance shall be settled by the financial supervision and regulation department; if the companies operating is non-life insurance, the amount of the withdrawal and carry-over shall be equal to 50% of the premium retained in the current year and so on.

There are two main insurance supervision ways in China: off-site monitoring and public information disclosure; on-site inspection. For the public information disclosure, the supervision institution should set out the scope and frequency of financial reports, statistics reports, actuarial reports and other related information provided by insurance companies within their jurisdiction shall be set. They also need to set standards for how to present technical reserves and policy liabilities in the reports and to make sure the qualification requirements of the external audit institution of the insurance company. The goal of the on-site inspection is to compare the insurance company's risk structure and ability to bear the risk and find any issues that may affect the insurer's ability to take on long-term obligations to policyholders.

The main goal of insurance supervision is to make sure the insurance company can have a good operation. Therefor the performance of insurance company can prove the supervision is efficiency or not.

In order to assess the insurance supervision efficiency, there are three aspects need to be considered: solvency, profitability and insurance capacity of the insurance company. Insurance companies underwrite a lot of the subject insured; thus, insurance is associated with a large number of debts. For the sake of policyholders, insurance companies should keep their debt at a relatively stable level and be supposed to repay their debt at any time. That is the reason why insurance supervision institution shall keep under the strict supervision of solvency.

CIRC (2015a) states the solvency regulation evaluation includes market risk management ability, credit risk management ability, operation risk management ability, liquid risk management ability and so on. CIRC (2015b) announces the main factors which need to be reported in solvency report are core tier one capital, admitted assets, admitted liabilities, real assets, core solvency surplus and so on.

One of the goals of insurance supervision in China is to improve the industry's development. The business circumstance of the insurance company is a piece of strong evidence that supervision is effective or not, the greater difference between insurance company's revenues and costs, the more effective supervision. The insurance company's profitability and capacity are to describe the business circumstance. The common indicators are paid-up capital, legal retention premium, total surplus accumulation fund, operating profit margin, return on equity, return on capital, cost expenses profit margin and so on. factor analysis will use some of these factors mentioned here.

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3   Methodology and Data

This paper will research insurance supervision efficiency in different periods. There is a problem before continuing the paper: there are lots of types of the insurance companies and many of insurance company in China, how to choose the target company to collect the related data?

CIRC (2017) found life insurance has the largest market shares in the insurance industry. CIRC (2016) concluded at the end of 2015, there were 11 insurance group company in China, 158 insurance company. 102 was Chinese insurance company, 56 was foreign insurance company. Chinese insurance companies are still the main force in the insurance market. This paper chose life insurance market as the example. China Life is the biggest life insurance company in China, thus all the data will be collected from China Life to represent the industry.

3.1   Factor Analysis

This paper chose factor analysis (FA) as the quantitative analysis method. Abbas and Wasin (2019) define factor analysis is a multivariate technique used to describe the relationships between different variables under study with new variables called factors.

There are lots of variables related to insurance supervision, it is not easy to compare the degree of efficiency just based on the value of them. Factor analysis will give a quantitative standard of these variables, the final score of the sum of components can represent how strong the supervision efficiency is. The score from different years also can use to compare the changes in supervision efficiency.

The fundamental idea of factor analysis is to classify the observed variables and put them in the same group with high correlation. In other words, the correlation between different types variables is low, while the same type variables are closely related. Each type of variable represents a basic structure named the common factor.

The core of factor analysis is to analyse several comprehensive indicators and extract common factor. Then build a scoring function by taking the variance contribution rate of each factor as the sum of weights and the score multiplier of the factor.

In general, the mathematical representation of factor analysis is a matrix: $x=\alpha f+\beta$, they are shown as following:

$$\left[\begin{array}{l} x_1 = \alpha_{11}f_1 + \alpha_{12}f_2 + \alpha_{13}f_3 + \cdots + \alpha_{1k}f_k + \beta_1 \\ x_2 = \alpha_{21}f_1 + \alpha_{22}f_2 + \alpha_{23}f_3 + \cdots + \alpha_{2k}f_k + \beta_2 \\ x_3 = \alpha_{31}f_1 + \alpha_{32}f_2 + \alpha_{33}f_3 + \cdots + \alpha_{3k}f_k + \beta_3 \\ \qquad\qquad \cdots\cdots \\ x_p = \alpha_{p1}f_1 + \alpha_{p2}f_2 + \alpha_{p3}f_3 + \cdots + \alpha_{pk}f_k + \beta_p \end{array} \right. \qquad (1)$$

where $k{\leq}p$; $x=(x_1, x_2, x_3, \cdots, x_p)'$ is an observable random variable; $f=(f_1, f_2, f_3 \cdots f_k)$ is the common factor, the common factors in the expressions of the original observed variables are independent and non-observable theoretical variables; A(α_{ij}) is the coefficient of a common factor, it also named factor loading matrix; α_{ij} is the covariance of x_i and f_j, the large absolute value it is, the greater the load f_j for x_i; $\beta(\beta_1,\beta_2,\beta_3\ldots\beta_p)$ is the specific factor, this factor is also unobservable.

There are two statistics in factor load matrix A which are very important for the economic interpretation of factor analysis results, they are the common degree of variables and the variance contribution of common factors.

The variable commonality is the sum of squares of elements in line i of factor load A,

$$h_i{}^2 = \sum_{j=1}^{k} \alpha_{ij}{}^2 \qquad (2)$$

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where $i=1, 2, 3, …, p$. It measures the contribution of all common factors to the variance of x_i and reflects the influence of all common factors on the variable x_i. The larger the h_i^2, the greater the dependence of x on each component of f.

Take variance on both sides of Formula (1), then the new formula is shown as follows:

$$Var(x_i) = \alpha_{i1}^2 Var(f_1) + \alpha_{i2}^2 Var(f_2) + \cdots + \alpha_{ik}^2 Var(f_k) + Var(\beta_i)$$
$$= \sum_{j=1}^{k} \alpha_{ij}^2 + \sum_{i=1}^{p} \beta_i^2 \tag{3}$$

if the result of h_i^2 is close to $Var(x_i)$, and β_i^2 is very small, the effect of factor analysis is better, and the transformation from original variable space to common factor space is better.

The sum of squares of each column element in the factor load matrix is denoted as:

$$g_j^2 = \sum_{i=1}^{p} \alpha_{ij}^2 \tag{4}$$

where $i=1, 2, 3, …, k$. g_j^2 refers to the contribution of the f_j to x, it is an indicator to measure the importance of the common factor. The greater the g_j^2, the stronger effect and influence of f on x. If calculate all the g_j^2, and make it sort by size, then the most influential common factor can be extracted from it.

The four main processes of factor analysis are: first, decide whether the original variables to be analysed are suitable for factor analysis; then construct factor variables; use rotation to make factor variables more explanatory, and calculate the score of the factor variable.

3.2 Data Collection

Three types of indicators are chosen as the variables. Solvency factors include the real rate of change in solvency, recognize asset-liability ratios, asset recognition rate, premium receivable to provident fund ratio and solvency margin ratio. For the profitability, there is the return on equity, net income interest rate and the ratio of profits to cost. The capacity factors are premium and accumulation fund ratio and reserve premium ratio. The period of the data is from 2010 to 2017, Table 1 shows the used data.

Table 11. Data Used in Factor Analysis （%）

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
Solvency Margin Ratio	211.99	170.12	235.58	226.22	294.48	359.02	297.16	277.65
Recognize Asset-Liability Ratios	85.08	87.79	88.25	88.72	87.29	86.82	88.59	88.77
Asset recognition rate	91.23	92.82	90.73	91.46	89.39	88.39	74.87	75.61
Premium Receivable to Provident Fund	8.31	12.04	9.06	12.58	11.12	11.10	11.84	11.90
Rate of Change in Solvency	-1.08	-8.12	15.36	-0.23	27.14	13.40	-4.13	5.74
Return on Equity	16.06	9.56	5.05	11.24	11.49	10.96	6.37	10.07
Net Income Interest Rate	8.70	4.80	2.78	5.90	7.29	4.45	4.66	4.91
Ratio of Profits to Cost	11.79	5.62	2.78	7.46	9.96	9.87	4.54	6.82
Premium and accumulation Fund Ratio	371.80	476.53	342.96	426.43	339.91	348.77	387.71	439.03
Reserve Premium Ratio	313.17	367.57	418.74	446.84	470.14	458.93	420.79	389.25

Source: China Life (2010-2017)

4 Empirical Results and Suggestions

SPSS software is used to make the factor analysis of 8-year data of 10 variables of China Life Insurance Limited. The results of commonalities show all the factor's information retains above 85%, that means the factor analysis has a high reliability. This paper extracts four principal component factor, Figure 1 shows the results.

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Figure 6. Result from Principle Component Analysis
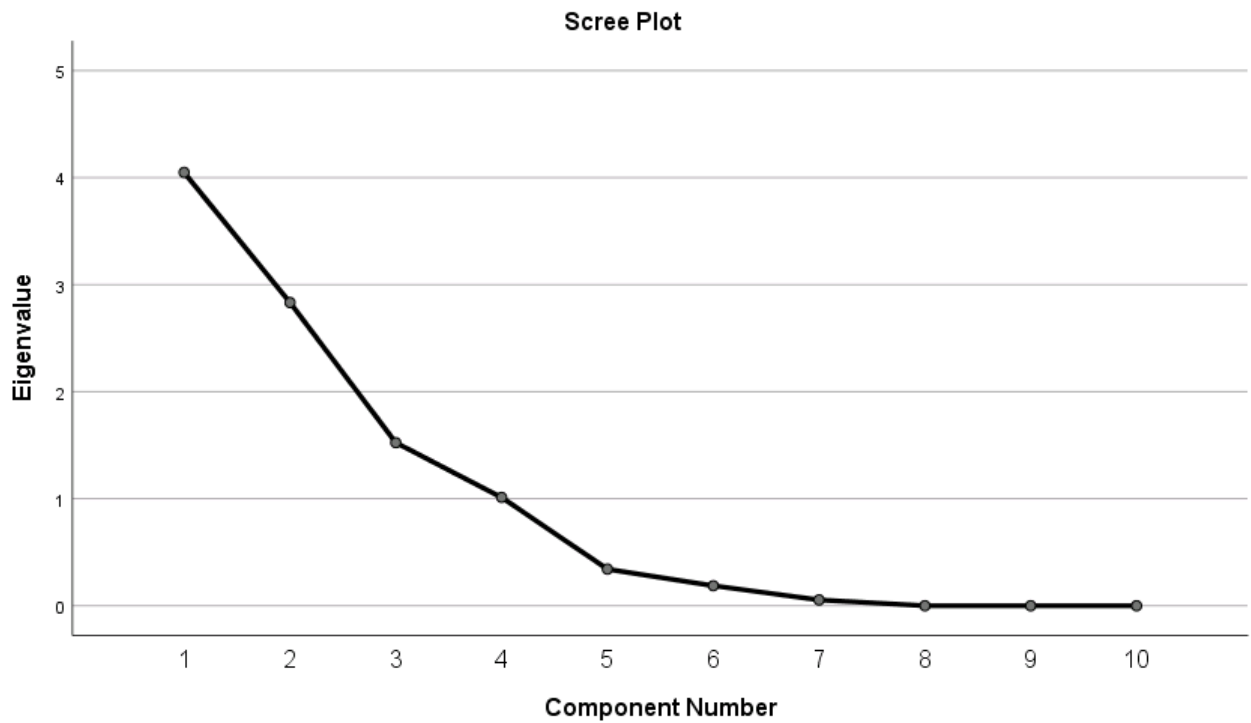
Source: SPSS

From this figure, it is easy to find when the component number is greater than five, the eigenvalue is below one, thus there are four principal component factors. Table 2 shows the rotated component matrix. The empty place does not mean there anything, that is because the analyse set up the loading is 0.6, thus ignore the smaller number when showing the results.

Table 2. Rotated Component Matrix

	1	*2*	*3*	*4*
Solvency Margin Ratio	0.970			
Recognize Asset-Liability Ratios	0.968			
Asset recognition rate	0.912			
Premium Receivable to Provident Fund	-0.716			
Rate of Change in Solvency		0.899		
Return on Equity		0.820		
Net Income Interest Rate		-0.790		
Ratio of Profits to Cost		0.768		
Premium and accumulation Fund Ratio			0.970	
Reserve Premium Ratio				0.946

Source: SPSS

Table 2 represents the first four factors belongs to the component 1; the next four factors belongs to component 2, and the last two factors belongs to component 3 and 4 separately.

From SPSS software calculation, the component score coefficient matrix is shown in Table 3. The total score for each year can be calculated based on the results from SPSS, the greater the score it has, the more effective supervision in that year of the insurance industry in China, the final results are shown in Figure 3.

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Table 3. Component Score Coefficient Matrix

	1	*2*	*3*	*4*
Solvency Margin Ratio	0.094	0.237	0.011	-0.417
Recognize Asset-Liability Ratios	-0.024	0.107	0.106	0.782
Asset recognition rate	-0.143	0.008	0.245	0.015
Premium Receivable to Provident Fund	0.125	0.025	0.566	0.030
Rate of Change in Solvency	-0.016	0.342	-0.012	0.173
Return on Equity	0.324	-0.027	0.129	0.012
Net Income Interest Rate	0.304	-0.029	0.087	-0.043
Ratio of Profits to Cost	0.336	0.085	0.125	-0.050
Premium and accumulation Fund Ratio	0.058	-0.258	0.309	0.053
Reserve Premium Ratio	0.002	0.340	0.334	0.214

Source: SPSS

Figure 2. Score for Each Year
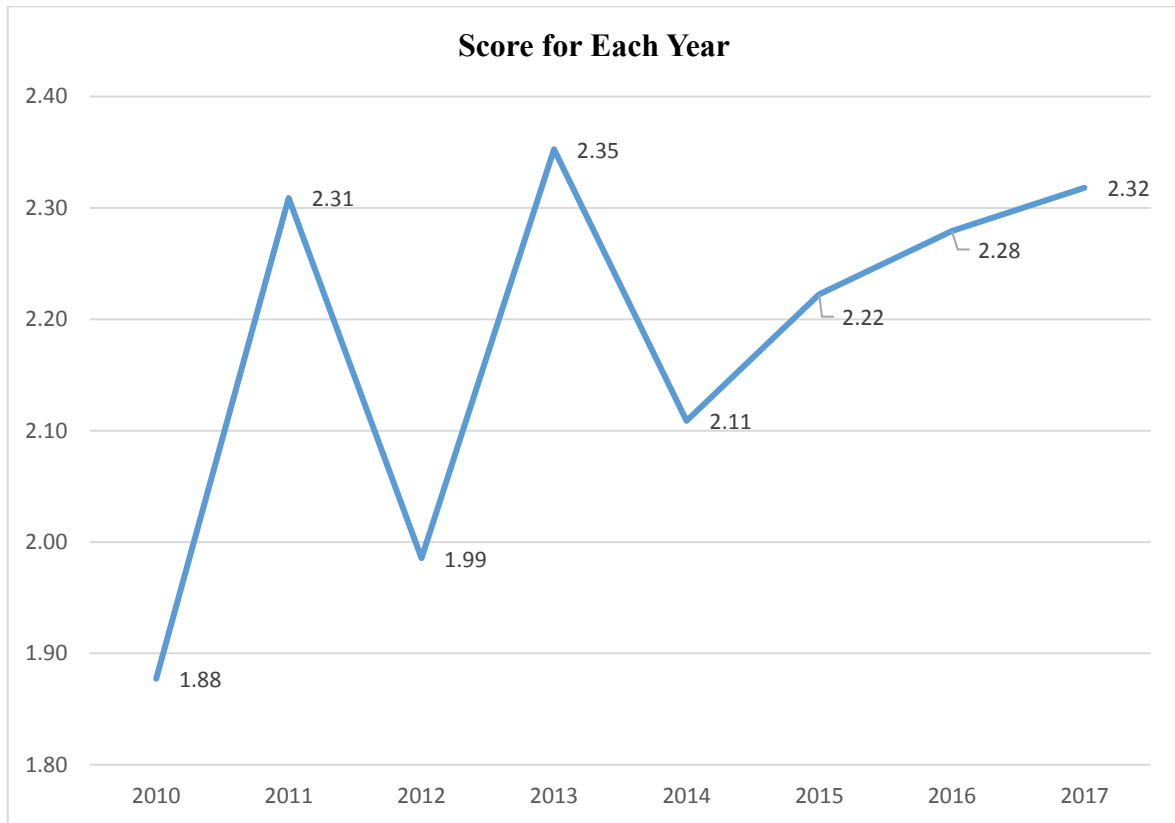
Source: Excel

The calculation formula of how the get the score of insurance supervision efficiency is:

$$x = 0.094 * x_1 - 0.024 * x_2 - 0.143 * x_3 + 0.125 * x_4 + 0.342 * x_5 - 0.027 * x_6 - 0.029 * x_7 + 0.085 * x_8 + 0.309 * x_9 + 0.214 * x_{10} \tag{5}$$

where x_1-x_{10} represent solvency margin ratio, recognize asset-liability ratios, asset recognition rate, premium receivable to provident fund, rate of change in solvency, return on equity, net income interest rate, ratio of profits to cost, premium and accumulation fund ratio and reserve premium ratio.

Figure 2 represents the final results of supervision efficiency which is shown by the score. The highest score was 2.35 in 2013, the general trend of this line is going up. There is an interesting situation that the supervision efficiency is constantly changing between strengthening and weakening every year from 2010 to 2014. From 2014 to 2017, the supervision efficiency was kept increased. Tao and Xu (2012) assessed the insurance

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supervision efficiency in China from 2005 to 2009 are 1.0735, 1.353, 0.893, 0.156 and 1.076. Comparing with these results, the insurance supervision efficiency in China is really stronger than before. The main reason is after 2011, insurance supervision not only deals with the relationship between the industry and the overall situation but also deals with the relationship between supervision and development. In the process of change, the number of market entities is larger, the role of the market mechanism is from weak to strong, and the focus of insurance supervision is to prompt change from cultivating the market to regulating the market, to keep up the supervision and development of the industry. In this process, regulators respect the law of the market, give full play to the basic role of the market in resource allocation, and attach great importance to the regulatory function of the government on the market. Through the support and policy guidance of the government, the more favourable external environment has been created for the insurance industry develop.

China Insurance Regulatory Commission had amended the Insurance laws and Insurance company solvency regulation in 2015. The requirements about the information disclosure are clearer and more specifically. With the stable growing development of the Chinese economy, there are more insurance companies and policyholders appear in the insurance market. One of the reasons why the supervision efficiency was still increased after 2014 is that after 2014, the financial crisis influence was not strong any more than before, the life-insurance market got into a stable increasing.

From 2011 to 2013, there are two heavy earthquakes happened in China, that also affected the insurance market, the unusual situations let the insurance companies have to prepare more reserved than other times. There exists one problem about the insurance supervision policy in China: now, there is no law on market withdrawal in China. So far, there is no insurance company in China's insurance market has been forced to withdraw from the insurance market due to poor management or illegal management. China Insurance Regulatory Commission always has a soft attitude about punish. However, the strict punishment for poor management and illegal management is necessary.

The insurance industry develops in China is speed now, especially the life insurance market. If the punishment is not heavy, the insurance companies may not be careful to invest anymore. That may reduce the solvency of an insurance company.

The supervision sector needs to pay more attention to the insurance company's solvency, the related ratios and factors should be supervised continually and strictly. It is necessary to gradually set up and improve the accounting and actuarial standards for solvency supervision. The supervision institution needs to make sure the insurance companies obey the Insurance company solvency regulation. And it is better if there is a specialized insurance rating agency rates the creditworthiness and solvency of the insurance company and publishes the rating results through the media. That will stimulate the insurance company to improve themselves and help the policyholders to understand the insurance company's economic position easier.

The insurance company also can optimize the ownership structure of insurance companies and realize equity diversification. The main channels are: listed on the capital market and introduction of strategic investors. There are lots of new investment product appear in the financial market, at the same time, the electronic economy is developing, the competition is intense now. More effective management of the insurance company is also needed.

5   Conclusion

The goal of this paper is to evaluate the insurance supervision efficiency from 2010 to 2017 in China. Factor analysis give a quantitative version of the degree of efficiency and shows the changes of efficiency during the past eight years. The score of efficiency in each year make it possible to compare the difference from different time. The results of the insurance supervision efficiency score from Tao and Xu (2012) and this paper prove in the past 13 years, the Chinese insurance industry supervision efficiency did have great progress.

Not the same as other countries, the history of insurance supervision in China is not long. The requirement about forced to withdraw from the insurance market is soft and not effective. In order to enable the supervisor to operate efficiently, the insurance regulator itself should have the following characteristics: the organization should be reasonable; the departments can coordinate the work, and not only considering the insurance company' benefits but also taking into account the interests of the policyholders.

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From the factor analysis, it is known the most insurance supervision efficiency year in China was 2013 during the past 8 years. And after 2014, insurance supervision is always effective, the situation is better than before. In order to get more effective insurance supervision, the supervisor should take stricter supervision of solvency. The insurance company also need to use the capital in a reasonable place and improve their underwriting capacity.

In recent years, Chinese insurance market's supervision has gradually developed a practical and effective regulatory model by exploring the rich regulatory practices. There are only three suggestions about how to get more effective insurance market: further, improve the solvency supervision system; strengthen corporate governance supervision; and strengthen the construction of information disclosure system.

Acknowledgement

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INTERNATIONALIZATION OF SMALL AND MEDIUM-SIZED EUROPEAN ENTERPRISES AS A DETERMINANT OF DEVELOPMENT

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Abstract
At the time of global economy, small and medium enterprises have to take care of its position among competitors in order to stay on the market. Achieving decent competitive position is the basic of functioning of enterprises belonging to the European Union. Globalization processes create many opportunities for small and medium enterprises but also many obstacles which an enterprise cannot overcome. Small and medium enterprises are the driver of the European Union economy. Due to them, the development which has an influence on lives of citizens of the European Union is possible. The decision related to taking up activity outside the domestic market allows small and medium enterprises to develop and gain a larger group of clients. Due to the openness of law and favorable solutions relating to the exchange of products between enterprises from different Member States, the enterprises from SME sector have an opportunity to develop their businesses. Enterprises which will not take an effort related to internationalization limit the chances for development and achieving a decent competitive position. Internal and external determinants of undertaking the internationalization which influence on the enterprises from SME sector have been presented in the paper. The main goal article is presentation of the most important internal and external determinants for SME enterprises from the European Union.

Keywords
Globalization, SME, European Union

JEL Classification
F, O, M

1   Introduction

The internationalization of enterprises as well as broadly known foreign expansion are one of the main subjects of the theory and also economic practice. The internationalization is a significant determinant conditioning the proper development of enterprises in a given country or business. The pace and direction of the economic development are conditioned by the initiation of activities connected with foreign emancipation (Beck, Demirguc-Kunt 2006a). More and more often the internationalization is the reason for commencing the cooperation between enterprises from different Member States. The period of significant social-economic changes which also have the influence on small and medium enterprises does not discourage activities related to internationalization.(Demirguc-Kunt, Love, Maksimovic 2006b).

Undertaking activities related to internationalization is important from the point of view of small and medium-sized enterprises operating in the economy of the European Union. Small and medium-sized enterprises influence the development of the Economic Union (Poznańska 2016, p. 143, 144).

The considerations in the paper are the result of the elaboration on the literature in the scope of internationalization and Eurostat reports.

2   Internationalization of small and medium enterprises in the European Union

Economic Union is an important step towards the integration of the European Union economies. It was established in 1992 and includes coordination of economic and budget politics of Member States. Additionally Member States can use simplified rules for goods trade as a part of their belonging to the European Union. Countries which belong to the European Union use the processes of economic integration which have an

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impact on the improvement of performance and resistance of the entire economic of the European Union. Economic integration brings multiplied results, contributes to economic stabilization, larger economic growth and employment, thereby it brings direct benefit to European Union citizens. The target of economic integration is also creating favorable and stable conditions for the development of enterprises.

The result of international economic integration for the international trade and internationalization is described in a comprehensive way in the literature. Generally, the findings of many types of research on internationalization of small and medium enterprises prove the positive trade effects for the economy of European Union, the particular Member States in which the trade is taking place and the enterprises as such (Zysk 2016, p. 53-74).

The effects of international integration is internationalization of enterprises which make a use of the opportunity to get new outlets, simultaneously eliminating current barriers between the economies of Member States. Thus the growth of trade flow and movement of capital can be expected (Daszkiewcz, Suchkova 2018, p. 234-235).

The leading factor making an influence on the level of innovativeness of the economy of Member State enterprises is the cooperation of particular economic subjects. Cooperation is significantly important at the time of moving towards the economy based on knowledge. Enterprises in order to meet needs of modern clients belonging to a new generation, have to cooperate, share knowledge and also unceasingly adapt to changes taking place at the market. The internationalization of small and medium enterprises is inter alia connected with (Oviatt, McDougall, 1997, p. 85–99):

- commercial cooperation, especially important for small and medium enterprises which are not capable of exporting or manufacturing products by themselves because of the lack of relevant foreign connections, lack of the knowledge on the market, the lack of sufficient financial resources,
- cooperation in the scope of development work, technoglobalization processes i.e. growing international innovation activity,
- production cooperation, in case of cooperation of foreign enterprises that share new technologies, knowledge or *know-how*, etc.

The undertaking of internationalization by enterprises is an opportunity for growth and it directly influences the functioning of an enterprise. Due to undertaking foreign cooperation between enterprises from different Member States, enterprises have larger capability to find ways of international expansion. Possibilities of undertaking the internationalization immensely depend on the inner qualities of a enterprise, competitive position and also research potential. The enterprises which have already undertaken different kinds of cooperation have bigger chances for effective start of internationalization process. Enterprises with experience in making new contacts and organization of cooperation have more experience which results in cooperation at the international level. Also important are earlier activities in the scope of creating cooperation with other enterprises in the given region or country. The necessary experience in undertaking joint projects with other enterprises can support the construction of contact with a potential foreign partner.

The participation of various Member States affects the increase or decrease of involvement of enterprises undertaking international cooperation. Differences in terms of law between given countries limit undertaking of cooperation between enterprises what have an impact on the limitation of the process of internationalization. Unification of terms will allow easier undertaking of cooperation between enterprises from different Member States. Important is attractiveness of investment, because the more attractive is the region the more foreign investments are drawn to it but also a permanent connection of investors with national economic of a given country. The important trend in the development of internationalization activity is becoming more and more significant as a result of globalization of economies and integration of economies. Along with this trend, the conditions for the flow of resources across borders and increased specialization of the value chain are improved, it has become easier to undertake international cooperation of small and medium-sized enterprises.

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Undertaking the cooperation between domestic markets requires openness of enterprises on the foreign cooperation at the international scale. Small and medium enterprises in order to start the internationalization process should implement the following actions:

● participation in international events,
● participation in international projects,
● cooperation between various enterprises,
● undertaking cooperation as part of EU projects,
● research and development cooperation,
● foreign investments, creation of cooperative chains (subcontracting).

The internationalization of small and medium enterprises develops through cooperation between various enterprises. The willingness to undertake the internationalization process may have various motives, inter alia. (Johnson, Mattsson, 1993, p. 94):

● establishing a position on the market by new enterprises (*international extension*),
● strengthening of the position and development of cooperation between enterprises (*penetration*),
● increasing cooperation between various entities from different Member States (*international integration*).

Due to growing significance of internationalization and globalization, economies of European Union countries, governments of particular Member States, have to rely their politics on the development between small and medium enterprises. Many Member States support cooperation activities of their entrepreneurs from public founds what affect the success of enterprises on the other markets. Starting a business on the foreign market is linked with a investment risk as well as with large financial resources. The concept of internationalization affects economic politics of the European Union and is a part of the "Europe 2020" priorities including (Communication from the Commission, EUROPE 2020, p. 5):

● smart development: development of knowledge-based economy and innovations,
● sustainable development: supporting a more resource efficient, more environmentally friendly and more competitive economy,
● growth contributing to social incorporation: supporting a high-employment economy that ensures social and territorial cohesion.

The European Commission makes many changes in the scope of undertaking the cooperation between small and medium enterprises. Actions are aimed at supporting the cooperation of enterprises, create favorable regulatory framework and work for the benefit of the knowledge exchange. Direct actions are of big importance, which supports numerous initiatives promoting undertaking the cooperation or emancipation outside the domestic market. It is accessed that actions supporting internationalization of enterprises from the European Union create development opportunities and increase competitive capabilities of enterprises from European Union. In the view of the development of information and communication technologies, the communication and relocation in the context of European economy, what it is used by many enterprises for purpose of creating desired competitive position.

Small and medium enterprises do not only influence on the political decisions which can be included to external factors but also internal factors. The enterprises make a final decision whether they want to achieve desired position and function on the European market. However, in order for decisions related to the internationalization of activities to be made, the enterprise must have an established position on the market, have experience, knowledge, capital and development potential, these factors can be included in the internal resources that the company can use when undertaking internationalization. Raising awareness of clients and larger needs enforce on enterprises of SME sector more efficient use of external factors. The shift of consumers preferences from the standard products towards more personalized and adjusted to needs requires from

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enterprises flexibility and undertaking the cooperation with other enterprises. As a result SME enterprises can make a use of a niche and more rapidly adjust their internal factors in order to acquire group of clients and improve its competitive position. Due to the lack of bureaucratic processes and procedures characteristic for large enterprises, small and medium ones can faster start the internationalization and adapt to a new foreign market or to undertake the cooperation with a entity from a different country belonging to the European Union. The several forms of undertaking internationalization exist however the enterprise should take an advantage of the one which will help it to find its position on the market by using internal and external factors for the purpose of maximisation of the enterprise value. Small and medium enterprises constantly seek for market opportunities by adjusting their activities to the conditions changing in the environment. In the process of undertaking internationalization for enterprises from SEM sector important is the awareness of information. Access to valuable information and experience valuable for a given company creates development opportunities that allow you to gain a competitive advantage.

3   External determinants of   undertaking internationalization by small and medium enterprises

Uncertainty and dynamically changing business environment is to a large extent the result of turbulent changes taking place in the global economy. The external determinants influence decisions made in the internationalization of enterprises in the SME sector. The impact of these determinants affects the functioning of enterprises, as well as decisions related to internationalization.

The first of the major external determinants is the effects of the ongoing economic globalization. It is an irreversible process occurring in the modern world. Companies themselves have a large impact on global processes. Mimicking consumers' tastes in different countries and homogenizing global markets has been used by large international companies that supply standard, identical goods and services to people around the world (Buckley 2009, p. 131).

Internationalization of enterprises expands globalization using not only traditional paths of internationalization but also more advanced forms. Co-operation in the conditions of globalization is an opportunity to be able to gain the desired competitive position by extending the enterprise's operating framework. Taking advantage of globalization by small and medium enterprises increasing the scale and scope of business operations. Taking into consideration small and medium enterprises of countries belonging to the European Union, they face similar international problems as large entities. Many enterprises in the SME sector have to undertake internationalization to survive on the market. The impact of globalization on small and medium-sized enterprises operating in the EU is growing. The access to resources facilitated by globalization, the increase in the possibilities of supplying production factors, the increase in production and sales influence the decision to undertake the internationalization of the enterprise. Therefore, coordination and integration is an important success factor because it enables enterprises to operate on many foreign markets where they can use competitive advantages (Przybylska, 2018, p. 106).

Technological and technological progress is another important factor, inter alia information, communication, transport and production. Innovative production methods, the development of international transport, information technologies are a symptom of a globalizing economy that focuses on reducing the transaction costs of international business (Etemad 2004, p. 13).

Access to information significantly accelerates the company's internationalization process. Internet access to which is available for every small and medium-sized enterprise provides knowledge about the foreign market, as well as information about potential recipients and distribution channels. Many small and medium enterprises use the Internet as the main sales channel for their products and supplies. Modern technological equipment facilitates the functioning of enterprises by guaranteeing more efficient operation. Access to technologies gives cheap communication options with foreign entities. Often, electronic communication is sufficient for small and medium enterprises to undertake the internationalization process. It reduces the costs associated with the creation of commercial offices and the use of intermediaries. Transport plays an important role in the exchange between enterprises and the development of this industry affects small and medium-sized enterprises. It is becoming cheaper and faster connections to expand operations on foreign markets. Automation of production processes, implementation of modern technologies allows cheaper generation and shortening of the production process, thanks to which small and medium enterprises can become competitive on other foreign markets.

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Declining technology costs allow access for a smaller entrepreneur and as a result they can become partners to large enterprises (Knight, Cavusgil 1996 p. 13).

Market development also has an impact on the development of internationalization. Globalization has led to the unification of the market and its segmentation, which results in a product offer. Unified needs make it possible for companies to use similar marketing activities in different countries, such conditions additionally encourage companies to implement marketing strategies more quickly. The growing needs of customers are the reason for the development of products. Many large enterprises support subcontracting of the SME sector, thanks to which they can obtain an appropriate scale of production. This cooperation, which is caused by the development and segmentation of the market, is connected with the network approach to internationalization.

Another important external determinant of undertaking internationalization is the location of the enterprise. There is a connection between the location of the enterprise and the speed of internationalization. The location enables cooperation in the field of undertaking research and development initiatives with other enterprises of joint marketing activities, as well as those that will lower production costs or improve the efficiency of the enterprise. The right location, which will ensure on the one hand recipients, and on the other hand, suppliers, or specialized employees. Information technologies have reduced the importance of localization in many areas, but they are not able to completely replace the advantages resulting from the appropriate location of the company, i.e. (Rocha, Sternberg 2005):

- higher export intensity, wide geographical range, i.e.,
- Access to the infrastructure,
- access to a specialized workforce, relevant suppliers and specialized business services,
- wyższa skłonność do podejmowania innych form internacjonalizacji,
- lower transaction costs.

In figure 1. a direct impact on the decision related to the internationalization of small and medium enterprises has been presented. Internal determinants depend to a large extent on the organization of the enterprise. On the other hand, external factors directly influence decisions about internationalization and, as a result, action by enterprises. It is worth noting that external determinants depend on the conditions prevailing in a given country. Therefore, it is important that Member States care for stable, uniform conditions for enterprises in the SME sector in every country, which in turn will affect the development of cooperation and decisions and internationalization.

4 Internal determinant undertaking the internationalization by the small and medium enterprises

Internal determinants affecting the internationalization have the source in the enterprise itself. The connection of internal determinants with the enterprise itself speeds up the process of making a decision on undertaking the internationalization. Important internal determinants are inter alias.:

- possessing unique knowledge about foreign and product markets as well as technical and scientific know-how,
- large innovativeness,
- specialization,
- flexibility of operation.

The first internal determinant, which particularly deserves focus in the age of the economy based on knowledge is the possession of unique knowledge. Small and medium enterprises often lack material and financial resources necessary for undertaking the internationalization. The decision to expand abroad is based mainly on the availability of these resources. If the company has a unique intangible asset, it has great potential to achieve the desired competitive position. It should include technical and scientific knowledge. In international business the viewer possessed by the company is a determinant that accelerates and facilitates entering foreign markets as well as undertaking operations. Therefore, knowledge is a unique and difficult internal determinant that will outperform competitive enterprises. Knowledge is a key strategic resource. Small and medium

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enterprises are obliged to acquire knowledge about the foreign market and the ability to navigate on it. Appropriate knowledge of these markets is a success factor that allows you to gain benefits and internationalize. It is thanks to the resources of knowledge and financial resources available that the company can carry out research and development processes, which result in innovative products improved processes accelerating internationalization.

Another important determinant directly connected to the company's existing knowledge is innovation. Innovation of the company understood as the ability to generate ideas, products on foreign markets, as well as determination to create creative solutions resulting from the desire to meet challenges. The increase in the competitiveness of the European Union enterprises and the faster development of new technologies distinguishes innovation as an important internal determinant of the enterprise. Due to that fact enterprises can build a competitive position, implement niche solutions, shorten production processes, increase sales volumes and most importantly build a strong competitive position. If the enterprise has innovations, it has an increased chance of gaining an advantage on its competitors. From the perspective of cooperation, if enterprises are open to cooperation, then it is worth to undertake joint projects because it presents the potential of a given entity from which an enterprise can learn a lot. The time of implementation of innovations is also important - the faster the implementation, the greater the chance of gaining a wider range of clients.

Small and medium-sized enterprises often specialize in manufacturing, so in order to survive, they need to look for a large scale of sales, which means using knowledge about the market, proposing innovative products and distinguishing specialization that will meet the needs of buyers. Therefore, the next important internal determinant of the enterprise is product specialization. Along with the enterprise's specialization, there is important operational flexibility. Shifting the recipients' preferences towards more standard and specialized products tailored to individual needs requires enterprises to be flexible in their operations. Small and medium-sized enterprises are forced to adapt quickly to changes and demonstrate greater flexibility to gain a competitive advantage and in many cases survive on the market. Respond quickly to emerging customer needs and new markets, they can attract customers and provide a source of advantage. A strong focus on the specialization and flexibility of operations puts the company in a positive light because it is perceived as a good business partner (Przybylska, 2018, p.121).

Internationalization is often associated with high investment risk, which is why small and medium enterprises are not willing to take such actions. Depending on the industry in which small and medium enterprises operate, decisions about taking up activities related to foreign expansion can be undertaken or completely unprofitable. Enterprises constantly looking for market opportunities, those that undertake processes of internationalization of activities should pay attention to the determinants to which they have the greatest impact. Therefore, it is worth paying attention to the experience of employees and people in the enterpirse responsible for decision-making that lead to the processes of foreign emancipation. It is also impossible to forget about the global vision of running a business, education abroad and good language skills, which is a gateway to internationalization. Enterprises must also have proactive and innovative activities and use social and business relations in an appropriate manner.

5   Conclusion

Internal and external determinants influencing the decision about the time of foreign expansion, the form and place of internationalization depend to a large extent on decision-makers in the enterprise.

With the progress of globalization, maintaining international competitiveness of enterprises is becoming an increasingly difficult challenge, requiring a thorough modification of business strategies, as well as actions of public authorities. In recent years, an effective strategy is to internationalize and expand beyond the home market. The globalization process means that SME enterprises operating in Member States should be characterized not only by strong local ties but also by dynamic links with similar foreign initiatives, in order to gain benefits from access to innovative technologies, knowledge, markets and acquiring new experiences. This is reflected in the economic policy of the European Union, which launches various initiatives for the internationalization of SME enterprises.

Globalization and economic integration, and at the same time the development of communication and information technologies, make proper use of external and internal determinants become crucial for gaining the desired market position. The phenomenon of internationalization of SME enterprises intensifying in the

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world economy testifies to the next phase of evolution. European initiatives to increase innovation between entities in different Member States, allow for the creation of supra-regional and transnational cooperation links and the building of cross-border between enterprises operating in the European Union. Internationalization plays an important role in modern innovation processes, in which the importance of interaction and cooperation between individual entities of national innovation systems is emphasized. The internationalization of initiatives can bring various benefits related to a more intensive transfer of technology, knowledge flow and diffusion of innovation, in particular in the face of processes of technoglobalization, that is globalization of innovative activity.

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IMPACT OF INTANGIBLE ASSETS AND R & D ON STOCK PRICES OF COMPANIES LISTED ON LSE

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Abstract

Information and technology are currently forcing society to favor the globalization of the economy and to compete in the global market. This makes innovation a key factor in success in global competition. Adapt transition companies from traditional accounting to modern accounting that requires more information. This shift reflects a number of long-term economic and institutional changes in the economies. The articles will identify companies where the most significant differences between the nominal values of shares and their market value are. Companies will be divided into sectors according to NACE where the regression analysis will assess the significance of the reported intangible assets and the costs of science and research. The model will be estimated for companies quoted on the London Stock Exchange on the basis of annual panel data in the time series from 2009 to 2017.

Keyword
Intangible assets, pricing stocks, regression analysis

JEL Classification
M410, M490

1 Introduction and literature review

The contribution of this article is the identification of sectors where significant intangible assets that affect stock prices are significant. Investors should pay enough attention to intangible assets in these sectors to evaluate the correct share price. The results show that sectors with significant intangible assets are Accommodation and food service activities, Information and communication, Financial and insurance activities, Professional, scientific and technical activities and Human health and social work activities.

The current impact of information and technology forces society to favor the globalization of the economy and to compete in the global market. This makes innovation a key factor in success in global competition. This responds to the economic, political and social environment that has resulted in a higher level of globalization. In connection with the above from traditional accounting, we move to modern accounting, which requires more information. Improved reporting does not avoid intangible assets that increase their importance according to Ciprian et al. (2012):

- In 1978, intangible assets accounted for 5% of the assets,

- in 1998, intangible assets accounted for 72% of assets,

- at present, 75-85% of intangible assets.

Investment and economic growth in OECD countries are increasingly motivated by the knowledge capital that, according to Erik Sveiby, is made up of human capital, structural capital and customer capital. In some countries, businesses now invest more in knowledge capital than in physical capital, such as attitudes, buildings and facilities. This shift reflects a number of long-term economic and institutional changes in OECD economies. The Organization for Economic Cooperation and Development distinguishes intangible property into three groups: computer information containing software and databases, innovative assets containing company patents, copyrights and trademarks, and economic competences such as corporate human capital (major managers, etc.) and organizational know -how. (OESD, 2012)

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Choi, Won and Lobo (2000) examined the relationship between the reported value of intangible assets and the related cost of amortization of market values of companies. The results showed that intangible assets affect the value of the company. In view of these results, it is necessary to identify the intangible assets so that their value can be reflected in the value of the company's shares. In general, quoted market prices are the most reliable for determining the fair values of intangible assets (Kirk, 2009).

For enterprises that have unrecognized intangible assets, design pricing models are required for these assets. Accounting and reporting defines certain intangible assets, but the enterprise may have such economic resources that, according to current rules, are not recognized in accounting.

An example of these intangible assets is intellectual capital, which, however, does not reflect the current form of financial statements. This intellectual capital includes knowledge, experience and intellectual strength of employees and knowledge stored in organizations' databases, systems, processes, culture and philosophy. This intellectual capital is managed and used to obtain services and products with the ultimate goal of generating revenue. (Ciprian 2012)

The model proposed by Nevada and Lopez (2006) is characterized by the division of intellectual capital into three components: human capital, intellectual capital, and unidentified capital. In each component of the intellectual capital, the absolute indicators (investments) and the efficiency indicators, based on which the intellectual capital extraction is performed, are determined.

There are many companies that have similar intangible assets, but the current form of financial statements can not capture this intangible asset even though it is often a key determinant of the company's value. According to the authors, most accounting reporting changes have to deal with vertical disintegration (eg outsourcing parts of manufacturing processes) and sustained innovation. Intangible assets are the key determinants of innovations that are gained through investments in intangible assets. In Europe, there is an increasing interest in the reporting of intangible assets, which includes Mobilizing the Intellectual Capital in Europe (2005) and The Meritum Project (2002), which contains an instruction for the management and reporting of intangible assets.

Intangible assets are not properly reported in the company's balance sheets. The overwhelming majority of intangible costs for intangible economic resources - research results, partly developments are charged to costs due to strict criteria for recognizing an IFRS or US GAAP Impact Assessment (Lev, Daum, 2004).

The study Jerman, Kavčič, Kavčič (2010) focuses on the importance of intangible assets in economies in the transition period, such as Croatia, Slovenia, the Czech Republic, Germany and the USA. The results of the study show that intangible assets are an important asset for traditional market economies, as it has not been proven for economies in the transformation period. Despite the fact that many analyses underline their growing importance in today's business environment.

Also, studies from Dunes, Hutchinson and Goodacre (2004), Edvinsson (2000) have shown that the formation of the future value of the company is largely based on intangible assets such as IP and goodwill.

The lack of rules and information on the definition, valuation and reporting of intangible assets makes it difficult for investors and lenders to evaluate the intangible value of an enterprise before conducting the related investment and credit decisions (Tsai, Lu, Hung, 2016) Intangible assets become important and their identification and measurement have become a point of high concern to all users of financial statements. (Bohušová, Svoboda 2018).

2 Methodology and Data

Data are used from the London Stock Exchange (LSE), data available for 1925 companies. The data are obtained from the Orbis and Morningstar databases. I focus on intangible assets that can significantly affect the company's share price. Intangible assets are it the total value of intangible assets based on a balance sheet.

The regression analysis will compare the influence of intangible assets on the share price. Based on the results, NACE sectors will be determined, where intangible assets affect the company's share price. It can therefore be assumed that non-intangible assets will also be reported in these sectors.

The model will be estimated based on yearly panel data in time series from 2009 to 2017.

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The following regression analysis will be used to achieve the goal:

$$Y_i = \alpha + \beta_1 X_{i1} + \cdots + \beta_h X_{ih} + \delta_i + \varepsilon_i$$

where Y_i is the return of shares examined by company i, α represents a constant in the model, X_h is the h variables (equity per share, costs of science and research, intengible assets) affecting the share price of i company, $\beta_{i,h}$ determines the sensitivity of the i action's profitability to the h change, δ_i determines the sensitivity of this intangible asset to the share price of the joint stock company i, and ε_i is errost.

The OLS method will be used as a model with fixed effects. The reason is that companies are considered heterogeneous and must be looked for separately.

3   Empirical Results

The results of the empirical analysis are presented in the tables below. The results of Hausman test are in Table 5 in Appendix. The Hausman test shows that we have to use the OLS estimator with fixed effects.

In order to identify unrecognized intangible assets, it is necessary first to identify the sectors where these assets are most commonly found and subsequently to identify them with financial statements and the media environment.

Table 1 shows the first four models. The first model (1) includes the variable equity. The results show that equity capital positively affects the stock price of companies. Equity includes individual items such as equity, capital funds, other funds, past profit or loss and current period profit. It is proven that the reported profit increases the share price. Since the economic result is part of equity, a positive relationship is confirmed. The second model (2) includes the costs of science and research. We assume that if the company spends on science and research, it creates added value in the company, and in the future, it will probably generate higher profits. For this reason, the cost of science and research positively affects the price of shares. Intangible assets are added to the third model (3). Not all intangible assets have to be reported in the statement. For example, if there is a manager in the company that moves the company further and is indispensable to Steave Jobs or a good and functional system in the organization. The intangible assets in the sample represent an explanatory variable.

The results in Table 1 show that intangible assets are not significant for all firms. The fourth model (4) includes all variables. It is proved that the coefficients in the models do not change and the model is stable.

Table 1: Results for all firms

VARIABLES	(1)	(2)	(3)	(4)
Equity per share	9.135***	9.154***	9.129***	9.173***
	(0.128)	(0.143)	(0.132)	(0.144)
Costs of science and research		0.102		0.101
		(0.071)		(0.075)
Intengible assets			0.001	0.000
			(0.002)	(0.002)
Constant	2.498***	2.511***	2.493***	2.535***
	(0.227)	(0.300)	(0.250)	(0.307)
Observations	10,835	8,848	10,114	8,738
R-squared	0.358	0.351	0.360	0.352
Firms	1,734	1,313	1,587	1,291

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Standard errors in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 2 includes the results for individual sectors. Equity is significant in most sectors. In the "Professional, scientific and technical activities" sector, equity has a negative impact on the share price. This may be due to the fact that companies in this sector show a negative economic result, or unpaid loss from past years or valuation differences. There is also a positive relationship in this sector with the change of "Costs of science and research" and "Intengible assets". In Education and Arts, entertainment and recreation, the equity is insignificant. The mining and quarrying sector and the "Professional, scientific and technical activities" sector have significant costs for science and research. In the "Mining and quarrying" sector, the costs of science and research have a negative impact on stock prices. The development of science and research costs does not always have to be positive, the costs of science and research can also be negative.

In the "Professional, scientific and technical activities" sector, the cost of science and research has a positive impact on the stock price. This may be because investment in science and research increases the value of a firm, but it is not always a project that ends with a positive result. Significant intangible assets are in the sectors of "Accommodation and food service activities", "Information and communication", "Financial and insurance activities", "Human health and social work activities". In these sectors we can assume the importance of intangible assets and there is potential for the occurrence of intangible assets not reported.

Tab. 2 Sectors by NACE

VARIABLES	(5) Agriculture, forestry and fishing	(6) Mining and quarrying	(7) Manufacturing	(8) Electricity, gas steam and air conditioning supply	(9) Water supply; sewerage, waste management and remediation activities	(10) Construction	(11) Transportation and storage	(12) Accommodation and food service activities	(13) Information and communication
Equity per share	4.781***	14.339***	11.585***	15.779***	12.705***	8.417***	3.754***	15.325***	3.698***
	(0.503)	(0.586)	(0.251)	(2.523)	(4.472)	(0.861)	(0.863)	(2.542)	(0.125)
Costs of science and research	-0.999	-0.498**	0.110	0.968	-9.163	-0.035	8.542	-3.176	0.035
	(94.441)	(0.218)	(0.120)	(5.441)	(5.521)	(12.262)	(5.465)	(3.039)	(0.050)
Intengible assets	0.027	0.003	-0.001	0.003	-0.024	0.036	-0.019	0.149***	0.002**
	(0.983)	(0.003)	(0.003)	(0.063)	(0.041)	(0.054)	(0.019)	(0.020)	(0.001)
Constant	5.321***	0.211	2.762***	0.519	3.747***	2.823	6.014***	-2.814**	2.379***
	(1.177)	(0.361)	(0.952)	(5.227)	(1.098)	(2.254)	(0.498)	(1.088)	(0.156)
Observations	97	1,006	2,524	151	80	595	208	189	1,028
R-squared	0.525	0.409	0.496	0.238	0.123	0.162	0.282	0.357	0.501
Firms	12	140	345	22	10	92	28	30	144

VARIABLES	(14) Financial and insurance activities	(15) Real estate activities	(16) Professional, scientific and technical activities	(17) Administrative and support service activities	(18) Education	(19) Human health and social work activities	(20) Arts, entertainment and recreation	(21) Other service activities
Equity per share	0.096*	6.754***	-6.644***	18.608***	16.016	4.848***	1.871	7.257***
	(0.051)	(0.233)	(0.238)	(0.921)	(9.283)	(1.770)	(3.361)	(0.526)
Costs of science and research	-1.176	-0.915	1.466***	-0.147		-0.257	3.575	0.258
	(1.271)	(0.759)	(0.467)	(1.738)		(0.757)	(32.572)	(56.559)
Intengible assets	0.077***	0.070	0.020***	0.023	-0.313	0.034***	0.034	0.739***
	(0.007)	(0.209)	(0.007)	(0.059)	(0.300)	(0.012)	(0.317)	(0.045)
Constant	2.648***	1.348**	3.880***	-0.506	0.111	1.935***	12.719	-0.673***
	(0.145)	(0.566)	(0.290)	(2.641)	(0.066)	(0.455)	(9.839)	(0.177)
Observations	699	466	583	449	14	95	139	181
R-squared	0.176	0.682	0.621	0.515	0.514	0.176	0.003	0.763
Firms	139	65	88	62	3	18	24	38

4   Conclusion

Based on the first results of an intangible asset, they do not affect the price of shares if all sectors are included in the regression analysis sector. In case the regression model is applied to individual sectors, intangible assets have a significant impact in certain sectors. Investors in these sectors should pay sufficient attention to intangible activities to evaluate the correct share price. In the work it was proved that intangible assets are not significant for all sectors. Intangible assets have a significant effect on the share price in the "Accommodation and food service activities", "Information and communication", "Financial and insurance activities", "Professional, scientific and technical activities" and "Human health and social work activities". In these sectors, the potential for the occurrence of unrecognized intangible assets may be assumed, which may significantly affect the cost of the share. The contribution of the thesis is the identification of sectors in which intangible assets are significant.

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Appendix

Tab. 3 Descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Market price	12,847	7.073021	54.37785	.0010775	2861.461
Equity per share	10,835	4111471	2.96e+07	-4.00e+08	1.07e+09
Costs of science and research	10,054	1.68e+07	1.98e+08	-7.33e+07	5.51e+09
Intengible assets	12,381	3.61e+08	2.81e+09	0	1.33e+11

Tab. 4 Correlation analysis

	Market price	Equity per share	Costs of science and research	Intengible assets
Market price	1.0000			
Equity per share	0.7514	1.0000		
Costs of science and research	0.0404	0.0143	1.0000	
Intengible assets	0.0460	0.0188	0.4136	1.0000

Tab.5 Hausman effect

	Fixed effects	Random effects	Difference	
Equity per share	9.173446	9.39781	-.2243641	
Costs of science and research	.1010597	.0417916	.0592681	
Intengible assets	.0000661	.0025653	-.0024992	
	Test: Ho: difference in coefficients not systematic			
	chi2(3) = 8.88			
	Prob>chi2 = 0.0309			

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WHAT IS THE PRICE OF THE CONFLICT? DECISIONS IN THE LIGHT OF HUNGARIAN AND SPANISH ALTERNATIVE DISPUTE RESOLUTIONS.

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Abstract
The warnings of encouraging litigation seem to have fallen into deaf ears, as the number of incoming cases to courts are still on the rise. Nonetheless, to address disputes, there are also increasing numbers of mediation cases. This study compares alternative dispute resolutions in two different national contexts and reviews the possible advantages of this method in conflict management. Our study is intended to review if context can help explain the increasing popularity of alternative dispute resolutions? We examine the status of mediation, as an alternative dispute resolution procedure, in both Hungary and Spain, to compare this alternative to the court proceedings filed annually. The study addresses the question of whether mediation reflects a more economic driven mentality, and what the drivers for this type of resolution are. We also examine the cost to the parties involved in conflicts who choose mediation in both Hungary and Spain. The way conflict is resolved can vary, however acting on a basis of mutual trust in conflict resolution management method, helps to obtain a fairer resolution to the dispute and this can be systematically facilitated. This form of conflict management can also help enable the parties to take responsibility for themselves in resolving their disputes.

Keywords
Alternative Dispute Resolution, Conflict Management, Mediation, Litigation.

JEL Classification
K00, K19, K36, K40, K42

"Discourage litigation… As a peace-maker the lawyer has a superior opportunity of being a good man."
– Abraham Lincoln, 1850

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1   Introduction

Conflict is everywhere. It can be found in human interactions as well as business interactions. Companies involved in formal conflict, search for lawyers and leaders that resolve conflict in an efficient way. This means not only to address the issue of conflict and come to a solution but also to do so with the best use of resources possible and that assures a final solution rapidly. In the last quarter century, alternative dispute resolutions (ADR) has become an increasingly efficient and popular strategy to conflict management. Among the most well-known ADR methods are mediation, conciliation, negotiation and arbitration (Lieberman, 1986)

Litigation present a series of inherent disadvantages for companies - the parties lose control, the lawyers and the judicial system have power over the timing and procedure of the conflict resolution, and in result, disputes can take years to come to any resolution. The parties lose the ability to communicate with each other in order to resolve the problem. This causes most business relationships to be ruined and erodes trust and cooperation. Also, the costs of litigation increase significantly due to delays and (mostly) the lawyer's fees. The companies that become embroiled in litigation can lose its competitive advantage.

On the other hand, ADRs have become progressively common due to the advantages to litigation such as benefits in costs, simplicity and maintenance of the power of the entire state of affairs. In case of usage of these methods, a resolution is only reached if both sides accept to engage in this voluntarily. This own-willed approach to a conflict management implies a rationalized approach to the conflict at hand. This same rationalized approach also looks to quick conclusions that allow to construct a scheme to frame the relationship to prevent future disputes.

While there are some notable nuances between the different ADRs, they share the common feature: the dispute is mostly decided by the parties involved and less power is given to the third party involved (i.e. mediator, referees). Whereas in the case of litigation, the jury is granted absolute powers for the resolution of the conflict and to enforce this resolution. In mediation, the parties determine the result of the dispute and are in power of the conflict management the whole time while in arbitration, the result is determined in accordance with a rule, the law applicable. In both cases of ADR, when deciding on a result, the parties can take account for a wider range of rules, and in particular, their respective commercial interests (Bercovitch, 2001). Therefore, mediation and arbitration are procedures based on interests and rights. The fact of taking commercial interests into account also means that the parties can decide the result by reference to their future relationship rather than solely by reference to his past conduct.

As stated by Abraham Lincoln, the role of lawyers in conflict management should be that of a facilitator, and conciliator. If lawyers fail to do so, they will only magnify the divisiveness and become part of the problem, rather than part of the solution (Reavley, 1990; Nies, 1991). This leads the conflict to transform into a destructive phase in which the parts are adversarial and confrontative. This destructive phase is an outcome that is not desired by the parties and that results in increase of costs, resources and impedes dispute resolution. The relationship between opposing parties and their capacity to cooperate and even trust the other party in their capacity to manage conflict the conflict can be resolved more rapidly, with less cost to the parties and in a constructive manner. This type of resolutions may even help rebuild connections, restore matters to its original state, create new relations between parties and develop communications between them.

The term conflict (Coser, 1956; Dahrendorf, 1959; Pondy, 1967; Fink, 1968) has no single clear meaning. Much of the confusion around the definition has been created by scholars in different disciplines who are interested in studying conflict. Reviews of the conflict literature show a conceptual sympathy for, but little consensual endorsement of, any generally accepted definition of conflict. There is tremendous variance in conflict definitions, which is mainly defined according to two approaches. First, a more specific approach which includes a range of definitions for more particular interests or areas. Second, a broader approach which include a variety of more wide-ranging definitions that attempt to be more all-inclusive in the subject matter. We use the definition of Rahim (2011) which is more of a broader approach. According to this author, "conflict can be considered as a breakdown in the standard mechanisms of decision making, so that an individual or group experiences difficulty in selecting an alternative". Conflict is even published by authors on the side of

peace: "Peace is nothing more than a change in the form of conflict or in the antagonists or in the objects of the conflict, or finally in the chances of selection." (Coser, 1998:21)

Some important aspects to consider regarding the nature of conflicts are the intentions, motives and evolution of the interests of the parties involved in the dispute. If the parties are focussed on one aspect of the nature of the conflict and mistrusts the opposing party, this might escalate and impede alternative dispute resolutions. In acting as problem-solvers and looking to resolve the conflict, the parties develop some trust in the conflict management process. This can be seen as a: "agree to disagree" approach to conflict. The development of trust between parties, even though they disagree on an issue, can be an asset and may help reduce transaction costs. This approach favours ADRs methods such as mediation or arbitration. (Cserépi, J, 2017).

2 Country state of affairs

2.1 Hungary

In the case of Hungary, the conflict management revolves around different litigation costs. Some of the most important costs are signalled in the study. In the case of litigation, which continues as the most popular formal conflict management procedure there are several costs to bear in mind. First, one can clearly compare the type of costs a plaintiff might have during a civil procedure. To this point, a plaintiff reviews general data about court fees. Regarding the court fees, the most significant question is the cost of court fees which depends on the value of the cause of the lawsuit.

Another important cost other than court fees is the court fee duty which has to be paid before or simultaneously with the filing of the complaint. This duty can amount to 6 per cent of the disputed claim, (therefore this is not a fixed cost, rather it is proportional to the amount of the dispute).

In other alternative dispute resolution methods and civil and non-litigation proceedings, this fee is based on, unless otherwise provided by law, the value of the subject-matter of the proceedings at the beginning of the proceedings and the value of the claim or part of the claim disputed in the appeal proceedings. When the value of the subject matter of the proceedings cannot be determined, and unless otherwise provided by law, the basis for calculating the fee of civil litigation shall be:

- 1089€ in litigation before the district court and 622€ in non-litigation proceedings;
  before the Tribunal:
- 1867€ for litigation at first instance and 1089€ for non-litigation proceedings,
- In appeal proceedings, in the case of litigation, 933€ and in non-litigation proceedings 529€,
- In appeal proceedings before the court of appeals, in case of litigation 1867€,
  in non-litigation proceedings 933€;
- Retrial procedure: 1556€ in appeal proceedings
- 2178€ in the review process (1990:XCIII. Act on Fees)

If a party states several claims arising from a legal relationship or from several legal relationships in a proceeding, the total value of the submitted claims shall be taken into account in determining the value of the subject matter of the proceedings.

- The fee for the divorce is 93€. It is not possible to take into account the value of the claim for the settlement of the housing usage in a marriage dissolution claim when determining the fee. If the party claims other property rights, only a portion -over divorce case fee- will be paid.
- Fees for labour disputes - if the value of the subject matter of the proceedings cannot be established - 31€.

In Hungary, the costs of the fees of experts, translators, interpreters and the compensation of witnesses are also regarded as procedural costs. Other costs in connection with the court procedure are the costs of administrator trustees, the costs of inspections conducted on premises (cost for *"going over"* or local inspection) and the costs of the courts' correspondence.

The numbers of incoming cases point out that seemingly the litigation in Hungary are avoided. Perhaps people and decision makers have changed their minds and increasingly make the choice to choose ADR methods. Between 2010 and 2016, data provided by registered mediators shown in Table 1 demonstrate that successful

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cases vastly overwhelm unsuccessful cases when using ADRs. In the graph exhibited in Figure 1, also demonstrate the superiority of what parties consider a successful resolution to the conflict through the mediation process.

Table 1: Mediation cases in Hungary

	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Successful (blue)	216	708	370	589	851	864	983
Unsuccessful (yellow)	63	203	160	204	260	487	400

Source: Prepared by the authors based on data of Ministry of Justice, Hungary 2018

Figure 1. Incoming cases to registered mediators at Ministry of Justice Hungary 2010-2016
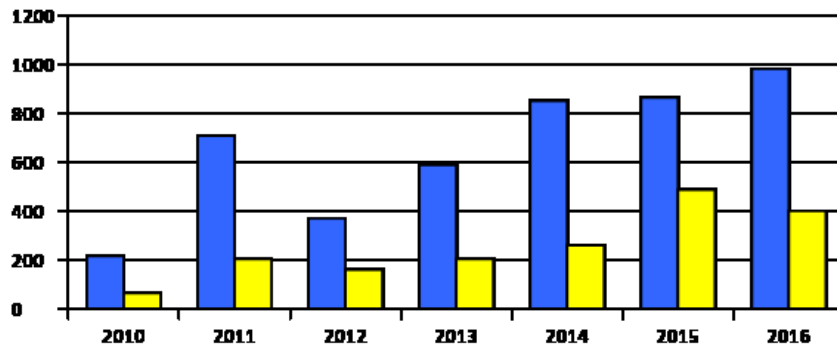
Source: Prepared by the authors based on data of Ministry of Justice, Hungary 2018

As presented in Table 1, there is a tendency of stable increasing in both –successful and unsuccessful ended incoming cases beginning in 2014. Based on the data presented in the table, an increase in ADR methods seems to be taking place, what might suggest more constructive and efficient methods of conflict management are taking place. This is despite the fact that Figure 2 shows the increase of litigation cases in numbers, and these figures show at the least very minor decreases, stagnation, or growth in litigation in all areas, except for one group of cases. This group is civil and business non-litigious cases, which data for 2010 shows to have decreased by 39% compared to 2009 figures and then decreased by 83% from 2010 in 2011.

The cycle of civil lawsuits between 1990 and 2016 can be said to have occurred as a result of the fall in the number of non-litigious procedures, and the burden of the courts that has been reduced from the year 2010 as depicted in Figure 2. Based on data about the cases, trials at Hungarian courts provided by the Hungarian Central Statistical Office clearly demonstrate that, in 2010, the total number of cases, decreased by 24% from 2009 to 2010. This shows the effect of the legislative change that a major group of non-litigious cases, as payment orders are mostly made by notaries.

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Figure 2. Changing of cases, trials at Hungarian courts 1990-2016
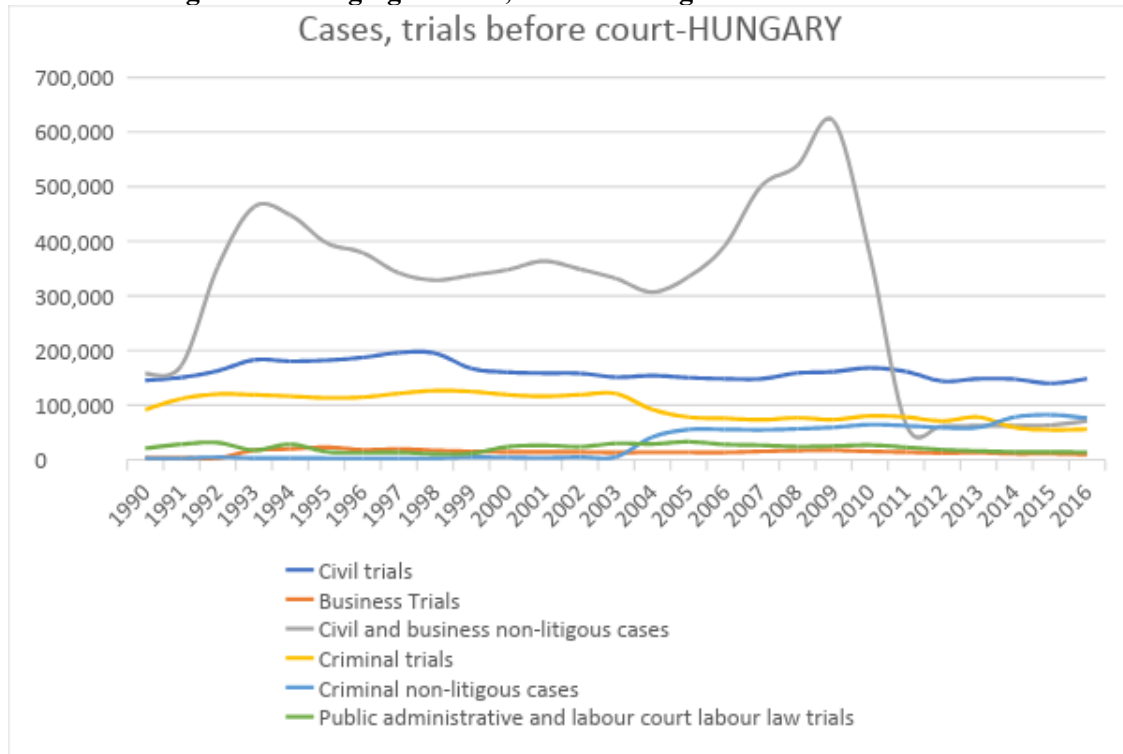
Source: Hungarian Central Statistical Office Hungary, www.ksh.hu

Alternative Dispute Resolution in Hungary

One example to introduce the difference of costs: Hungarian Financial Arbitration Board. As a member of the FIN-Net international organisation, since 2013, the Board is also available for the management of cross-border consumer disputes. It accordingly helps the respective plaintiffs resolve their disputes with a financial service provider (bank, insurer, investment firm, etc.) operating in a different member state, relying on the alternative dispute resolution forum of the specified country or, if this is not possible, find an alternative dispute resolution forum that is able to resolve the case through conciliation or mediation.

What are the costs of the procedure of the Hungarian Financial Arbitration Board and who should pay it? The procedure of the Financial Arbitration Board is free of charge, no procedural fee or fee duty is charged to the consumer or the financial service provider. However, costs may be incurred by the parties during the procedure. The cost of the procedure is deemed to be the costs incurred by the parties in connection with the use of the Financial Arbitration Body's proceedings, subject to the requirements of a reasonable and in good faith procedure (cost of preliminary inquiries, consultation and correspondence, travel expenses and loss of earnings, etc.). In the case of a binding decision, provision shall be made for the amount of such other costs and for their payment. The cost of the proceedings shall be borne by the party against whom the matter was decided by the Council. The results obtained when analysing Hungarian data seems to indicate that, as pointed out by Ábrahám & Eörsi (2003) it is bad to litigate.

2.2 Spain

The conflict management for litigation processes in Spain is complex due to the combination of relations between the various legal operators and the authorities several different authorities (autonomous) that make up the public judicial administration. The judicial system is often criticized for the excessive slowness on the one hand, opaque functioning (particularly for citizens), and because its considered to be excessive or disproportionate regarding its costs.

There have been notable efforts of the Central Government and the Autonomous Communities Governments to improve the efficiency and effectiveness of the services offered by this public service. Efforts have been

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concentrated in two fronts: First, through the creation of public offices that provide a structure for the various legal professionals (lawyers, prosecutors, and experts to a lesser extent). Second, the governmental agencies have adopted a tariff regulation specifically designed to protect people from risks that may result from a lack of information. Nonetheless, there are still many legislative loopholes and several instances found through litigation that are seriously damaging to citizens and make processes unnecessarily long.

The total cost of a procedure depends not only on the professionals who will be involved, but also on the nature of the dispute of the type of procedure and its complexity. To any of the fees that plaintiffs face, a fixed fee for right of procedure is added that is calculated according to the dispute and the person (physical or juridical). Tax fees have to be paid before any introduction of proceedings. Intervening agents, translators and interpreters may also be involved depending on the complexity of the dispute, which will result in a higher cost than the mere intervention of a lawyer and a prosecutor. The lawyers' fees will vary according to the Autonomous Community and the territory of this according to the province. In fact, each Bar Association (i.e., Madrid, Castile and Leon, Barcelona, Andalusia) publishes its own criteria for guidance on fees, while the rights of prosecutors are set for the entire territory of the Spanish State and the Fixed procedure fee is also a national tax.

Plaintiffs can obtain an idea of the proportion of each cost in proportion to the value of the disputed claim (even though some are not stated according to the value of the dispute and are fixed taxes). A regular litigation process in Spain is more or less reflected in these costs:

Court fees	10% - 30%
Bailiff fees	5%-20%
Lawyer fees	80%-95%
Expert fees	5%-15%
Witness compensation	1%-3%
Translation/interpretation	10%-20%

When analysing litigation processes in a more international viewpoint, the legal costs can be considerably higher, precisely because of the cross-border nature of the dispute. In these cases, plaintiffs should consider the increase in the costs of translations and interpreters, of witnesses and lawyers travel, if deemed necessary. Increase in costs are also manifested in the more expensive costs for notification or execution of decisions, or those related to the obtaining of evidence. All of these cross-border litigation costs can be a barrier to access to justice, and increase the transaction costs for litigation, primarily to individuals and small companies.

The fixed fee for cost of procedure (bringing the conflict to the courts) mentioned previously are generated according to a fixed scale. These costs are represented in the following manner:

- In civil matters the fixed costs range from 90 to 600 € according to the procedure:
    - 90 € for civil proceedings oral and negotiable instruments.
    - 150 € for ordinary procedures, judicial liquidation of companies, or forced execution of enforceable titles of extrajudicial origin as stated in Article 517 of the Code of Civil Procedure.

– In administrative litigation matters, the fixed cost is:
    - 120 € for a quick procedure.
    - 210 € for an ordinary procedure.

To the taxable base litigators add a variable cost according to the applicable percentage which varies, according to the rules of procedure between 0,5% to a maximum of 1 million euros and 0,25% of the amount of the litigation decided by a judge, but never exceeding 6,000 €.

To this fixed procedural tax may be added, if the proceedings so require, costs relating to the copies of the application and the attached documents to be submitted at the same time as the lawsuit. Each copy must be accompanied by as many copies as there are parties to the proceeding, the original documents must be delivered to the judge. These other procedural costs also include obtaining, once the judgment has been rendered, original documents brought to the proceedings and that each party is entitled to be returned. While these might not

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seem to be elevated costs, and depend on the issue of the conflict and number of parties involved, they may prove to be relevant if there is an elevated number of parties and subject matter.

These expenses are paid by the public prosecutor, who presents to his client a bill of fees that takes into account these fees and whose rates set by Royal Decree 1373/2003 of 7 November published in the Official State Gazette no. 278 of November 20, 2003 and are as follows:

- To obtain and authorize copies, the public prosecutor will receive the sum of 0,16 euros per sheet (Article 85).
- For any request to the court of restitution of the documents or obtaining a copy of the judgment rendered certified in conformity with the original the prosecutor will perceive the sum of 2.97 €, (article 88).

Article 24 of the Royal Decree also provides that the parties shall pay the following procedural costs:

1.- For each request for the provision of a deposit, for the presentation of documents outside the time allowed for the presentation of evidence, for the lifting and cancellation of a confiscation, for the determination of the amount of the procedure, for an adjudication, a subrogation of rights or a withdrawal, the public prosecutor will receive the sum of 22,29 euros for each one of them.

2.- For each request for measures to provide a guarantee to the creditor, such as the anticipated methods of proof, the preventive entries of confiscations entered on the public registers such as those of the property and their extension, the opposition to the confiscation by a third party, confiscation of remuneration, increases in the amount of confiscation, and confiscations of convictions in absentia, the prosecutor will receive the sum of 37.15 euros.

3.- For the patrimonial investigation carried out, the public prosecutor will receive the sum of 30 euros.

One of the mentioned shortcomings of the litigation process are its many (and long) phases. After a first lawsuit is filed, there are several appeal processes that might be taken. This of course impacts in the length and duration of the conflict. Some of the costs related to these appeals are:

Fees for the payment of a fixed procedural right for judgments that may be the subject of an administrative appeal, this appeal can be both before the civil court that before the administrative court contentious in case of judgment at first instance, or an appeal in cassation against the judgments of the Court of Appeal as described in Article 35 of Law 53/2002.

As in the first instance, this right includes a fixed share according to the procedure and the jurisdictional order, and a variable rate whose result is obtained by the application, at the tax base determined by the procedural laws, of a pre-established rate according to the following scale:

- The fixed share in both the Civil Juridical Order and Administrative Litigation:
  – 300 € for appeal proceedings.
  – 600 € for the appeal in cassation (last instance/high court).

- Variable rate: From 0 to 1,000,000 € the applicable rate is 0,5%
  – For the sums above the applicable rate is 0.25%, up to a maximum of 6.000 €.

Alternative Dispute Resolution in Spain
Spanish ADRs are regulated internally by arbitration laws. The two-main national legal resolutions in Spain regarding arbitration as ADR are Law 60/2003 and Law 11/2011. These regulations have coexisted with the European Convention on International Commercial Arbitration of Geneva of April 21, 1961, which was also ratified by Spain on March 5, 1975. A few years ago you could talk about arbitration as a closed box, which had unintentionally acquired an elitist nature applicable only to international commercial arbitration. Thus, Spain has a long legal tradition in conflict management with the usage of ADR.

There are several out-of-court dispute resolution mechanisms found in criminal, civil or matrimonial, commercial, social or consumer protection matters. The ADRs that are more typically employed in Spain for conflict management are conciliation, mediation and arbitration. Some of them are compulsory before beginning a litigation process, in particular in social law where the worker must submit a prior request in case of dismissal before the Mediation, Arbitration and Conciliation Centre, before resorting to the jurisdictional

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route (last option). In this case these are provided as free public services. The worker may decide to appear alone on the day of the conciliation or accompanied by a lawyer, who will present him a bill of honour. The fee for the orientation criteria to the lawyer is provided in Article 6.1.a) that recommends that in case of conciliation of social conflicts, to fix the fee per minute from 150 € for the drafting of the conciliation request and to a minimum of 200 € for the appearance at the conciliation hearing if the resolution was not in favour of the employee .In case the resolution is in favour, the article recommends applying factor of 1, on the basis of one year's wages and the wages due from the submission of the application until on the date of amicable resolution of the conflict, and a minimum of 400 € if the sum obtained in the resolution was lower.

For disputes settled under the Arbitration Act 36/1988 of December 5, this regulation provides in Article 16 that unless otherwise agreed, the arbitrators may require the parties to pay a deposit the amount of which will be fixed according to the costs of managing the procedure and the fees of the arbitrators.

Lastly, family mediation is also provided for by Acts approved at the level of each Autonomous Community, such as the Law 18/2006 applicable in the territory of the Autonomous Community of the Balearic Islands or the Law 4/2001 of 31 May for Galicia). This is a private service, the mediator's fees (usually a lawyer, a psychologist or a social worker) will be set according to the complexity of the situation exposed by the parties. The bar fees criteria approved by the Bar of Barcelona stipulate in their article 2.4 the prices practicable by any lawyer brought to play mediators or referees. For example, in the case of arbitration, it is recommended not only to the lawyers who can represent the parties but also to the arbitrators the application of the criterion 4.5 in the same terms as for the ordinary civil procedure, that is to say a note fees of a minimum amount of € 1,000 if the amount obtained is lower, except for consumer arbitration.

The famous traditional Spanish law firm Roca Junyent, The University of Comillas and the Association Corporate Counsel Europe (ACC) presented in 2018 the First Study of Arbitration in Spain, in which this ADR procedure is analysed as an alternative in the determination of conflict resolution between companies. The study shows that arbitration begins to be an established method of dispute resolution in Spain, although it still has a long way to go if we consider its use in other jurisdictions. According to their survey, 53% of the companies surveyed still prefer to use litigation, however arbitration is an extended practice in the remaining 47% of companies, either as a single instrument or together with other methods of alternative resolution. The growing trend of ADRs seems to point to a more cost-effective strategy and one that has as objective a more cooperative resolution of disputes.

3 Data collection

To go deeper into the topic of analysis, we contacted experts on the subject. The profile of the subjects were lawyers, businessmen and officials from both Spain and Hungary. We consulted them on the topic of analysis, the research tool used was a survey. The survey can be defined as a primary technique of obtaining information, based on an objective set of people. The data collection is made up of a series of questions that the researcher administers and applies to the people of analysis in order to obtain the necessary information to determine the values or responses of the variables in the study. (Malotra, 2018).

The study made a questionnaire in the subject of costs of court proceedings and costs of alternative dispute resolution in the countries mentioned. In each country 20 expert people were contacted and responded the questions. The questions of the study focused in asking about the cost of litigations and cost of ADR, specifically:

1. Do you know the difference regarding the formal method of conflict resolutions: a. ligations (Court proceeding) or b. the the costs of alternative dispute resolution (ADR) such as Mediation and Arbitration?
2. Are the cost of alternative dispute resolution (ADR) inferiors to the litigations (Court proceeding)?

- The 45% of respondents know the differences between the ADRS and the cost of litigation because they have heard it from other people, such as: acquaintances, friends, colleagues, lawyers.
- The figure shows that 30% of respondents know the differences between ADRS and the cost of litigation because they experience with them.
- The rest of the participants 25% they cannot provide information about it. In many cases, companies/Businesses do not know about their existence, which is an obstacle to its potential use.

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Figure 3. Identification of differences between methods of conflict resolutions (ADR/Litigation) in Hungary
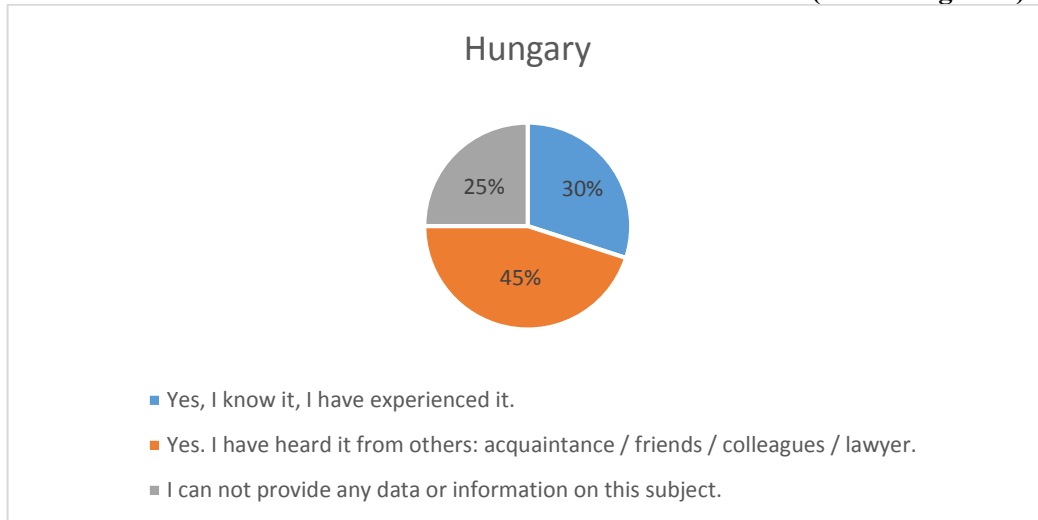
Source: own research

- The figure shows that 55 % of respondents know the differences between ADRS and the cost of litigation because they experience with them.
- The 35% of respondents know the differences between the ADRS and the cost of litigation because they have heard it from other people: Acquaintance, friends, colleagues, lawyers.
- The rest of the participants 10% they cannot provide information about it. Some define ADR as parallel judgments and this positioning is detected in other interviews.

Figure 4. Identification of differences between methods of conflict resolutions (ADR/Court Proceeding) in Spain
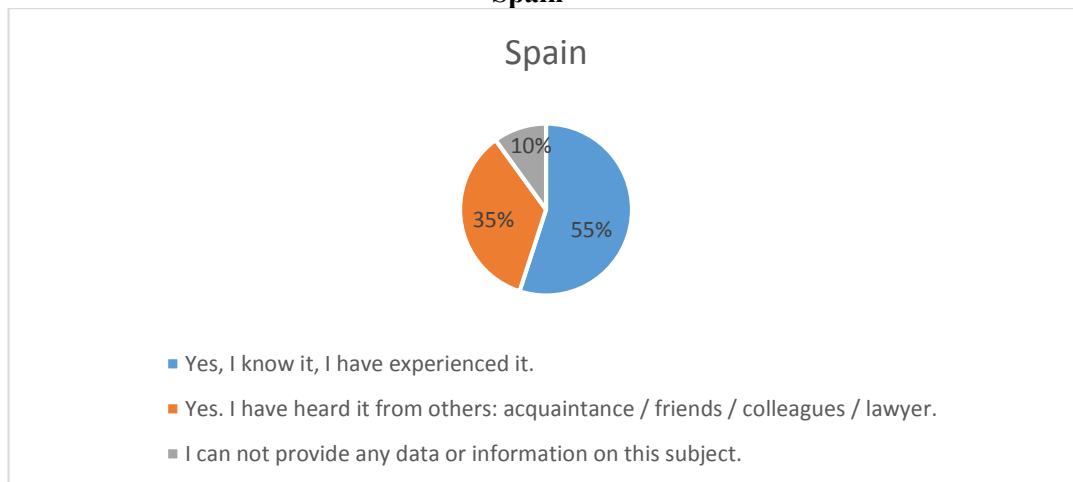
Source: own research

In Spain most participants know the difference between ADR and Cost of litigations because they have experienced with them. Regarding Hungary most participants know about the difference because they have heard it from another person (Lawyer, colleagues, friend, acquaintance). It is important to highlight that one of the motives of the unawareness of the conflict resolution methods is the limited knowledge that exists of methods that comes from press releases and publicity campaigns from the Chamber of Commerce to advisers or articles in the press in both countries.

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Figure 5. Comparative figure with information of both countries (Hungary and Spain) regarding question 1.
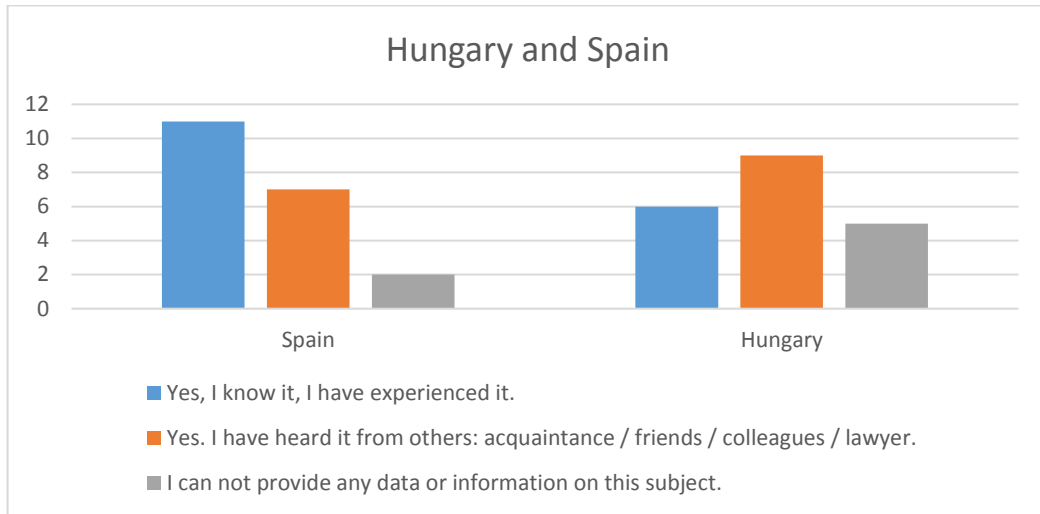
Once we had asked of the knowledge of the formal conflict management options, we focus on the knowledge of the cost implications of each of the strategies. We then asked about the awareness of the cost relation and to know about the reputation or experiences of the experts we have consulted.

The 45% of the participants knew about the inferior cost of ADR because they have heard it from others (Acquaintance, friends, colleagues, lawyers).

The 30% of participant knew that the cost of alternative dispute resolution (ADR) are inferiors to the litigations (Court proceeding) because they have experienced it. The rest of the participates (25%) can not provide information about this cost differences.

Figure 6. Perception of Cost of ADR inferiors regarding the cost of litigations in Hungary
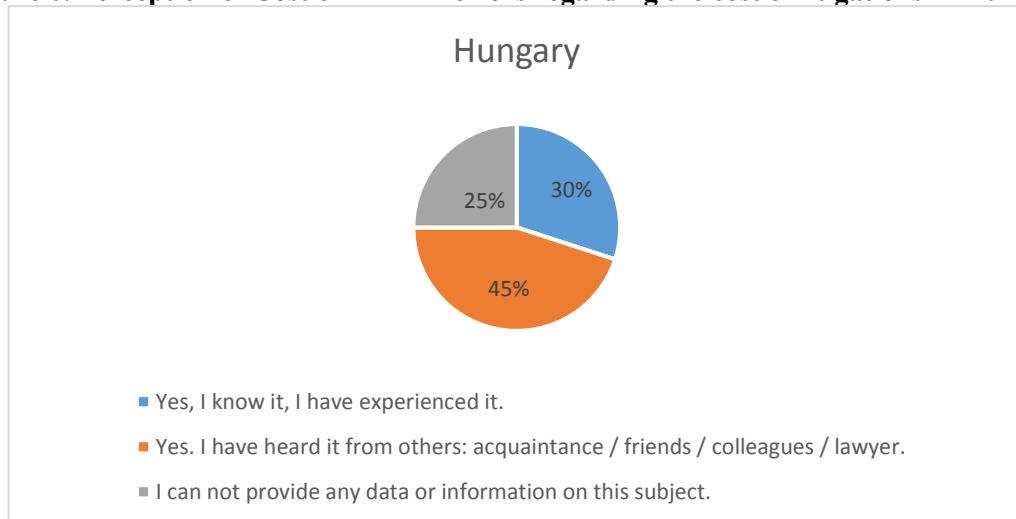
Source: own research

In Spain the 45% of participant knew that the cost of alternative dispute resolution (ADR) are inferiors to the litigations (Court proceeding) because they have experienced it. The 35% of the participants knew about the inferior cost of ADR because they have heard it from others (Acquaintance, friends, colleagues, lawyers). The rest of the participants (20%) cannot provide information about this cost differences.

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Figure 7. Perception of Cost of ADR inferiors regarding the cost of litigations in Spain
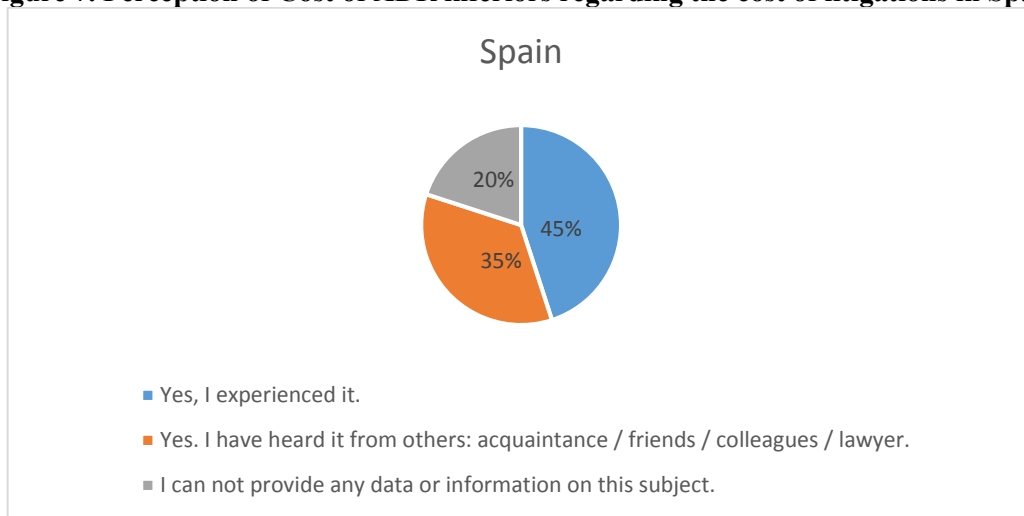
Source: own research

In Spain most participants know about the inferior cost of ADR because they have experienced with them. Regarding Hungary most participants know about the difference because they have heard it from another person (Lawyer, colleague, friend, acquaintance).

Figure 8. Comparative figure with information of both countries (Hungary and Spain) regarding question 2.
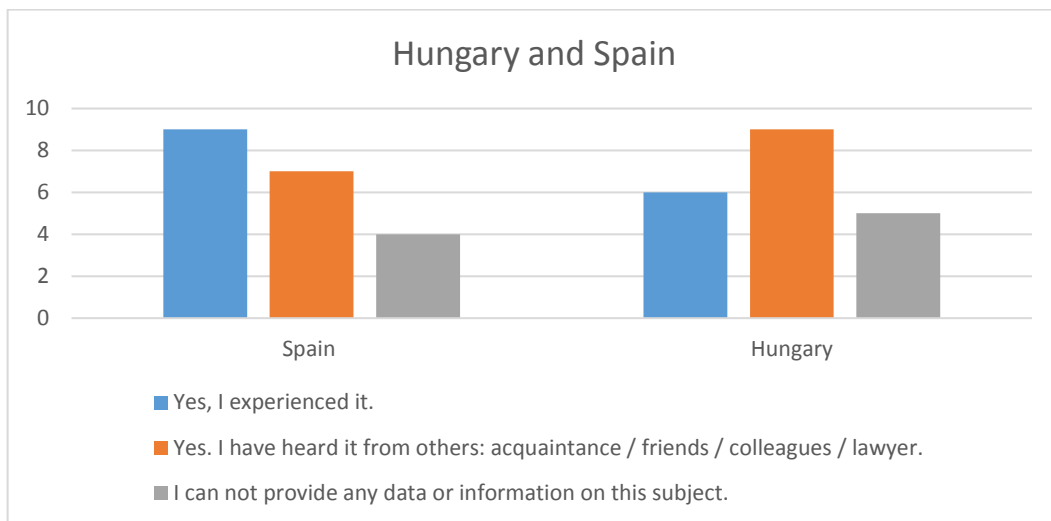
Source: own research

5 Conclusion

The results of this study suggest that according to the current data of proceeding fees, alternative dispute resolution in terms of cost, are a more economical alternative in conflict management as they allow a more expedite resolution. In addition to court proceedings, alternative dispute resolution (i.e. mediation, arbitration) is another way to achieve a lasting more peaceful solution to conflicts. As it allows the parties to maintain the negotiation power necessary to conduct the conflict management, it helps them keep communications open. This also seems to be hinted in the respondents' answers to the above question in this study performed in Hungary and in Spain. There is an almost 50% divide in those who prefer to compromise and will even accept a certain loss of power in order to obtain a better resolution. The study highlight the significance of power relationships in conflict management and the selection of ADR. The preference towards ADR is an indication that parties see the conflict resolution as an opportunity to grow and progress the relationship with other parties rather than a battel that must be won. As the Spanish saying suggests: "It is best to have a bad resolution than

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to have a good conflict". There is also indication of a 50% chance the conflicts is resolved satisfactory for the parties.

Despite the many advantages of ADR, particularly in international deals, it has come paired to an increase in litigation. The purpose of conflict management should not be victory but rather progress and compromise in the disputed issue. In mediation, turning to trust to parties and cooperation is a step forward in conflict management. This paper aims to be progressive in the sense that it emphasizes the importance of trust as a basis for conflict management, connectivity between parties in a dispute resolution and peaceful settlement.

Results in different contexts do not signal significant differences in the selection of ADR or litigation as conflict management strategies. The conditions under which ADR are chosen in conflicts (particularly in international conflicts) have not yet been fully reviewed. This study brings attention to the effect of context on this choice. The findings point to a general increase in ADR in both contexts, while litigation seems to be on the rise as well at a slower pace. This suggests that firms are eager to find more cost-effective solutions and that conflict management positions that are less confrontative are increasingly preferred. The study postulates that formal disputes that are characterized by willingness of the parties to settle peacefully, maintain cooperation and surrender a position of power to reach a better resolution for the parties will increasingly pick ADR over litigation procedures. This is a promising outcome as companies seem to be looking to diminish the cost of conflict in different contexts.

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COMPARISON OF CORPORATE SOCIAL RESPONSIBILITY PROGRAMMES WITH THE ANP METHOD

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Abstract

Corporate social responsibility is a wide and popular topic in both academic field and a business environment. Complex CSR strategies are typically used in bigger companies. However, due to the popularization of the topic and its benefits, more companies are implementing activities to ensure responsibility to all their stakeholders. Complexity of the topic makes it difficult to assess the level of CSR in a specific company, thus the comparison of various business subjects is not usually possible. The aim of this paper is to evaluate corporate social responsibility of selected companies, using multicriterial decision making method ANP. In addition, acquired results from evaluation are used for comparison of selected companies. Complex overview of relevant CSR factors, their evaluation and comparison are also possible to use for deeper understanding of decision-making process in compliance with CSR activities.

Keywords

Corporate social responsibility, Corporate social performance, Analytic Network Process

JEL Classification

M14, M40, Q56, C38

1 Introduction

Competition in the general business environment is based on individual firm performance, which is possible to measure, evaluate and compare with other subjects. Measurement of company performance is usually based on quantitative factors, mostly related to the field of corporate finance. It is possible to see annual changes in financial statements, we can also count created value to the shareholders with various methods and complex indexes. Nowadays it is possible to perceive certain need for sustainability for which could the business world be very beneficial source. This need created a shift to more wide understanding of evaluation firm activities in recent years from only financial to more sustainable approach. Mentioned concept is called "Corporate social responsibility" (or CSR), which is possible to describe as a firm responsibility for all their stakeholders.

CSR is a broad topic, that still must be standardized for wider adoption of CSR programmes in firms. Due to qualitative sections of firms' social responsibility, it is also difficult to measure and compare these activities between specific subjects. This paper is focused on evaluation of CSR program of four selected companies and comparison, based on multicriterial decision making method called Analytical Network Process (ANP).

2 Defining Corporate Social Responsibility

In literature it is possible to find Corporate social responsibility in various related topics. Firstly, there has been a theoretical approach to better understanding what the responsibility to stakeholders mean and why is it important. Arguably it was Howard R. Bowen (1953), who came up with the term "Social responsibility". Furthermore, the term gained attention in the academic sphere and in 1960s and 1970s, many researchers contributed to the theoretical understanding of Corporate social responsibility. Notable academics in the field are for example Davis, Frederic or McGuire. Other definitions were created in 1970s by Harold Johnson, who presented new concepts for society and business. In 1979, there was presented a framework by Archie B. Carroll, that standardized sections, which are included in Corporate social responsibility. (Carroll, 1999).

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Following years are notable especially for more research and empirical approach to Corporate social responsibility. Empirical studies focused mostly on CSR and profitability or financial performance, such as the research from Cochran and Wood (1984). Further studies incorporated terms Corporate social performance, which contributed to more understanding of relationship between CSR activities and corporate performance. (Carroll, 1999). Contribution to the outcomes of Corporate social performance is also possible to add to Wood with emphasis on connection between business and society. Later definitions also highlight importance of firms' influence on their surroundings, such as Kotler and Lee (2005) defining CSR as a commitment to improve community well-being with business practices and corporate resources. Current application of CSR theory is typically connected with triple bottom line. This concept is based on three dimensions: people, profit, planet. (Elkington, 1999) Thus activities of corporate social responsibility are divided into the economic, social and environmental sections.

2.1 CSR Measurement

Evaluation and further comparison of specific CSR programmes is difficult, considering qualitative data and not strictly specified CSR activities. Common approach of CSR consists of evaluation of internal or external experts. Larger firms could use their specialized department, small and medium enterprises could incorporate CSR related activities into other departments. Methodology of mentioned evaluation is based on analysis of factors in economic, social and environmental pillars. It is possible to demonstrate involvement of CSR practices with certificates, such as ISO 14001, ISO 14004 for environmental management systems; ISO 26000 for social responsibility or AA 1000 – AccountAbility. Furthermore, we can find national and international indexes, that are created to assess corporate social responsibility. These indexes include Dow Jones Sustainability index; FTSE4GOOD Index Series; S&P/TSX Renewable Energy and Clean Technology Index; United Nations Global Compact. Evaluation closely connects to the reporting of CSR and it is important to mention initiatives for more standardized CSR reporting. Most important is framework, offered by Global Reporting Initiative (GRI), that specifies exact parts of CSR. (Rodek Berkes, 2017; Paulík et al., 2015)

3 Analytic Network Process in CSR

To assess and compare level of CSR in selected companies, multicriteria decision making method ANP is used in this paper. ANP or Analytic Network Process is a method for measuring tangible and intangible factors, which could be found in common CSR framework. ANP is considered as a generalization of Analytic Hierarchy Process, which is based on a hierarchical dependency of chosen criteria and sub criteria. Network is possible to create for multicriteria decision making problems that are not only hierarchy in its nature, but also with added interdependencies between clusters and elements. These links between clusters and elements create more accurate depiction of a real-life decision problems due to the complexity of the network. To develop a network-based model, we need to write down elements, that influence our decision into the clusters. (Saaty, 2014)

In the specific CSR example, clusters are represented by criteria, that are specified in the triple bottom line framework. Subcriteria are specific CSR activities in the economic, social and environmental pillars. For complete assessment, there are four firms in a cluster named Variants.

Analytic Network Process steps (Saaty, 2014):

[1] Network model with cluster and their influence links and dependencies

It is necessary to create clear depiction of the specific factors, that are used for chosen goal. Factors are enclosed in clusters, which could relate to outer dependency (between clusters), but also with inner dependency (among cluster). Links are specified with arrows, as it is possible to see in Figure 1.

[2] Pairwise comparison

Weights in the ANP model are based on pairwise comparison between elements. Pairwise comparison is based on a scale $1-9$, which represents relative importance with respect to the control criterion. Priorities that derive from pairwise comparison are added into the supermatrix.

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[3] Construction of supermatrix

Firstly, it is necessary to compute original - unweighted supermatrix, which represents relations of all elements in created network model. Furthermore, weighted supermatrix is created with corresponding priorities. Lastly, it is important to raise matrix to powers, which creates limit matrix

Figure 1 Corporate social responsibility in ANP model
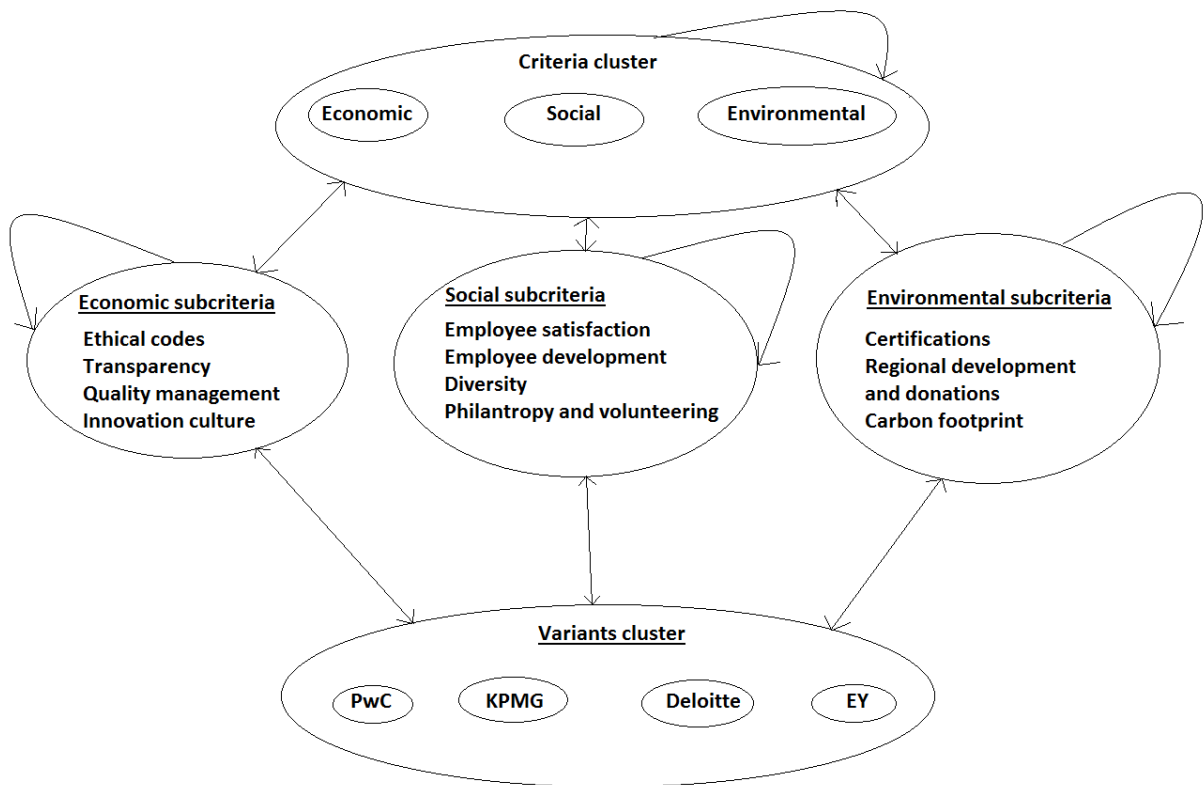
Source: Own creation

Network is created with emphasis on the criteria in triple bottom line concept. Three most important pillars of CSR concept are included in the Criteria cluster. Specifically, there is economic, social and environmental field for chosen criteria. Other three clusters are subcriteria or specific CSR activities. These activities come from CSR reports of chosen companies. Cluster economic subcritreria consists of: Ethical codes, Transparency, Quality management and Innovation culture. Social subcriteria are focused mostly on the employees. According to the available reports, it was possible to evaluate: Employee satisfaction; Employee development; Diversity; Philanthropy and volunteering. Lastly, environmental subcriteria are included. Specifically: Eco certifications; Donations and support of regional development. Environmental subcriteria also included carbon footprint, as important measurement of released emissions. Specific indicators of mentioned subcriteria are shown in Table 1.

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Table 1 Evaluation indicators for ANP pairwise comparison

Criteria	Subcriteria	Indicators
Economic	Ethical codes	Ethical codes compliance, ethical incidents, sustainable entrepreneurship prizes
	Innovation culture	Support of innovative solutions - qualitative
	Quality management	Clients satisfaction
	Transparency	Details of CSR reports, occurrence of illegal activities, other information from ARs
Environmental	Carbon footprint	Emissions in various fields, Carbon footprint per employee
	Eco certifications	Number of most important certifications
	Regional development and donations	Donations, cooperation with communities, other qualitative factors
Social	Diversity	Involvement of minorities at workplace
	Employee development	Mentoring, coaching, workshops, seminars, promotion of employees and other development related activities
	Employee satisfaction	Specific index in the reports based on opinion of employees
	Philanthropy and volunteering	Charity, employee volunteering, pro bono cases, employee involvement

Source: Own creation

List of the indicators as shown in the table above is not exhausting because of the qualitative form of acquired data. However, it includes most important factors, that influenced pairwise comparison of created model. Specific indicators are chosen with accordance to the CSR reports or other data, that were available, mostly on the company websites. Indicators comes from publicly known information, which could create limitations of evaluation. Negative impacts of CSR criteria are usually not disclosed, with exception of big scandals and public cases with media attention.

Selected companies for comparison

For evaluation and comparison purposes were chosen "Big four" accounting firms. These companies are independent entities on Czech market, united under international co-operatives. Thus, all big four firms have a parent company on Czech market, that embodies several important services, such as audit, management

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consulting, actuarial services, corporate finance and legal advisory. Big four companies include KPMG, PwC, EY and Deloitte. Due to the structure of their business, non-financial reports hold to the high standard, which makes it possible to find relevant data for evaluation and comparison.

4   Results of ANP method

In this section specific results of previously described process are presented. It is important to firstly present computed weight priorities in the respective clusters. Further, overall priorities of economic, environmental and social responsibility are presented.

Computed priorities

In the table 2 below, there are clusters with economic, social end environmental criteria. Subcriteria are shown with respect to their priority weights as a result from pairwise comparison. To get better presentation of the results, weights are normalized by cluster and shown in percentages.

Table 2 Computed priority weights per clusters Subcriteria

Criteria	Subcriteria	Priority Weights (in %)
Economic	Ethical codes	28.06
	Innovation culture	26.31
	Quality management	26.54
	Transparency	19.09
Environmental	Carbon footprint	32.62
	Eco certifications	26.04
	Regional development and donations	41.34
Social	Diversity	14.70
	Employee development	25.47
	Employee satisfaction	40.64
	Philanthropy and volunteering	19.18

Source: Own creation

In economic cluster, weights are almost equally distributed, except transparency, which scored on 19 %. Other economic subcriteria are with similar importance, according to the chosen methodology and available data.

Environmental subcriteria have highly prioritised regional development and donations, followed by carbon footprint. Least important in this cluster resulted certifications, which could company get. This could be affected by the disproportion between acquired certifications and real-life results of environmental policy in company, which create measurable and quantifiable data, such as emission per employee.

Social subcriteria are mostly connected to the employees and responsibility of company to them. Most important weight was gained in the employee satisfaction subcriteria with 40 %. This is based on complexity of the subcriteria, which could include many activities, that resulted in employee satisfaction. Very important

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is also employee development, especially in turbulent market, that could make current experts' knowledge obsolete in upcoming years without further development, especially in chosen business.

Table 3 Computed priority weights per clusters Criteria

Criteria	Weights (in %)
Economic responsibility	36.00
Environmental responsibility	31.65
Social responsibility	32.35

Source: Own creation

Overall, most important criterion is in the economic responsibility with 36 %, followed by social responsibility with 32 % and environmental responsibility with 31,6 %. This could be perceived as a very narrowly distributed result, as the weights does not show higher differences. Basically, results of priority weights in this cluster are influenced by subcriteria, according to the ANP methodology. Priority weights in clusters are used for final evaluation and comparison, which is shown in the final synthesized model in Table 4.

Table 4 Final synthesized model with "Big four" firms

Company	Ideals (in %)	Normals (in %)	Rank
Deloitte	93.69	27.09	2.
EY	82.78	23.93	3.
KPMG	**100**	**28.91**	**1.**
PwC	69.41	20.07	4.

Source: Own creation

Final results show highest score in company KPMG with 29 %, followed by Deloitte with 27 %. Company EY score 24 % and PwC 20 %. Results could also be shown in relative form to the company with the highest score (KPMG). Relatively small differences in the scored results are cause of the similarities in the companies' business orientation. Reports of CSR activities are on the same basis, yet small differences, that could be measured with chosen indicators are the reason for differentiation and final order of companies.

5   Conclusion

Evaluation and comparison of selected CSR programmes is difficult due to the mentioned factors, including qualitative data, not standardized or incomplete reports and many different factors, that could influence results. Chosen method Analytic network process is possible to use with respect to the CSR field. With constructed network, we could include many criteria of corporate social responsibility and subcriteria, according to the available reports. In this specific case, chosen approach is possible to use as a metric for comparison of selected companies. Quality of model is dependent on data and profound CSR report is needed. Big four firms are usually example in business field and non-financial reporting is on a high level. Due to this, it was possible to create an order, based on the resulted scores. Even with small differences, we could perceive KPMG as the most involved in CSR activities, neatly followed by Deloitte. Third is the rank of EY and last company is PwC. More than the order itself is important the method in this case. It is notable to mention the limitations of chosen approach. With help of specific software SuperDecision, pairwise comparison and further computations of supermatrixes is simpler. However, with more variants, comparison is getting more confusing and not available for non-experienced person in the matter. This also applies for criteria and subcriteria, which should be limited for the sake of evaluation of the model.

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To support further research in the area, it is advised to increase count of selected companies, also include more industry areas, and thus increase diversity in researched sample. To achieve this, it is also possible to change used method. Approach to the small and medium companies should also be taken in account, as these companies usually do not report on CSR activities. With increased number of companies following GRI framework, it will be possible to recreate research with more exact data. There is also possibility to get more objective result with more experts in the CSR field.

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[10] Websites of selected companies (KPMG, PwC, EY, Deloitte) and other data for respective companies were acquired from their CSR reports, Annual reports and other openly accessible sources.

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FINANCIAL PERFORMANCE OF A COMPANY EVALUATED ON THE BASIS OF SELECTED APPROACHES

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Abstract

The paper focuses on the financial performance of a company evaluated on the basis of selected approaches. At present, the problem of the impact of International Financial Reporting Standards (IFRS) on the reporting of the financial level of the particular enterprise, in particular of the stock companies listed on the stock exchange, is at the forefront. The problem arises when choosing the right criteria for measuring financial performance with respect to international reporting. The starting point is an understanding of the elementary differences between international accounting standards and Czech standards. This differentiation distorts the input data for the calculations of individual financial indicators and thus the overall financial performance. The article will address one of the most widely used and most comprehensive indicators of economic added value (EVA™). Comparison of financial performance results for input data according to Czech Accounting Standards and IFRS will be performed.

Keywords

Value Added (EVA), financial performance, Czech Accounting Standards (CAS), International Financial Reporting Standards (IFRS), Cost of capital, Risk premium.

JEL Classification

G20, G30, G00.

1   Introduction

Financial performance is an important concept in the financial management of a company and its increase is generally considered to be the main objective of financial management of each business. The term performance is most often defined as the ability to evaluate the capital invested by individual owners compared to the possibilities of alternative use of that capital for other purposes. However, it is important to note that the performance of an enterprise can be viewed from a variety of perspectives, from the point of view of the owners or managers, since the two groups are pursuing slightly different interests and goals. The world economy has been decimating national borders for decades. In Europe, together with economic globalization, political unification takes place within the European Union. As a consequence of these processes, there is a growing need for accounting harmonization. Accounting information is necessary not only for the implementation of qualified business decisions, but also for the provision of subsidies, etc. There are currently three significant lines of international accounting harmonization. These are International Financial Reporting Standards (IFRS), the Accounting Directives of the European Union, and the US GAAP (General Accepted Accounting Principles) also play an important role. This paper will only take into IFRS and, of course, Czech Accounting Standards.

2   Literature Review

There are currently many approaches and methods evaluating financial performance. This issue is addressed by a number of authors, such as Young (2001), EHRBAR (1998). Some approach to measuring financial performance from a management point of view, for example, with the Balanced Scorecard. (Damodaran, 2011). Economic value added (EVA) is based on concept of an economical profit, which is part of the financial theory for a long time. Economic value added is measures of firm's performance, which have been created with the aim to motivate managers on shareholder"s value increase. EVA is brand of Stern Steward and

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company, who has been popularised this approach to measure financial performance in United State, where this method has been implemented into management system of many firms. Its role is growing both in transition economies and, above all, in market economies. According to Dluhošová (2010), the fact that the indicator shows a strong correlation to the development of the shares of the companies, which is important especially for the shareholders, can be considered. EVA is a comprehensive instrument in business management. EVA can be used to evaluate an enterprise or as a tool for managing and motivating workers, especially managers, etc. This way, performance can be characterized by the **4M** (measurement, management, motivation and mindset) rule, as Young (2001) states. The indicator is relatively new and is becoming increasingly used in the area of performance measurement indicators.

The resulting value indicates whether or not the value for owners has increased. When considering financial performance, there are problems with the quality of input data, variations in methodological approaches, the risk and uncertainty of future financial flows, etc. Moreover, another problem arises in the difference between Czech accounting regulations and International Financial Reporting Standards. (IFRS). Unlike national accounting systems, IFRS do not provided guidance on accouting procedures.

2.1   Definition of International Financial Reporting Standards

The International Financial Reporting Standards are a summary of the best accounting procedures and experience of the accounting profession and of users´ requirements upon the range of publicly information. Their purpose is to increase comparability of reporting on financial effectiveness and financial position of different companies, operating under different national conditions. Financial Reporting Standards are a summary of the best accounting procedures and experience of the accounting profession and of users´ requirements upon the range of publicly (IFRS), the original name was International Accounting Standards, (IAS), are currently one of the three basic regulations in the context of international accounting harmonization. IFRS used mainly in Europe. Priority objectives of published standards are not the methodological accounting procedures, but the main emphasis is placed on the interpretation of accounting data in the form of financial statements. The financial statements prepared according to these standards provide high-quality, transparent and comparable information, which can help the users to make economic decisions. (Procházka, 2015).

2.2   Czech companies and IFRS

As Dvořáková, (2017) states, since 2005 the IFRS application has been compulsory for companies operating on EU regulated markets. According to the Regulation No. 1606/2002 of the European Parliament and the Council of 19 July 2002 on the IAS, the accounting entities that are trading companies and that are issuers of securities registered at a regulated securities market in the EU member countries, have to apply the IAS, adapted by the European Union law, for accounting and drawing a financial statement. A key problem of accounting based on IFRS is the tax basis which is obtained from the accounting profit in the Czech Republic. For this reason, the accounting entities which account and report according to IFRS by law have, for the purposes of calculation of the profit tax payable, to transform the business result to such a result which they would have if they accounted and reported according to the Czech regulations

For income tax purposes, these companies have to rely on the economic result expressed in accordance with Czech accounting regulations. To solve this situation, there is a two-fold approach:

- To create a high-quality bridge for these operations, which will be displayed differently in both accounting systems and then to convert it according to IFRS based on the Czech regulations, or
- to account and prepare financial statements in two accounting systems, i.e. according to IFRS, and according to Czech accounting regulations.

Application of IFRS in Czech companies requires high demands on the professional knowledge of accountants and all other employees.

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2.3 Basic differences between CAS and IFRS

It should be noted that IFRS do not specify a specific form of financial statements, they do not require any accounting framework. IFRS also do not report standard account balances, as is the case with Czech accounting. So, IFRS defines the minimum amount of information that an enterprise must publish. The primary goal of the IFRS financial statements is to provide high quality information for decision-makers. Conversely, Czech accounting is very closely linked to tax laws. IFRS thus requires the transactions to be traded consistently according to their economic substance and not in accordance with the legal standard.

3 Calculation of Economic Value Added

General concept of EVA, as a measure of financial performance, expresses the difference between profit and cost of capital, which reflects a minimal rate of return of capital invested. The calculation of the EVA is determined on the one hand by the input data and the way of the cost of capital calculation, variations in methodological approaches, the risk and uncertainty of future financial flows. Moreover, it is also important, if me want to calculate an absolute or a relative value. According to Dluhošová (2004), are two basic concepts of calculation: operating profit concept and value spread concept. EVA calculation on base of operating profit is general defined as:

$$EVA = NOPAT - WACC \cdot C, \tag{1}$$

where *NOPAT* is net operating profit after taxation, *WACC* is weighted cost of capital and *C* is value of total capital invested.

The second aforementioned approaches is being used in this paper, namely the value spread concept. Specifically, this is EVA based on a narrowed concept of value spread, which is defined as follows:

$$EVA = (ROE - R_E) \cdot E, \tag{2}$$

where R_E is market cost of equity, *E* is equity and *ROE* is return on equity. For the owner, it is important that the $(ROE - R_E)$ spread to be as large as possible or at least positive. Only in this case investment to the firm brings more than an alternative investment.

3.1 Cost of capital calculation

Another the decisive factor in EVA calculation is cost of capital, which is one of the key issues due to their sensitivity to EVA. As Dluhošová (2010) states, Cost of capital represents minimal rate of return, which must be achieved by firm no do decrease wealth of investors. There are three basic types of capital costs. The first type is Weighted Average Cost of Capital (WACC), which is a combination of different forms of capital:

$$WACC = \frac{R_D \cdot D + R_E \cdot E}{D + E}, \tag{3}$$

where *D* is debt, R_E is cost of equity, *E* is equity, R_D is cost of debt, *D + E* is total capital invested.

The second type is cost of equity. Generally, cost of equity can be calculated using capital assets models of construction models. In this paper, the cost of equity was determined using the construction model, specifically a ranting model (INFA) used by the Ministry of Industry and Trade of the Czech Republic. Cost of equity can be expressed as a sum of return of a risk-free assets and risk premiums. The INFA model calculation is as follows:

$$WACC_U = R_E^U = R_F + R_{entrepreneurial} + R_{finstab} + R_{size}, \tag{4}$$

where R_{size} is risk premium for share liquidity, $R_{entrepreneurial}$ is risk premium for trade risk, R_F is risk free rate, $R_{finstab}$ is risk premium resulting from financial stability and $WACC_U$ are the weighted average cost of capital of the non-indebted entity.

Because $EBIT \cdot CZ/Z = WACC_U \cdot UZ$, then the cost of equity can be determined as:

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$$R_E = \frac{WACC_U \cdot \dfrac{UZ}{A} - \dfrac{CZ}{Z} \cdot UM \cdot \left(\dfrac{UZ}{A} - \dfrac{VK}{A}\right)}{\dfrac{VK}{A}}, \tag{5}$$

where UZ financial (paid) resources, A are total assets, VK is equity, Z is gross profit, UM is interest rate, when $UM = \frac{I}{B+O}$, where B are bank credits, O are bonds and I are interests.

The cost of equity can then be determined using these risk premiums as follows:

$$R_E = WACC_U + R_{finstr} = R_F + R_{entrepreneurial} + R_{finstab} + R_{size}, \tag{6}$$

where R_{finstr} is risk premium resulting from the capital strukture and can be expressed as follows: $R_{finstr} = R_E - WACC_U$ If $R_E = WACC_U$, after $R_{finstr} = 0\%$. In case, when $R_E – WACC_U > 10\%$, then $R_{finstr} = 10\%$.

Risk free rate **R_F** correspond to the yield of the T-bonds with the time to maturity from five to ten years, most often with a maturity of 10 years.

Determination of risk premium characterizing enterprise size, **R_{size}**, which is the function of the size of a fimr´s equity. If the value of the financial resources $(UZ) > 3$ mld. CZK, then $R_{size} = 0\%$. If $UZ < 100$ mil. CZK, after is $R_{size} = 5.0\%$. If i tis $UZ > 0.1$ and $UZ < 3$ mld. CZK, then $R_{siz} = (3 mld. Kč – UZ)^2 / 168,2$.

$R_{entrepreneuril}$ is risk premium reflecting the production power of the enterprise. This risk premium is dependent on indicator $EBIT/A$, which is compared to the indicator XI expressing the replacement of external paid capital with equity. The indicator is calculated as: $X1 = \dfrac{UZ}{A} \cdot UM$, Consequently, if EBIT/A $>XI$, then $R_{entrepreneuril} = min\ R_{entrepreneuril}$. If EBIT/A < 0, then $R_{entrepreneuril} = 10.0\%$. If $0 \leq$ EBIT/A $\leq X1$, then

$$R_{podnikatelské} = \left(\frac{X1 - EBIT / A}{X1}\right)^2 \cdot 0,1,$$

Risk premium **$R_{finstab}$** is a function of gross liquidity (L3), current assets/(short term liabilities + short term loans). If $L3 > XL2$, then $R_{finstab} = 0\%$. If $L3 \leq XL1$, then is 10%. And finally if XL1 < L3 <XL2, then is $R_{finstab} = ((XL2 – L3)/(XL2 – XL1))^2 \cdot 0.1$. X1 and X2 are the recommended liquidity limits in the industry, when X1 = 1 and X2 = 2.5.

3.2 Selected company for comparison

The input data for the purposes of this article were used by XY. The name of XY is to keep business secrets. XY is a joint-stock company specializing in the production of heavy castings. The history of the company dates back to the 1960s. The company is focused on the aerospace industry, where it has a number of certifications and supplies subcontractors for world-class aircraft brands. In addition to this, XY is also active in power engineering and electrotechnics. The company's export accounts for 60% of the company's turnover. According to CZ-NACE the company falls into 25 section - manufacture of metal structures and fabricated metal products. The input data were obtained on the basis of the company's annual reports

4 Empirical Results

The following key part of this paper will assess the effect of IFRS on the financial performance of the selected enterprise, measured on the basis of the EVA indicator. The following Table 1. lists the input data for the calculation of the individual risk premium, the calculation of the cost of capital determined on the basis of the INFA model (construction model) and for calculating the EVA. It is necessary to recall that the calculation of the EVA will be based on the accounting model, because the INFA model is based on the accounting principle.

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Table 1. Input data for the calculation of the risk premium, R_E and EVA (T.CZK)

CAS	2013	2014	2015	2016	2017
Total assets	**100 316**	**107 052**	**105 727**	**108 747**	**106 328**
Property, plant and equipment	45 431	46 756	42 732	51 836	43 432
Current assets	54 416	60 072	62 720	56 203	62 391
Total liabilities and equity	**100 316**	**107 052**	**105 727**	**108 747**	**106 328**
Equity	44 816	53 513	61 126	69 111	76 567
Non-current liabilities	27 722	25 481	12 841	11 533	8 714
Bank credits and loans	22 722	20 481	7 841	6 533	3 714
Current liabilities	27 778	28 058	31 760	28 103	21 047
Trade and other liabilities	8 000	5 000	5 000	5 000	5 000
Bank credits and loans	11 150	13 676	19 502	16 288	7 219
EBIT	**8924**	**9350**	**8067**	**8340**	**7761**
EAT	**7373**	**8319**	**7613**	**7985**	**7456**
Interest expense	863	706	206	153	99
IFRS	**2013**	**2014**	**2015**	**2016**	**2017**
Total assets	179 339	182 454	174 933	171 865	160 626
Property, plant and equipment	125 342	122 743	112 466	115 465	98 282
Current assets	53 997	59 711	62 467	56 400	62 344
Total liabilities and equity	179 339	182 454	174 933	171 865	160 626
Equity	75 435	83 341	83 462	89 230	92 353
Non-current liabilities	73 025	68 009	57 005	51 448	45 056
Bank credits and loans	22 722	20 481	7 841	6 533	3 714
Current liabilities	30 879	31 104	34 466	31 187	23 217
Trade and other liabilities	18 024	21 636	28 286	23 191	15 379
Bank credits and loans	8 000	5 000	2 000	3 168	2 770
EBIT	**7158**	**8000**	**4560**	**7533**	**6890**
EAT	**2442**	**6961**	**3127**	**5646**	**5148**
Interest expense	5 505	4 136	2 272	2 882	1 923

Source: Own creation

In the calculation of risk premiums, a risk-free rate was first established. The value-free rates R_F were derived from data published on the Czech National Bank website. These values ranged from 2.26% in 2013 to 0.98% in 2017. Subsequently, it was necessary to calculate the value of the financial (paid) resources for the calculation of the risk premium characterizing the size of the enterprise R_{size}. In the case of XY, the financial resources are the sum of equity and bank loans. Considering that the value of the financial sources was less than 100 million crowns for the whole time, then the value of this risk premium was set at 5% over the whole period. These are CAS values. Then, was determined the value of the risk premium of $R_{entrepreneurial}$, which characterizes the productive power. First, it was necessary to calculate the value of the indicator X1 and the value of the interest rate. The size of the interest rate was as follows: $UM = I/(B + O)$ The values of the X1 indicator are then determined as: $X1 = \dfrac{UZ}{A} \cdot UM$, . This value was then compared to the return on assets.

Given to, that the return on assets is greater than the X1 indicator, then $R_{entrepreneurial}$ is equal to the minimum $R_{entrepreneurial}$ for the sectors available in the financial analyzes of the Ministry of Industry and Trade published on www.mpo.cz. In the first four analyzed periods, the overall liquidity was greater than XL2, then the risk premium was calculated as: In the last year, the indicator L3 was larger than XL2, then the value of the risk premium was 0. Of course, the values of individual risk premium were different for IFRSs. Based on the calculation of individual risk margins, then $WACC_U$ and subsequently R_E were calculated. $WACC_U$ were calculated based on formula (1) and R_E then by (5) and (6), respectively.

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Table 2. Risk premium, cost of equity and value of spread (%)

CAS	2013	2014	2015	2016	2017
R_F	2,26%	1,58%	0,58%	0,48%	0,98%
$R_{entepre.min.}$	4,05%	3,50%	3,00%	3,49%	3,76%
R_{size}	5,00%	5,00%	5,00%	5,00%	5,00%
$R_{finstab}$	1,30%	0,57%	1,23%	1,11%	0%
$WACC_U$	12,61%	10,65%	9,81%	10,08%	9,74%
R_E	14,86%	14,37%	12,14%	11,34%	9,61%
R_{finstr}	2,25%	3,72%	2,33%	1,26%	-0,13%
ROE	16,45%	15,55%	12,45%	11,55%	9,74%
Value of spread	1,59%	1,17%	0,32%	0,21%	0,12%

IFRS	2013	2014	2015	2016	2017
$R_{entepre.min.}$	3,89%	2,99%	6,21%	5,53%	5,85%
R_{size}	4,98%	4,97%	5,00%	5,00%	5,00%
$R_{finstab}$	2,51%	1,50%	2,10%	2,13%	0,00%
R_F	2,26%	1,58%	0,58%	0,48%	0,98%
$WACC_U$	13,64%	11,04%	13,90%	13,14%	11,83%
R_E	16,70%	10,10%	13,67%	12,14%	11,11%
R_{finstr}	3,06%	0,94%	0,23%	0,99%	0,73%
ROE	3,24%	8,35%	3,75%	6,33%	5,57%
Value of spread	2,49%	4,32%	1,87%	2,42%	1,56%

Source: Own creation

All variables are now known to determine the indicator EVA. It was calculated on the basis of the narrow range according to formula (2.7). The following Figure 1shows EVA values under IFRS and CAS for the period from 2013 to 2017.

Figure 1. Evolution of EVA over the period from 2013 to 2017

	2013	2014	2015	2016	2017
EVA	713.009749	628.1512299	194.4065948	146.4874101	95.10939312
EVA(IFRS)	-10157.31724	-1453.329506	-8279.893161	-5189.863627	-5109.051663
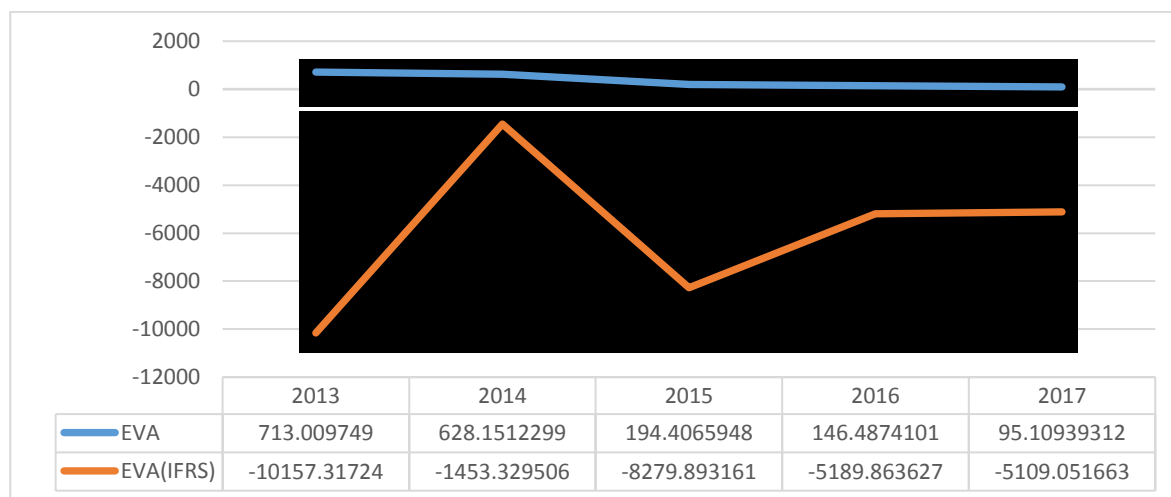
Source: Own creation

As can be seen from the chart, the resulting values of EVA are quite different. It is clear from the analysis that no positive EVA based on IFRS was achieved at any time.These different results are due to the fact that the EVA based on IFRS data has a significantly negative value of spread *(ROE – R_E)* against EVA based on CAS. The negative value of the spread is mainly due to the lower return on equity. Under IFRS, less profits were due in particular to higher depreciation of new assets, namely machinery and equipment leases and leased premises. Decreasing return on equity also affected the revaluation of fixed assets.

The following section will explain and compare the impact of the difference between IFRS and CAS on EVA. As can be seen, the value of assets, liabilities and profits under IFRS adjustments has changed significantly. Of course, the names and structure of the individual financial statements have changed. However, the objective

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of this paper is not to describe differences in the structure of individual indicators, but to assess the difference and impact of IFRS financial statements on total financial performance. The first thing that caused a substantial difference in the resulting value of EVA is the **rental** of production premises. According to IFRS, the lease of such premises must be capitalized in the value of the property as it uses its premises for its economic activity and, at the same time, an increase in the liability must occur. For CAS, this rental only appears in off-balance sheet records. Therefore, for realistic display of reality, the item 'Long-term rentals' must be capitalized in the balance sheet. Expert estimate was the estimated net book of leased premises at 1.1. 2013 in the amount of 52.4 million CZK, when it is assumed that this property will be used in the form of 25 years. This data is important for setting up additional costs that have arisen due to the activation of the property (space rent). These annual depreciations were calculated as the portion of the net book and the economic life of the building, 52.4 mil. CZK / 25 = 2096 thousand CZK. The amount of the annual depreciation is a short-term liability, the rest of the amortized amount being part of long-term payables. Under IFRS, the original amount of the lease (4 400 thous. CZK) is deferred to annual depreciation, interest expense and maintenance and administration. Rental is considered as a form of foreign capital, so it is necessary to quantify interest. Interest was determined on the basis of the PRIBOR interest rate and the selected risk margins. The second thing that caused a substantial difference in the resulting value of EVA is **financial leasing**. In particular, the Company acquires in the form of financial leasing primarily machinery and equipment. According to IFRS, the current value of the lease payments must be capitalized in fixed assets. This will increase valu efor property, plant and equipment. At the same time, there will be an increase in non-current liabilities and current liabilities, as finance lease liabilities. In addition, the capture of these assets will also be reflected in the statement of profit and loss. In particular, there will be an increase in financial costs (interest) and, of course, depreciation. Compared to IFRS, the capture of the finance leasing was quite different for CAS. According to CAS, financial leasing would only be reflected in the form of operating costs. Its value is recorded only in off-balance sheet accounts. Another very significant difference with CAS is the **revaluation** of fixed assets. Under IFRS, the tangible and intangible assets may be revalued at fair value at the balance sheet date. In this way, the situation in the company more corresponds to reality because the property is valued at fair value. At the same time, the revaluation is shown in equity. The revalued value becomes the basis for determining the new amount of depreciation. Precise revaluation of long-term assets can not be fully carried out, as the investor needs a subordinate internal information.

5   Conclusion

The objective of this paper was to assess the impact of IFRS on the financial performance of an enterprise. Comparing accounting procedures and reporting of some items according to the Czech Accounting Standards and according to IFRS results in differences in the accounting data reporting. According to one reporting frame a company can reach a profit, while according to another it can show a loss. Of big difference can also be total balance sums, asset value, and value of other items of property or liabilities. Financial analyses indices and comprehensive conclusions about performance could differ considerably. Compilation of the financial statements according to IFRS will change the assessment of financial stability and financial performance, both in positive and in negative direction. On the contrary, according to CAS, XY created an economic added value of CZK 0.713 million. Consequently, the conclusion can be deduced from the results, the impact of IFRS on financial performance is well founded and more relevant to reality because assets and liabilities are measured at fair value, and all transactions related to the economic activity of the enterprise are recorded in the financial statements. It can be argued that EVA according to IFRS is so close to the market method and is not a mere approximation.

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STOCK VALUE AND CURRENCY EXCHANGE RATE PREDICTION USING AN ARTIFICIAL NEURAL NETWORK TRAINED BY A GENETIC ALGORITHM

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Abstract

Prediction of a stock value or a currency exchange rate is a complex problem which has benefited from recent advancements and research in machine learning. Very popular model for the predictions are deep neural networks. This paper discusses two training algorithms for the feedforward neural networks – the backpropagation algorithm and a genetic algorithm. Although the backpropagation algorithm is a reliable way to train a neural network, it can be very demanding on computational resources for lager datasets which are common in some types of trading. Heuristics like the genetic algorithms can help to lower the demands of the training process. The discussed genetic algorithm is an implementation of a classical genetic algorithm with Rank selection of parents for crossover and genes represented as a real number. The accuracy of predictions made by the network trained using this algorithm is then compared to the network trained by the backpropagation.

Keywords

Genetic algorithm, Neural network, Time series prediction.

JEL Classification

C63 Computational Techniques, Simulation Modeling,
C61 Optimization Techniques, Programming Models, Dynamic Analysis,
C53 Forecasting and Prediction Methods, Simulation Methods

1   Introduction

The stock values or currency exchange rates can be precisely predicted using ARIMA models which work well in situations when the users are not strictly time-constrained. Creating an ARIMA model can be very demanding on computational resources and time especially when a large data set is used for making the model. The process of creating an ARIMA model is also hard to parallelize which means it cannot fully use the computational potential of nowadays computers.

Artificial neural networks are mathematical models which can approximate every math function (Hornik, K., Stinchcombe, M., White H. 1989) including an ARIMA model and can be developed (trained) using machine learning algorithms. This paper discusses a genetic algorithm for training a neural network and compares it to backpropagation. Backpropagation is an algorithm based on computing an error the neural net made and computing which parameters of the net affected the error. For larger networks, especially the deep neural networks which have more than three layers, this leads to computing many partial derivatives which can be rather demanding on nowadays computers. Genetic algorithms on the other hand generally do not have this issue however since they are heuristic algorithms, they can give an imperfect result.

The goal of this paper is to find a genetic algorithm for training an artificial neural network so that the network trained by this algorithm gives essentially the same results for prediction as a neural network trained by backpropagation.

The chosen data set for prediction is high frequency trading data representing a currency exchange rate between Czech Koruna and Euro for the 1ˢᵗ week of December 2018. The data were analysed, pre-processed and an AR prediction model was created. Two neural networks were trained, one using backpropagation and one using the chosen genetic algorithm. The genetic algorithm was refined so that the networks give statistically the same result which was validated using a t-test.

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2   Used data

The data used for research discussed in this paper were published by GAIN Capital company and are freely available at http://ratedata.gaincapital.com/.

2.1   Data description

The data comes in CSV (Comma Separated Values) format and data for exchange rate of CZK (Czech Koruna) to EUR (Euro) for the 1st week of December 2018 was used.

Table 1 Preview of used data

lTid	cDealable	CurrencyPair	RateDateTime	RateBid	RateAsk
7131607008	D	EUR/CZK	2018-12-02 18:00:52.52	25.9425	25.9918
7131607013	D	EUR/CZK	2018-12-02 18:00:52.52	25.9408	25.9918
7131607070	D	EUR/CZK	2018-12-02 18:00:53.53	25.9408	25.9908
7131607081	D	EUR/CZK	2018-12-02 18:00:53.53	25.9408	25.9918
7131607112	D	EUR/CZK	2018-12-02 18:00:54.54	25.9408	25.9913
7131607122	D	EUR/CZK	2018-12-02 18:00:54.54	25.9408	25.9918
7131607206	D	EUR/CZK	2018-12-02 18:00:55.55	25.9408	25.9883
7131607232	D	EUR/CZK	2018-12-02 18:00:56.56	25.9408	25.9918
7131607299	D	EUR/CZK	2018-12-02 18:00:57.57	25.9408	25.9891
7131607307	D	EUR/CZK	2018-12-02 18:00:57.57	25.9408	25.9918

As you can see from data preview in Table , two exchange rates are given for the currency pair. The bid rate was used. The choice is arbitrary since both values show similar trend and predicting either of them represents the same problem.

The data set starts at the 2nd December 2018 17:02:14 and ends at the 17th December 2018 16:59:55. It contains 60586 values. It should have 1-minute time resolution however some values are duplicate, some are missing.

2.2   Data pre-processing

For creating a prediction model for a time series, the series must be free of duplicate values and the values must be evenly spaced in time. The STATA software was used for this. After removal of duplicates and interpolating the missing values, the time series shows a declining trend, see Figure 1.

For successful usage of the Box-Jenkins method for creating an ARIMA model, the data should be stationary. If the time series is differentiated, the trend disappears, see Figure 2.

2.3   ARIMA model

AR, MA and ARIMA models are popular tools for predicting time series. AR stands for autoregressive model, MA for moving average model and ARIMA is a combination of both – autoregressive integrated moving average model. Since ARIMA models are integrated, they can be used for predicting non-stationary time series as well (Marček D. 2013). Neural networks mentioned in this paper were used as approximation of an ARIMA model therefore it was needed to create one.

2.4   Box-Jenkins, ARIMA model

On 99% confidence, both the autocorrelogram and the partial autocorrelogram show autocorrelations up to 10th value, see Figure 3 and Figure 4. According to the Box-Jenkins method, the ARIMA (10, 1, 10) model can be used. The parameters for the model were found using STATA software, see Figure 7. This model can be approximated using artificial neural networks (Marček D. 2013). Actual coefficients of an ARIMA model are in column labelled Coef. Exact explanation of the table can be found in on-line STATA manual (https://www.stata.com/manuals13/tsarima.pdf).

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Figure 1. EUR/CZK time series, interpolated
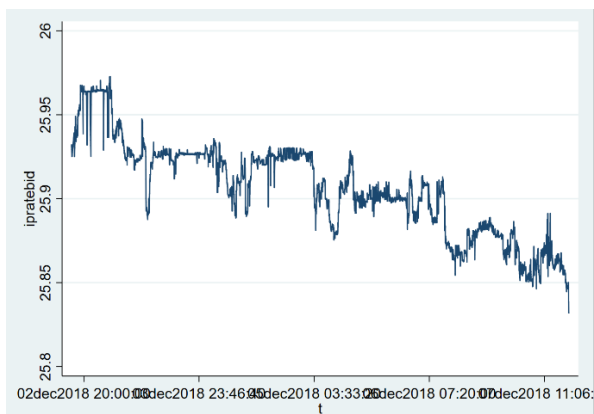
Figure 2. Time series differentiated
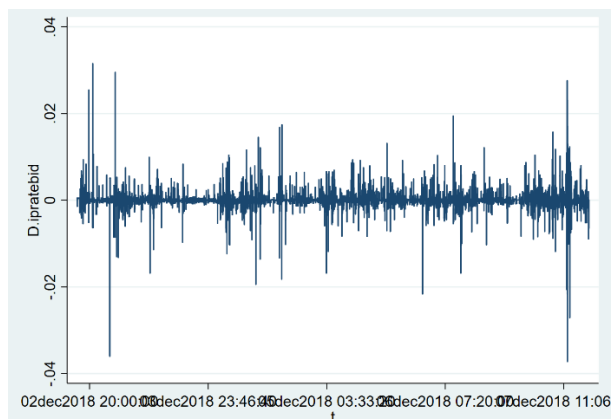
Figure 3. Autocorrelogram for time series
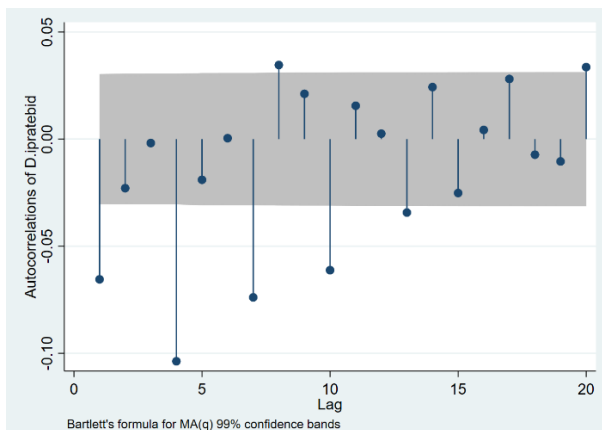
Figure 4. Partial autocorrelogram for time series

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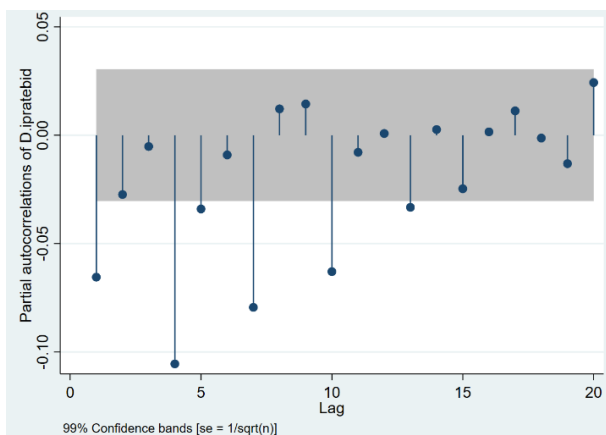
Figure 7. ARIMA (10,1,10)

```
Sample:   02dec2018 17:03:00 - 07dec2018 16:59:00
                                        Number of obs    =       7197
                                        Wald chi2(19)    =  148975.77
Log likelihood =  34099.69              Prob > chi2      =     0.0000
```

D.ipratebid	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf. Interval]	
ipratebid						
_cons	-.0000122	1.19e-06	-10.28	0.000	-.0000146	-9.91e-06
ARMA						
ar						
L1.	-.5591765	.249423	-2.24	0.025	-1.048037	-.0703164
L2.	-.2349692	.1623016	-1.45	0.148	-.5530746	.0831362
L3.	.648816	.1061538	6.11	0.000	.4407584	.8568736
L4.	.530892	.2372566	2.24	0.025	.0658777	.9959063
L5.	.8331457	.1947631	4.28	0.000	.451417	1.214874
L6.	-.0083992	.2047483	-0.04	0.967	-.4096986	.3929001
L7.	-.0294048	.1720482	-0.17	0.864	-.3666132	.3078035
L8.	-.2710065	.1204172	-2.25	0.024	-.5070199	-.0349931
L9.	.2560415	.1139643	2.25	0.025	.0326756	.4794075
L10.	-.2016631	.1313104	-1.54	0.125	-.4590268	.0557006
ma						
L1.	.4866756	.277928	1.75	0.080	-.0580533	1.031405
L2.	.16528	.1472552	1.12	0.262	-.1233349	.4538949
L3.	-.7151753	.	.	.	.	.
L4.	-.6077084	.2240039	-2.71	0.007	-1.046748	-.1686688
L5.	-.8693586	.2114018	-4.11	0.000	-1.283698	-.4550187
L6.	.049309	.195784	0.25	0.801	-.3344205	.4330385
L7.	.0513134	.1531564	0.34	0.738	-.2488677	.3514945
L8.	.3561364	.1168793	3.05	0.002	.1270571	.5852156
L9.	-.1624173	.1280688	-1.27	0.205	-.4134276	.088593
L10.	.2459452	.1363641	1.80	0.071	-.0213236	.5132139
/sigma	.0021181	.000067	31.60	0.000	.0019867	.0022495

3   Neural network trained by backpropagation

Although the goal is to develop a genetic algorithm for training neural networks, a baseline for comparison is needed. Based on author's experience in commercial software development, there are several options currently available for use in commercial software. One of the commercial-grade libraries is Deeplearning4j (https://deeplearning4j.org/), a deep learning and vector/matrix library for the Java platform. Since the author is the most experienced with Java and has experience with Deeplearning4j from commercial software development, this one was chosen as the baseline.

Deeplearning4j defines an API (application programming interface) for defining multi-layer neural networks to be trained using the backpropagation algorithm. This algorithm is dependent on vector and matrix operations, which are optimized for currently available computers or computer clusters and the math operations can be run on either CPUs (central processing units) or GPUs (graphical processing units) if CUDA (library for C programming language created by the NVidia company allowing software to perform parallel computations on their graphical cards) is available. The author's computer does not have a GPU supporting CUDA, therefore only the CPU was used for computations. The author's computer has a CPU with 6 independent cores supporting the Hyper-Threading technology.

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3.1 Shape of the network

ARIMA model for predicting this time series is based on 10 values, as shown in chapter 2.4. Therefore, the network should have 10 neurons in the input layer. The Deeplearning4j implementation of neural networks uses a neuron with no input wired to each other neurons as a bias. Since the mean of the differentiated bid rate is not exactly 0 (it's $1.4e^{-4}$), bias is used in this layer. It is crucial that the values of (input + bias) are rather small, because sigmoid function is used as an activation function of the one hidden layer. The last, output layer has the identity function the activation function and has only 1 output neuron. Such configuration can be used for predicting one value in future from past 10 values, exactly like the ARIMA (10,1,10) model. Based on empirical experience the good size of the hidden layer is 25 neurons. Larger size did not provide better results while smaller provided worse.

The resulting shape of the network was three layers, having $10 - 25 - 1$ neurons each.

3.2 Training the network

The network was trained using Stochastic Gradient Descent algorithm with learning rate of 0.25 (this value was based on empirical experience) and the loss function was Mean Squared Error. Their implementations were provided by the Deeplearning4j library.

The time series data was split into training and evaluation data so the training data consist of 90% of the original series. The training data were split into mini-batches of 1000 samples. Parameters of the network were changed after each mini-batch. After passing through all the original data, Mean Squared Error (MSE) was computed for evaluation data. When the MSE for evaluation data started to raise, the training was stopped because this is a usual sign of overfitting and overtraining.

3.3 Performance evaluation

For the size of input data, training of the network took on average roughly 20s on the author's computer and average CPU load was 77% on 6-core CPU with Hyper-Threading. The predictions based on validation data were stored into a CSV file for further analysis.

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4   Neural network trained by genetic algorithm

Since Deeplearning4j does not allow custom training algorithms (in the time of writing this article), a custom implementation of both genetic algorithm and neural networks was used. Since the author has experience with implementing machine learning algorithms in LISP language, which was traditionally popular in machine learning and artificial intelligence, Clojure language was chosen for this implementation. Clojure is a modern dialect of LISP language, dynamically compiled to Java bytecode (https://clojure.org/). Although it does not support all features of Common Lisp, all the libraries and frameworks used in Java can be seamlessly used form Clojure as well (and Clojure libraries can be used from Java).

4.1   Neural network implementation

Neural networks are represented as a collection of matrices of weights and biases. Clojure is a functional programming language, not object oriented – therefore there is no benefit in defining classes or interfaces (these features exist in Clojure mainly for interop with Java).

Each layer of the network is represented by a matrix of weights and vector of biases.

Equation 1 Weighted input of neural network layer

$$\begin{pmatrix} w11 & \cdots & w1n \\ \vdots & \ddots & \vdots \\ wm1 & \cdots & wmn \end{pmatrix} \times \begin{bmatrix} a1 \\ \vdots \\ an \end{bmatrix} + \begin{bmatrix} b1 \\ \vdots \\ bm \end{bmatrix} = \begin{bmatrix} z1 \\ \vdots \\ zm \end{bmatrix}$$

$$W^L \times A^{L-1} + B^L = Z^L$$

Equation 2. Activation of a neural network layer

$$A^L = \sigma(Z^L)$$

Equation 1 shows the weighted input of each layer in both expanded matrix form and using capital letters as matrices. Equation 2 shows the computation of activation of a layer. L and L-1 are indices, not powers. L represents current layer, L-1 the previous one. Note that weight matrix (W) is transposed compared to the most literature sources. This way it is easier to work with it in code. So w11 is weight of the synapse from 1st neuron of the previous layer to the 1st neuron of the current layer, w21 is the weight of the synapse from 1st neuron of previous layer to the 2nd neuron of the current layer, see Figure 8. Vector A represents activation of a layer. Activation of the first layer equals to the network input, activation of the last layer is output. B is vector of biases for each neuron of the current layer. Z represents the weighted input of each neuron of the current layer. $\sigma(Z^L)$ is a simplified notation for applying an activation function to each element of Z vector, creating A vector. These equations are based on Nielsen, M. A. (2015).

Figure 8. Weights in neural network layers

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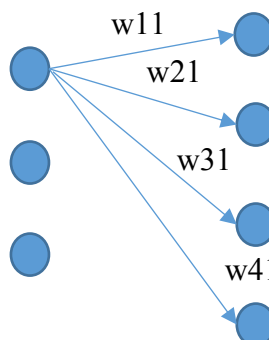
4.2 Genetic algorithm implementation

Genetic algorithms traditionally work with genes either 0 or 1. For this application, this is inadequate, because this algorithm need to find weights and biases of a neural network, which can be an arbitrary floating point decimal numbers. On the other hand, for genetic algorithms to be efficient, the state space needs to be limited. Therefore, each parameter is transformed into interval [0, 1]. An individual for the genetic algorithm then consist of floating point numbers from [0, 1] interval and count of parameters in intervals equals to count of all weights and biases of the network.

Equation 3. Individual of the neural algorithm

$$i = \frac{p - lowest\_possible\_p}{highest\_possible\_p - lowest\_possible\_p}$$

$$I = (i_1 \cdots i_n)$$

Genetic algorithms work with populations of individuals, which are then evolved using crossbreed, mutation and selection. Equation 3 shows the way an individual is constructed in this case. Parameter p in this equation is either weight or bias. Individual I is a list of parameters from interval [0, 1].

The individuals in each generation are crossbred using single crossover point technique and mutation randomly mutates a gene, generating a new floating point number from interval [0, 1].

Selecting individuals for crossbreeding uses a rank-selection technique. From a technical point of view, a linked-list is constructed and the worst individual is added once, second worst twice etc. Therefore the best individual in population consisting of 300 individuals is 300x more likely to be chosen than the worst. In contrast to technique based solely on a loss function value, if one individual is much better than others, it does not prevent others from being chosen for cross breeding. The rank selection helps preventing a loss of diversity in population.

Loss function of this algorithm reconstructs a neural network from each individual and uses the training data to compute predictions. Predictions are compared to expected (correct) values and Mean Squared Error is computed for each individual. This is the result of a loss function. The lower, the better (some genetic algorithms use vitality function – the higher, the better).

Next generation consist of elites which are preserved, crossbreds, mutated crossbreds and couple of newly generated individuals. Table 12 shows the empirically chosen parameters of the genetic algorithm for training this neural network. The genetic algorithm is created as a library therefore it can have more general use in the future.

Since computing the loss function for an individual does not affect the other individuals, its call is parallelized. The genetic algorithm does not define the loss function, it only defines a callback keeping it general. It is up to the calling code to ensure its thread-safety.

Table 12. Genetic algorithm parameters

Parameter	Value
Population	300
Elites	1 individual
Crossbreds	145 pairs
Mutants	1% chance either elite or crossbred
Randoms	300 – (elites + crossbreds + mutants)

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4.3 Performance evaluation

For the size of input data, training of the network took on average roughly 40s on the author's computer and average CPU load was 85% on 6-core CPU with Hyper-Threading. The predictions based on validation data were stored into a CSV file for further analysis.

Compared to the Deeplearning4j's backpropagation algorithm, this one is slower but the average CPU load is higher. This is due to good optimization techniques used in Deeplearning4j.

The algorithm was analysed using VisualVM profiler for Java Virtual Machine. Further optimizations for the genetic algorithm are possible:

1. More efficient rank selection. Currently, there is a rather naïve implementation and the profiler showed rather high CPU time.

2. More efficient usage of memory. Although Clojure immutable data structures are rather well optimized (Clojure was created for usage in processing of large volume of data), some of the functions for its processing produce temporal structures which are immediately garbage collected. Merging more collection operations together (e.g. using Clojure transducers https://clojure.org/reference/transducers) can be beneficial.

3. Using another matrix library. Clojure in its core library (equivalent to standard libraries of other programming languages) defines an API for vector and matrix operations, but its default implementation is pure Clojure/Java. On the other hand, Deeplearning4j uses Intel MKL library which is hand-optimized assembler implementation, making it faster for numerical computations.

5 Conclusion

Each value from the prediction results of both networks was compared to the actual value and a difference was calculated. Two data sets were created, one for each network, containing these differences. Variance ratio test was performed (see Figure 9) showing that both result sets have statistically equal variances. A t-test with equal variances was performed (see Figure 10) showing that the mean of the result sets is statistically equal. It was therefore concluded, that there is no statistically significant difference between predictions made by each of the neural networks.

It was shown that the genetic algorithm mentioned in chapter 4 can be used to train a neural network to approximate an ARIMA model for predicting currency exchange rates. Although the implementation of the algorithm has room for improvement, the shortcomings can be addressed as mentioned in chapter 4.3.

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Figure 9. Variance ratio test between results

```
Variance ratio test

      Group │       Obs        Mean    Std. Err.    Std. Dev.    [95% Conf. Interval]
────────────┼────────────────────────────────────────────────────────────────────────
   Backprop │       500    .0019818    .0001624    .0036317    .0016627    .0023009
    Genetic │       500    .0021717    .0001653    .0036958     .001847    .0024964
────────────┼────────────────────────────────────────────────────────────────────────
   combined │     1,000    .0020768    .0001158    .0036633    .0018494    .0023041

        ratio = sd(Backprop) / sd(Genetic)                              f =   0.9656
    Ho: ratio = 1                                      degrees of freedom = 499, 499

      Ha: ratio < 1                  Ha: ratio != 1                    Ha: ratio > 1
    Pr(F < f) = 0.3480        2*Pr(F < f) = 0.6961            Pr(F > f) = 0.6520
```

Figure 10. T test between results

```
Two-sample t test with equal variances

      Group │       Obs        Mean    Std. Err.    Std. Dev.    [95% Conf. Interval]
────────────┼────────────────────────────────────────────────────────────────────────
   Backprop │       500    .0019818    .0001624    .0036317    .0016627    .0023009
    Genetic │       500    .0021717    .0001653    .0036958     .001847    .0024964
────────────┼────────────────────────────────────────────────────────────────────────
   combined │     1,000    .0020768    .0001158    .0036633    .0018494    .0023041
────────────┼────────────────────────────────────────────────────────────────────────
       diff │             -.0001899    .0002317                -.0006446    .0002649

        diff = mean(Backprop) - mean(Genetic)                            t =  -0.8193
    Ho: diff = 0                                       degrees of freedom =      998

      Ha: diff < 0                    Ha: diff != 0                    Ha: diff > 0
    Pr(T < t) = 0.2064        Pr(|T| > |t|) = 0.4128            Pr(T > t) = 0.7936
```

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WAGE DIFFERENTIAL BETWEEN FEMALE AND MALE EMPLOYEE IN CHINA

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Abstract

The differential of wage between male and female employee in China became unignored after its market-oriented reform. The increasing privatization of Chinese economy leads the labor mobility, that workers moved from the state-owned enterprise to the private business, from the rural area to the urban area. The former feature of the labor market in China was its management of the labor force of *HouKou* registration system and its strict controlling of the mobility of worker and the employment, which dominates the wage of individual person. This paper selects 2,359 observations from the data of the Chinese General Social Survey in 2015 to study the determinant of gender wage and the decomposition of gender wage gap caused by the characteristics of the employee, such as the educational level, the status of *Hukou* and the property of enterprise. The aim of this article is to learn the earning's differential of the full-time employed female and male laborers in China with the empirical evidence. The result indicates that the gap in the earning between female and male observations is over 20%, and the wage of female is less than male worker. This paper finds out that *Houkou* of the residence has no significant influence on the difference in wage now. The education has a significantly positive influence on the wage for both men and women, but there are different degrees of this influence in different parts of China. Education contributes a lot to narrow the gap in wage between female and male worker.

Key Words

Wage gap, Education, Gender, Full-time employment.

JEL Classification

J16, J21, J24, J31

1   Introduction

After 1978, the mobility of labor force in China caused the internal migration from the rural area to the urban area. The development of Chinese labor market in recent years shows a broken segmentation which caused by the household registration system (*Houkou*) before. Although the *Houkou* still has effects on the individual welfare and the opportunity for employing in some cities, the importance of this factor in Chinese labor market is much less than before (Weng, 2016).

Before 1978, the state-owned enterprises dominated the national economy in China. The employment of urban graduates was unifiedly arranged by the government. The female and male worker were equal in employment opportunity and had no much difference in their payment of work. In that circumstance, the human capital function did not work (Wang, 2005).

With the reform of becoming a market-oriented economy, the non-state-owned enterprise and business with multiple-property creates the main demand of labor force in China. By the end of 2017, there are more than 27 million private enterprises and 65 million individual and private businesses in China. The total number of those private enterprise and business accounts for 90% of all enterprises in China and

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the non-state-owned entity provides over 80% of the position of job (Wuhan University, 2018). The market mechanism was gradually formed. The choice of hiring and firing the worker and the decision of payment is a duty of company (Cai *et al*, 2009).

Meanwhile, the female labor force participates rate (LFPR) of China is much higher than the average level around the world. From 2010 to 2017, the female LFPR of China was 63.8%, 63.3%, 63.1%, 62.8%, 62.4%, 62% and 61.5%. The average LFPR of female in world was 49.35%, 49.13%, 48.96%, 48.93%, 48.85%, 48.79%, 48.88% and 48.68% from 2010 to 2017 (World Bank, 2018). Women of China involved more in the daily work.

With the improving social and economic living environment in China, more and more labor force come into the labor market with a higher level of education, the number of graduates with a college and junior college degree was 5.119 million, 5.311 million, 5.754 million, 6.082 million, 6.247 million, 6.38 million, 6.59 million and 6.80 million from 2008 to 2015 (NBSC, 2018).

The fundamental theory of running a modern enterprise is to hire the employee more efficiently. With the development of its modern labor market, the differential of income between male and female worker in China became a social phenomenon which cannot be ignored. The new report shows that difference in monthly income between the female and male is 22 % in 2017, and the wage gender gap was even higher as 30% before. (Jiang, 2018).

The main purpose of the paper is to study the difference in the gender wage of full-time employee in China. They are employed in the different enterprises which separated by the property of company. The Mincer earning function and the Oaxaca decomposition function are used in this research to find out the determinant of gender wage, and to test the contribution of relevant factors on the earning.

This study is presented as follows. Section 2 is selected previous literature review. In Section 3, the data used in this paper with an overview of the differential of the wage of full-time employees and the methodology are described. In Section 4, the results of the estimation and decomposition are presented. Section 5 concludes.

2   Literature

The classical statement about the education as an investment of the human capital which related the distribution of earning is from Mincer in 1970s. The studies from China show that the rate of return of the education increased since the 1990s and the capability of education improved the income significantly. The higher educational level has an increasing marginal return. There is no significantly difference in return between the junior middle schooling and the primary schooling, and the employee with the higher education obviously higher benefit from their schooling. However, the education doesn't dominate the income of worker, the factor such as the industry, the region and so on also plays as an important role. The expanding of scale of the college education doesn't decrease the return of higher education (the junior college certificate and more schooling), in contrast, the higher education's return increased. The study indicates that the characteristics of human capital had the different contributions on the changing wage gender gap in China overtime in the past two decades. (Wang, 2005; Park and Qu, 2013; Yang and Wang; 2015; Fang and Huang, 2017).

The difference in the wage between female and male in China became a problem and an obvious social phenomenon after its market-oriented reform. The movement of labor force from the state-owned enterprise to the non-state-owned company, and the mobility of laborer from the secondary sector to the tertiary sector changed the structure of the labor market of China. The previous studies show that the gender wage gap in urban China gradually widen from 1995 to 2007, and this differential decreased after 2007 and turn back to be wider again from 2014 (Song *et al*, 2017). The similar research from Chen (2011) states that the gap in gender wage increased by 10% from 1989 to 2009. The most obvious wage gap between men and women shown in the group which the employee is working in the non-state-owned sector and over 40 years old with less schooling (Zhang, 2004).

Peng (2011) studies the gender difference in the return of education and finds that women with higher education has a higher rate of return of schooling but has a lower payment than man. The gender wage gap in China mainly caused by the intersectoral factor as the labor market discrimination. Same result came from Liu (2008) and his study indicates that women has a higher rate of return of education than man. The level of education negatively relates with the degree of discrimination. The difference in income between female worker who schooled more and women who schooled less is greater than this differential of male group.

The gender gap of earning caused by lots of reasons. The transform of economy creates the different wage paid in various sectors and areas. The sectoral feature determines the wage level and the difference in earning of worker (Song *et al*, 2017). Lots of small state-owned enterprise bankrupted because of the reform of enterprise in the middle of 1990s. This resulted the mobility of worker from the state-owned enterprise to the private business. The increasing privatization of Chinese economy increased the gender gap of income since more and more women employed by the private enterprise and this increased the discrimination in the labor market (Chen, 2011).

Meanwhile, more and more migrant moved from the rural China to urban China for the better employment. They work in the different industries and enterprises instead of the traditional agriculture sector. The private sector has more gender wage differential than the public sector (Chen, 2011). However, the social insurance and protection for the migrant in the informal employment is not enough (Cai *et al*, 2009).

The new regulation, *The Employment Contract Law*, is implemented in China in 2007. The strict enforcement of this law allows that the worker who has less protection or worse working condition has more choice to require the better payment from the employer. This improves the equal income of worker in the labor market (Cai *et al*, 2009). The labor market policy, such as *The Minimum Wage Policy* in 2007, positively improves the difference in gender wage after (Song *et al*, 2017).

Wang (2005) study the difference in gender wage of China with the data of employment in five big cities. The decomposition result shows that the wage gap between men and women mainly caused by the intersectoral wage difference, and only little impact on this gap comes from the difference in the types of industry. Over 80% of all difference in gender wage in the same industry can't be explained by the observed variables. The gender discrimination is significant and causes the differential on wage between female and male. Human capital doesn't affect the easing effectively. The similar result is stated by Chen in 2011.

Li and Dong (2008) use the characteristics of the enterprise as the independent variable to study the gender wage gap. Their result shows that the return of education decreased significantly when adding the relevant factors. The scale of enterprise, the level of the privatization of company's property and the outside competitive environment are important to determine the gap in gender wage.

The wage gap also be tested between the informal employment and the formal employment. The study from Hou (2013) states that the employee's characteristics of individual can explain one-third of the wage gap in the formal and informal employment in urban China. The female who works as informal employment carry more discrimination in the labor market. Park and Qu (2013) investigated data from six Chinese cities and found out that the wage gap between the formal sector and the informal sector increased. The employee of the informal sector has a lower rate of return of education than the employee of the formal sector. However, the education has more efficient contribution on employee's earing in the informal employment.

More study states that the declining of the birth of young generation and the increasing single individuals would narrow the gap in gender earning in urban China. There is less gender wage gap for the unmarried worker than the married worker who has one or more children (Song *et al*, 2017). Zhang *et al* (2006) use the spatial econometrics to analyze the wage gap between the different areas and indicate that the economic transformation, the local regulation, the educational level, the reform of company's ownership and the capital investment, affect the wage gap between the various areas.

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3 Data and Methodology

3.1 Data

This paper uses the data from the Chinese General Social Survey (CGSS), which is a representative and national survey in China. The earliest CGSS started in 2003 and it be undertaken once in about two years. This project is designed to collect systematically the original data of level of social, family and individual residence, which include the basic information as main content and some specific resources that supposed to study the different fields in every survey. CGSS focus on the changing relationship between the social structure and the quality of life in both urban and rural China. Data of CGSS is the main database of the social and related research of the academic institutions and government.

The data in this research is from CGSS (2015), which is the newest opening one of this survey. The CGSS (2015) covers 23 provinces and 4 municipalities and randomly interviews about 11,000 individuals with more than 1,000 variables. This paper chooses the observations which are 18 to 59 years old and have a full-time job (not serviceman and work in the non-agricultural sector) to limit the sample. Those residences take a clear statement of the selected questions that used as the variables in this research. Thus, there are total 2,359 observed objectives in this paper and the non-related variables are excluded. The national average monthly minimum wage of full-time work in China is about 1,050 *Chinese Yuan* in 2014. Considering this regulation and to avoid those unreasonable data, the observations in this research are the residences who have the payment as not less than 12,500 *Chinese Yuan* in 2014.[12] Moreover, the original observations in CGSS also include the owners of a private company as an employer. In this analysis, those observations are eliminated.

In this paper, the selected variables of the location of observed objectives are East China, Central China, and West China according to the definition from China Health Statistics Yearbook.[13] East China is much more developed compared with the central and west China. In the *Top 10* province or municipality of per capita income of China in 2014, seven of them belong to the east part of China.

Education is an important factor in human capital model and the measurable competence of individuals. In this research, the years of education of observed objectives is calculated according to their educational level. It will be discussed in the next part. Secondly, the educational level also be divided into five categories which represents the different types of educational capability[14].

The different employment and the enterprise ownership of company may cause the difference in wage. In the paper, the observations are separated into five categories according to their employment. They are the labor force who self-employed as an individual and private enterprise, the employee who work in a private enterprise, the employee belongs to the state-owned or collective enterprise, the employee hired by the foreign and Hongkong, Macao and Taiwan fund enterprise, and the staff works in the government or institutional organization.

Table 1 shows the detail of data in this paper. About 60% of those observed objectives have the urban residence "*Hukou*" and most of them are living in the urban area. The proportion of female who has the college and junior college degree is much higher than other who has different educational level. Regarding the distribution of male's education, the share of middle school, the share of high school and technical secondary school and the share of college and junior college are approximate, and each of this

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[12] The purpose of this paper is to study on the wage of full-time employment, which excludes the income of the part-time and the unemployed worker. Therefore, the group selection bias is not considered.

[13] In the mainland of China, East China includes Liaoning, Beijing, Tianjin, Hebei, Shandong, Shanghai, Jiangsu, Zhejiang, Fujian, Guangdong, and Hainan; Central China includes Heilongjiang, Jilin, Shanxi, Anhui, Jiangxi, Henan, Hubei and Hunan; West China includes Inter-Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shanxi, Gansu, Qinghai, Ningxia, and Xinjiang.

[14] The five types of capability related with the education level are: the primary school and less education, the junior middle school, the high school and technical or secondary school, the college and junior college degree and the master or higher degree.

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share is about 30%. The higher proportion of highly educated women are observed, which proves that the women need more schooling to take the employment positions than men.

Table 1. Overview of Observed Objectives of Female and Male of China (2015)

	Female	Male
Area		
West	158 (15.74%)	199 (14.69%)
Central	243 (24.20%)	392 (28.93%)
East	603 (60.06%)	764 (56.38%)
City	876 (87.25%)	1,086 (80.15%)
Education		
Primary school and less education	103 (10.26%)	102 (7.52%)
Junior middle school	247 (24.70%)	399 (29.45%)
High school and technical secondary school	239 (23.80%)	398 (29.37%)
College and the junior college degree	387 (38.55%)	425 (31.37%)
Master and higher degree	28 (2.79%)	31 (2.29%)
Urban residence *(hk)*	652(64.94%)	799 (58.97%)
Employment		
Self- employed		
Individual and private enterprise	155 (15.44%)	215 (15.86%)
Employed		
Private enterprise	467 (46.51%)	635 (46.86%)
The State-owned and collective enterprise	118 (11.75%)	204 (15.06%)
Foreign and Hong Kong, Macao and Taiwan fund enterprise	28 (2.79%)	33 (2.44%)
Government and institutional organization	236 (23.51%)	268 (19.78%)
Total	**1,004**	**1,335**

Source: Author calculated the values in this table based on data from CGSS 2015

Considering the employment of observations, 46% of observations are employed by the private enterprise, and about 16% of observation are self-employed. The proportion of female staff who work in the government or institution is about 24% of all female worker, and this share of male worker is about 20%. Working with government or institutions is more attractive to women. The ratio of the formal and informal employment of those observations matches the study from Meng (2017), which calculates the share formal employment is about 20% in China based on the national statistics data of China.

Figure 1 shows the annual wage of female and male full-time employee of China in 2014, which excludes the employer who doesn't have a job or works as a part-time employee. The calculated *Gini Coefficient* of those 2,359 samples is 0.16 and is much less than the official *Gini coefficient* which was 0.469 in 2014. The missing average wage of people who work in the foreign, Hongkong, Macao and Taiwan fund enterprise in central and west China caused by the few numbers of observed objectives in this research, which is less than 5 observed objectives in each area.

The amount of annual wages is about 55,900 *Chinese Yuan* for male and 44,700 *Chinese Yuan* for the female. The income of female is about 24% lower than the male. Without a doubt, the average wage in east China is much higher than the average wage in central and west China. The employees who work in the foreign, Hongkong, Macao and Taiwan fund enterprise in east China are paid as the highest wage for both male and female, and the employees who work in the private company in west China has the lowest payment, which is only one-third of the highest level. The differential of average wage between

central China and west China is not evident, but women who self-employed and work in the state-owned and collective enterprise in west China earn more than women in central China.

Figure 1. The Average annual wage of full-time employed labor in different areas of China in 2014
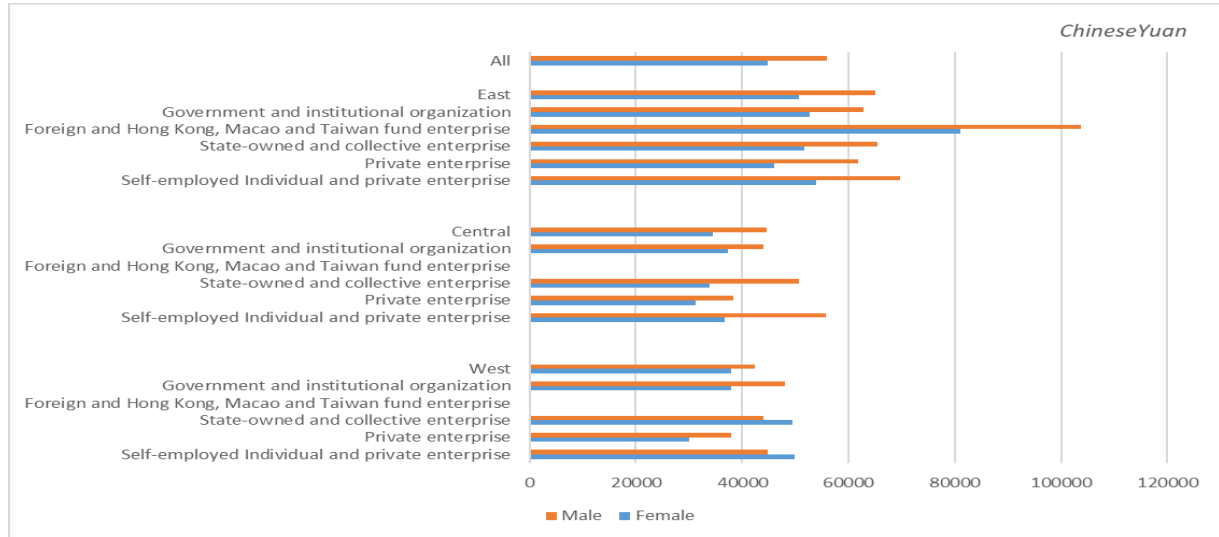
Source: CGSS (2015)

3.2 Methodology

The classic function of earning is the Mincer's Earning Function, which is a simple and tractable regression method and widely applied since 1958 (Polachek, 2007). It is a single equation that explains the relation between the income, the schooling and the experience, shown as

$$Ln(wage) = \alpha_0 + \alpha_1 Edu + \alpha_2 Exp + \alpha_3 ExpSq + \cdots + \mu \qquad (1)$$

Where *ln(wage)* is the logarithm wage, *Edu* represents the years of schooling, *Exp* is a variable of years of working experience in labor market and *ExpSq* is a variable of squared years of working experience to describe the declining of wage with the aging of worker. Years of schooling is a continuous variable. Using the declaration from Xie and Hannum (1996), considering the duration of the different stages of Chinese educational degree, the years of education are 6 to 19 in this analysis.[15] The $\alpha_1, \alpha_2, \alpha_3$ and α_4 are the coefficient of variables. The term μ contains other factors influencing a worker's wage. The study estimates the model by Ordinary Least Square (OLS) using the relevant functions.

To test the differential of gender earning, the expanded Mincer's Earning Function used, shown as

$$Ln(wage) = \beta_0 + \beta_1 Female + \beta_2 Edu + \beta_3 Exp + \beta_4 ExpSq + \mu \qquad (2)$$

Where, *Female* presents the gender of worker. And it is dummy variable which equals 0 for female and equals 1 for male. Added the function (2) with the factor of employment of observations, the function shows as

$$Ln(wage) = \beta_0 + \beta_1 Edu + \beta_2 Exp + \beta_3 ExpSq + \beta_4 Emp_1 + \beta_5 Emp_2 + \beta_6 Emp_3 + \beta_7 Emp_4 + \mu \qquad (3)$$

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[15] The year of education in the primary school is 6 and less education is 3 years; the year of education in the middle school is 9 ; the year of education in the general high school is 12 ; the year of education in the junior middle technical school is 11; the year of education in the special secondary school is 13; the year of education in the junior college is 15; the year of education in the college or university is 17 and the year of education with a degree of master or higher is 19.

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Where, Emp presents the different types of employment of worker. Emp_i is the type i employment in this paper. The five categories of employment based on the property of enterprise showed as table 1. The reference group is the worker who self-employed as an individual and private business.

To analyze the differential of rate of return from different educational level, this paper creates the dummy variable to present the status of education. The coefficient of the dummy variable shows the difference in educational rate of return between each group, as follows

$$Ln(wage) = \beta_0 + \beta_1 Edu_1 + \beta_2 Edu_2 + \beta_3 Edu_3 + \beta_4 Edu_4 + \beta_5 Exp + \beta_6 ExpSq + \beta_7 Emp_1 + \beta_8 Emp_2 + \beta_9 Emp_3 + \beta_{10} Emp_4 + \mu \qquad (4)$$

Where, Edu present the factor of education. Edu_i is the type i educational level. The reference group is the employees who have the primary school educating or less education in this paper.

And, adding the location of observations as independent variable in function (3), this linear regress function shows as

$$Ln(wage) = \beta_0 + \beta_1 Exp + \beta_2 ExpSq + \beta_3 City + \beta_4 Middle + \beta_5 East + \beta_6 Edu + \beta_7 Emp_1 + \beta_8 Emp_2 +$$
$$\beta_9 Emp_3 + \beta_{10} Emp_4 + \mu \qquad (5)$$

Where, $City$ presents the factor of the location, and it is a dummy variable. It equals 0 if the working place of the observations is the rural area and equals to 1 if it is the urban area. $Middle$ is factor of location of observation who are in middle of China and it is a dummy variable, as well as $East$. The observation in west China is the reference group. Using the level of education to present the factor of schooling instead the years of education, the function shows as

$$Ln(wage) = \beta_0 + \beta_1 Exp + \beta_2 ExpSq + \beta_3 City + \beta_4 Middle + \beta_5 East + \beta_6 Edu_1 + \beta_7 Edu_2 + \beta_8 Edu_3 + \beta_9 Edu_4 + \beta_{10} Emp_1 + \beta_{11} Emp_2 + \beta_{12} Emp_3 + \beta_{13} Emp_4 + \mu \qquad (6)$$

The age of observed individual is not included in this paper[16]. And, the linear regression to estimate logarithm wage of the individual i in group A is

$$Ln(Wage_{Ai}) = X_{Ai}\beta_{Ai} + \mu_{Ai}, \mathrm{E}(\mu_A) = 0 \qquad (7)$$

Where X is a vector of explanatory variables, β is vector of coefficients and μ is an error term.

To find out the wage difference in two groups, the Oaxaca-Blinder decomposition which discovered by Oaxaca and Blinder separately in 1973 is chosen in this research. The difference in mean wage can be expressed as the difference in the linear prediction at the group-specific means. Let $\hat{\beta}_m$ and $\hat{\beta}_f$ be respectively the regression estimates of coefficient of male and female group, then the mean difference of logarithm wage between male and female decomposed as

$$Difference = Ln\overline{W}_m - Ln\overline{W}_f = \left(\overline{X}'_m - \overline{X}'_f\right)\hat{\beta}_m + \overline{X}'_m(\hat{\beta}_m - \hat{\beta}_f) + \left(\overline{X}'_m - \overline{X}'_f\right)\left(\hat{\beta}_m - \hat{\beta}_f\right)$$
$$(8)$$

This equation decomposes the gender wage gap into three part. $\left(\overline{X}'_m - \overline{X}'_f\right)\hat{\beta}_m$ is part of the wage gap that can be explained by the differential of observed characteristics of individual (the endowments). $\overline{X}'_m(\hat{\beta}_m - \hat{\beta}_f)$ represents the unexplained wage gap caused by the effects of discrimination in the labor market. $\left(\overline{X}'_m - \overline{X}'_f\right)\left(\hat{\beta}_m - \hat{\beta}_f\right)$ is the interaction between coefficients and endowments (Jann, 2008; Guo *et al*, 2011).

In this paper, the "Index problem" [17](Guo *et al*, 2011) is not considered. The female labor force is the reference group in this analysis.

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[16] The years of age is omitted in this paper because of its collinearity with the year of experience.
[17] The term of" index problem "is the choice of reference group in the model. The different reference group leads the different result of decomposition.

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4 Empirical results

Using the function (1) and (2), the basic estimation of model shows that the full-time employed men earn much higher than women by 21%. Annual education leads a higher rate of return for both male and female by about 7%, shown as table 2. The regression result with the independent "*hk*" shows that the factor "*hk*" does not affect the wage of observed full-time employee in 2014 significantly, shown as table 4.

Table 2. Estimating result with function (1) and (2)

	Function (1)			Function (2)
	Total	Female	Male	Total
Male				0.213 (9.23)**
Education	0.072 (20.07)**	0.068 (13.31)**	0.075 (15.45)**	0.072 (20.45)**
Experience	0.019 (4.37)**	0.016 (2.52)*	0.024 (4.00)**	0.021 (4.82)**
ExpSq	-0.000 (4.28)**	-0.000 (2.43)*	-0.001 (4.21)**	-0.000 (4.96)**
_cons	1.979 (28.81)**	1.942 (19.88)**	2.001 (21.58)**	1.856 (26.96)**
R^2	0.18	0.20	0.18	0.21
N	2,359	1,004	1,355	2,359
* p<0.05; ** p<0.01				

Source: author's calculation

With the function (3) and (4), the results shown in table 3 state that the differential of educational contribution on wage of men and women in the west, central and east China. The extra year of education contributes more on the wage of female and male employee who work in the east China. The education has a more positive effect on the earning of the full-time employed women in the west China, even the junior middle schooling does help to raise the payment by 30% significantly. The effect of higher education on wage shows the different effectiveness in the west, central and east China. Education has less efficiency to improve the earning of worker in middle China for both female and male.

Table 3. Estimate rate of return of education to income in the west, central and east China

	Female			Male		
Function (3)	West	Middle	East	West	Middle	East
Education Year	0.073	0.050	0.084	0.048	0.050	0.099
	(4.78)**	(4.95)**	(11.42)**	(3.74)**	(4.95)**	(14.15)**
R^2	0.23	0.12	0.30	0.15	0.12	0.26
Function (4)						
Primary school and less education	Reference			Reference		
Junior middle school	0.304	-0.095	-0.028	0.097	-0.016	0.152
	(2.02)*	(0.97)	(0.33)	(0.70)	(0.15)	(1.75)
High school and technical secondary school	0.554	-0.010	0.242	0.356	0.154	0.285
	(3.27)**	(0.09)	(2.83)**	(2.44)*	(1.39)	(3.22)**
College and junior college	0.823	0.361	0.646	0.468	0.403	0.838
	(4.51)**	(2.77)**	(7.13)**	(2.92)**	(3.24)**	(9.09)**
Master and higher degree	1.442	0.754	1.073	0.354	0.742	1.404
	(3.37)**	(2.67)**	(7.67)**	(0.90)	(3.14)**	(9.37)**
R^2	0.25	0.16	0.30	0.16	0.13	0.27
* p<0.05; ** p<0.01						

Source：author's calculation

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The estimated results with robust regression of function (5) and (6) is showed in Table 4. The wage of full-time female employee in the east China is higher than the wage of female in west China by 18%. The wage of full-time male employee in east China is higher by 26% than the wage of male in west China. And the wage difference between female in west China and female in east China is 17%. The opportunity of working in east China shows more attractive to the labor force.

The specific educational degree has more contribution on rising male income than female income. The marginal effects of various educational degree are statistically significant. For both male and female, the high school education or similar schooling show a significantly positive effect on improving of wage compared with the reference group, it is about 20% higher. Specifically, the group with the college and junior college educating has more than 50% higher income. The worker who has a master or higher educational degree earns more than 100% higher than the group that worker educated with the primary school or less level.

The worker who self-employed in an individual or private business has more payment and this group are the reference group in this research.[18] The female staff of government and institution earns less money by 39% compared with the reference group. The female worker employed by the private company earns less by 30% and female employee who work in the state-owned and collective enterprise earns less by 30% with statistical significance. The male group shows a similar result. Regarding to the difference in wage between the reference group and every study group, the wage gap of male is narrower than female by 10%.

Table 4. Estimating Hourly wage of the female and male employee in 2015

	Female	Male	Female	Male
Demographic				
Experience	0.015	0.026	0.021	0.027
	(2.61)**	(4.33)**	(3.37)**	(4.51)**
Experience Squared	0.000	-0.001	-0.000	-0.001
	(2.33)*	(4.52)**	(3.28)**	(4.79)**
Rural	Reference		Reference	
Urban	0.093	0.054	0.102	0.068
	(2.00)	(1.41)	(2.23)*	(1.77)
West	Reference		Reference	
Central	-0.049	-0.039	-0.038	-0.034
	(0.99)	(0.87)	(0.77)	(0.74)
East	0.177	0.264	0.172	0.263
	(3.95)**	(6.18)**	(3.82)**	(6.14)**
Education Year	0.074	0.077		
	(11.32)**	(13.23)**		
Primary school and less education			Reference	
Junior middle school			0.004	0.085
			(0.08)	(1.47)
High school and technical secondary school			0.204	0.236
			(3.17)**	(3.86)**
College and the junior college			0.589	0.644
			(8.32)**	(9.43)**
Master and higher degree			1.039	1.111
			(8.37)**	(7.91)**

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[18] The payment of the worker who is self-employed as individual and private business usually includes all income come from their business. Strictly, this income should include some contribution from the money capital, not only the working and the time cost of labor force. In this research, we use the loose assumption to test the earning gap of different property enterprise. The amount of this income decided by the employee themselves and it should be the payment with no discrimination.

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Employment
Self-employed

Individual and private enterprise	Reference		Reference	
Employed				
Private enterprise	-0.315	-0.194	-0.305	-0.188
	(6.01)**	(4.01)**	(5.78)**	(3.84)**
The State-owned and collective enterprise	-0.302	-0.185	-0.289	-0.164
	(4.49)**	(3.06)**	(4.34)**	(2.71)**
Foreign and Hong Kong, Macao and Taiwan fund enterprise	-0.029	0.050	-0.031	-0.026
	(0.22)	(0.42)	(0.24)	(0.22)
Government and institutional organization	-0.388	-0.292	-0.391	-0.283
	(6.04)**	(5.06)**	(6.18)**	(4.91)**
_cons	1.967	1.945	2.526	2.527
	(16.27)**	(17.53)**	(24.38)**	(25.94)**
Adj R^2	0.270	0.250	0.276	0.255
Mean VIF	4.66	5.12	4.47	4.88
N	1,004	1,335	1,004	1,335
* $p<0.05$; ** $p<0.01$				

Source：author's calculation

Following the methodology presented above, the author uses the function (8) to decompose the differential of earning. More specifically, this paper analyzes the pure difference caused by the educational effect. The decomposition result is given in table 5.

Table 5. Decomposition of income of the full-time female and male employee

Difference	-.1825219	Difference	-.1825219
Explained	.0421946	Explained	.0529292
Education	.0254084	Junior middle school	-.004055
		High school and technical secondary school	-.0131512
		College and junior college	. 0462667
.		Master and higher degree	.0055641

Source：author's calculation

The explained part of gender wage gap shows a positive effect to narrow this difference. Education contributes over 50% on the improvement of female earning. The high-level education has a much more positive effect on equal wage of female employee. The college and junior college education of women narrows the observed earnings' differential as over 80%. The master and higher educating does affect positively the differential of earning between male and female as 10% of explained part.

5   Conclusion

This paper aims to research the differential of wage between the female and male full-time employee of China in 2014 with survey data from CGSS 2015. With the expanded Mincer Earning Function and the Oaxaca-Blinder decomposition function, this paper analyzes the contribution of years of schooling and the level of education of employee on individual earning. The employment of worker is divided into five types according to the different property of enterprise. The differential of earning of individual of each kind of employment status are obvious. In the decomposition of gender wage gap, the paper doesn't discuss that "how to choose the reference group" in labor market since the main purpose of this research is to find out the differentials between gender wage with the classical model and methodology. The problem of sample selection bias was not discussed since the limitation of research target which focuses about the situation of full-time employed workers, not all working laborers.

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The main finding of this paper is the differential of the earning between the full-time employed female and male worker in China is about 20% in 2014. Education shows a positive contribution on increasing the payment for both men and women. However, the education has different efficiency to raise the payment of work in different areas of China. The imbalance of economic development and other various social factors maybe determine the differential of the structural payment system in different parts of China. The education helps to narrow the gap in earning between female and male significantly. The higher education level of women, such as the junior college and more educating in particularly, does improve the unequal problem of gender wage significantly. However, women who only has the lower level of education, such as the education of junior middle school and high school, take more discrimination.

Houkou doesn't hinder the equal payment to the observed full-time employee. The employee who self-employed earning much than worker in other status of employment. The employment in government and institution is not attractive to worker if only for the benefit from wage. In fact, the government and institutions provide better social security and welfare and almost the permanent employment contract to their staff.

The suggestion from this paper is that the wage gap between female and male is real and significant in China. Education contributes to the earning of employee positively. The government should invest more into education industry and encourage worker to have more education. The policy should consider the different efficiency of return of educational investment in the west, central and east China. Education, especially the higher level of education, would improve the remuneration of female employee significantly. Therefore, government and household should invest more into the higher education of female and avoid the unequal of education of gender.

This paper only selected several factors to analyze their effect on the earning of individual. More dependent variables such as the characteristics of household and employment that determinate the wage of worker potentially should be considered in further study.

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DESIGN THINKING AS A TOOL USED BY STUDENTS IN THEIR LEARNING PROCESS

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Abstract

The aim of this research is to discuss the role of the design thinking methodology in academic purposes. Design thinking is a versatile approach to problem solving, which can be applied in many environments ranging from business to education. This methodology gains popularity every year and helps face complicated problems and issues with unusual tools. Its aim is to provide innovative solutions by using specific work methods that stimulate creativity. Solution creators must go beyond the comfort zone in thinking and acting. Ready-made solutions cannot be used and approach to the presented problem with humility is necessary while the recipients' needs are placed at the centre of the process. In the article a brief introduction to the topic of design thinking and its commonly used methods were presented, as well as the research results concerning the students opinions about design thinking methodology. The research was conducted among 134 students of Lodz University of Technology (Poland) in the fourth quarters of 2018. During the realization of research, the indirect method of gathering information, using a survey technique was applied. The research showed that majority of students are acquainted with design thinking methodology, is able to apply it to their learning process and indicate its particular tools. Several ideas of introducing design thinking methodology to more young academic were presented.

Keywords

Design thinking, creativity, invention, problem-solving.

JEL Classification

L1, O.

1 Introduction

Design thinking is a comprehensive approach to problem solving, which can be applied in various environments ranging from preliminary school classrooms to big corporations, owing to its universal tools. Design thinking has its beginning in the 1960s when the first books on the topic were published. It was understood that a method is needed to create innovative products and services based on a deep understanding of users' expectations and needs. In that time, the first theories on different fields using creativity techniques appeared such as Asimow's book on engineering (Asimow, 1962), Alexander's publication on architecture (Alexander, 1964), and Archer's book on industrial design (Archer, 1965). Then many issuances followed and first companies brought design thinking into their problem solving processes. At the turn of the eighties and nineties, design thinking was applied to the study program at Stanford University (Brown, 2008). The next step was the use of commercial design thinking by Kelley, Moggridge, and Nuttall, who in 1991 founded the consulting company IDEO, applying design thinking tools by introducing the client-focused approach and customer-friendly terminology, hints and lessons learned. Design thinking has been developing through all these years and now is widely used in companies as well as in schools and universities in order to improve students' performance.

The objective of this article is to discuss the role of the design thinking methodology in academic purposes. Whilst it becomes one of the most known tools both in business and education, it will be analysed to what extent it is used on a daily basis in academic environment. Modern universities are called third generation universities whose functioning is no longer based only on research and education,

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but also cooperation with the industry to solve specific problems and implement it in real-life solutions (Szewczykowski, 2015). It will be measured whether design thinking is the term students are familiar with and if so, what particular tools they are using not only at the university, but also in studying on their own.

2   Design Thinking and its stages

Design Thinking is a systematic approach to the innovation process when solving a problem. The first step is to gather an interdisciplinary team, composed of people who can look at the issue from different perspectives: engineering, technological, marketing, designing, sociological, etc. Next, the team applies the following steps of the method using a set of tools and techniques to ultimately develop a solution that can be implemented. The team's goal is to generate the ultimate solution and check its functioning at the prototyping stage. The path leading through the subsequent stages does not have to be linear. The failure incurred at the prototyping stage may require returning to the stage of generating ideas or even defining the problem and starting the process from the beginning.

The design thinking methodology consists of five basic elements (Helman et al, 2016), which are shown in Figure 1.

Figure 1: Stages of Design Thinking
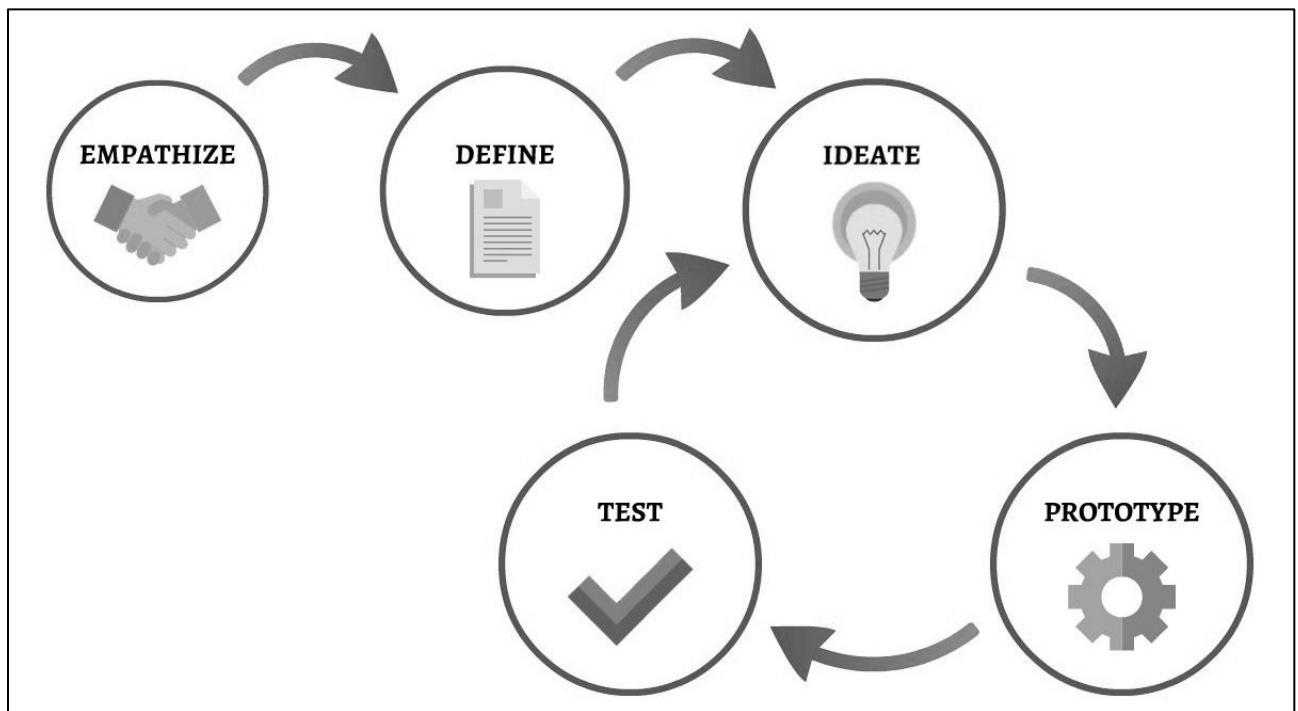
Source: own elaboration

Every stage is an important part of the whole process. The elements are as follows:

Empathize – empathy is the first step of innovation. This is the first and probably the most difficult phase in the whole process. The riddle is the fact that this stage seems to be the simplest one and does not require from people involved in its implementation competences associated with a solid experience developed in teamwork, in contact with other people and interpersonal relationship management skills. Meanwhile, without a solid preparation on the part of soft skills, it is difficult to pass this stage successfully. The aim of this step is to observe and understand human behaviour and needs. For this purpose, tools such as empathy maps, user observations, reconnaissance surveys and thorough environmental analysis are used. People entering the team who work on a given issue do not solve it at the desk. Participants ask target groups, what they expect from a product, service, or process. On this

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initial, however very important stage members of the team ask questions, listen and collect preliminary data - people tend to rationalize their statements and avoid critical comments. Discreet observation of behaviour can show that users apply some of their own amateur enhancements that can become an inspiration for new solutions (Liebersbach et al. 2018). In the end, as a result of the observations made, the team should understand what to work on.

Define - next important element is the right definition of the problem to be solved and finding appropriate point of view. Without the verbalisation and interpretation of the issue of the problem, it may be difficult to take action needed. The proper definition of the issue will affect the whole team's work. It may also happen that during the process continuation, it will turn out that the team has incorrectly defined the issue and will have to go back to this element and try again. This stage can be a huge challenge because most people prefer to work on a specific solution right away and not move in the uncertainty of many possible directions (Helman et al, 2016). Defining the problem narrows the whole picture too quickly. It may turn out that the money, time and energy invested do not address the right problem.

Ideate - the generation of a maximum number of ideas and solutions in a relatively short time, based on the methodology of Design Thinking on the so-called brainstorming. Another commonly used tools are: mind mapping, visualising, 5 Why method etc. This stage requires not only a strong substantive background, but above all courage in creating new, unconventional solutions. In order to carry out this process in the right way, some basic rules should be followed that are not always perceived as easy to accept. Above all, the team at this stage gets rid of restrictions in the form of unreality of the solution or lack of money. Even if the idea submitted by the participant seems absurd, it is not he is rejected. The team needs adequate space at this stage, inspiration and an array, where each participant can freely share their idea. In the final phase, the team chooses one or two solutions and proceeds to further work.

Prototype – means the stage when the best ideas generated during ideation are turned into something concrete (Wyatt et al, 2010). The basis of the implementation process is prototyping, meaning transforming ideas into real products and services, which then are tested and improved. Creating new solutions requires abductive thinking - imagining possible things and situations, based on incomplete data, own knowledge and the team. This is the stage of creating low budget prototypes. The creation and visualization process itself eliminates basic design and conceptual errors at an early stage of looking for the best solution. On the other hand, new prototypes appear during the implementation of the prototype questions and new ideas that can still inspire the team. The goal of this stage is to start a discussion with simple, cheap model and possibly eliminate the idea at an early stage of the process creation or its development to a better version.

Test - this stage is extremely important and should not be overlooked in the course of the project. It involves testing the subject in a real environment, which allows the team to check its correct functioning. Each of the prototypes is assessed by the group, and the best is chosen for further improvement. Testing should be repeated until satisfactory results are obtained. Only after the tests ended with a positive result, it can be assured that the given product or service is ready for final implementation. Unfortunately, the testing stage is often neglected in the implementation of many projects, which means that seemingly good ideas and solutions are directly implemented for everyday use and then it occurs that they do not meet the requirements and expectations.

The expected result from implementing Design Thinking allows creating opportunities for people of different disciplines over a given solution, overcoming resistance in cooperation with other people, and in the long run, creating the right culture promoting innovation and creativity. Applying this methodology and its tools, throughout the prototyping and testing stage, many errors can be eliminated so that the best solution can be achieved more quickly and efficiently.

3   Methodology and Data

The aim of this study is to discuss the significance of the design thinking methodology in the academic environment. The research method applied in the article is anonymous questionnaire among 134 students

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of Lodz University of Technology carried out by the author of this publication. Students who took part in this research are from many different faculties in order to examine using Design Thinking tools by students of many different interests and fields of studies.

A condition for the survival of universities, especially in the current demographic situation, is an attitude towards cooperation with the economy and innovative companies, on the basis of technologies and patents generated by universities (Szewczykowski, 2015). Taking into consideration that modern customer is expecting customized and personalized products and services, companies need to introduce creative and innovative methods such as Design Thinking. The aim should be to prepare students for the modern working environment and tools they will be using when entering the job market. The Scandinavian countries, the Netherlands, Belgium, the United Kingdom, the United States and Canada in the educational process already place great emphasis on practical aspects, including a large number of projects carried out by students during classes conducted in the learning system through the development of practical skills (Chybowski L, 2015). In this article, it will be analysed whether students indeed are familiarized with design thinking methodology and if so, what tools of this technique they are using during their studies.

4   Research and Results

The analysis was conducted among 134 students of various faculties at Lodz University of Technology (TUL). TUL is known as 5th Polish university considering the number of applications for studies per one place in a given public Polish university. Lodz University of Technology is an international and modern educational institution, recruiting foreign students from at least 25 countries. The university promotes modern approach to education and establishes numerous cooperations with companies. Collaborating with companies and analysing various case studies, students have many opportunities to evaluate modern approaches to problem solving and hence such tools as design thinking. The faculties of students who filled the questionnaire are as shown in Figure 2:

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Figure 2. Fields of studies of students taking part in the research
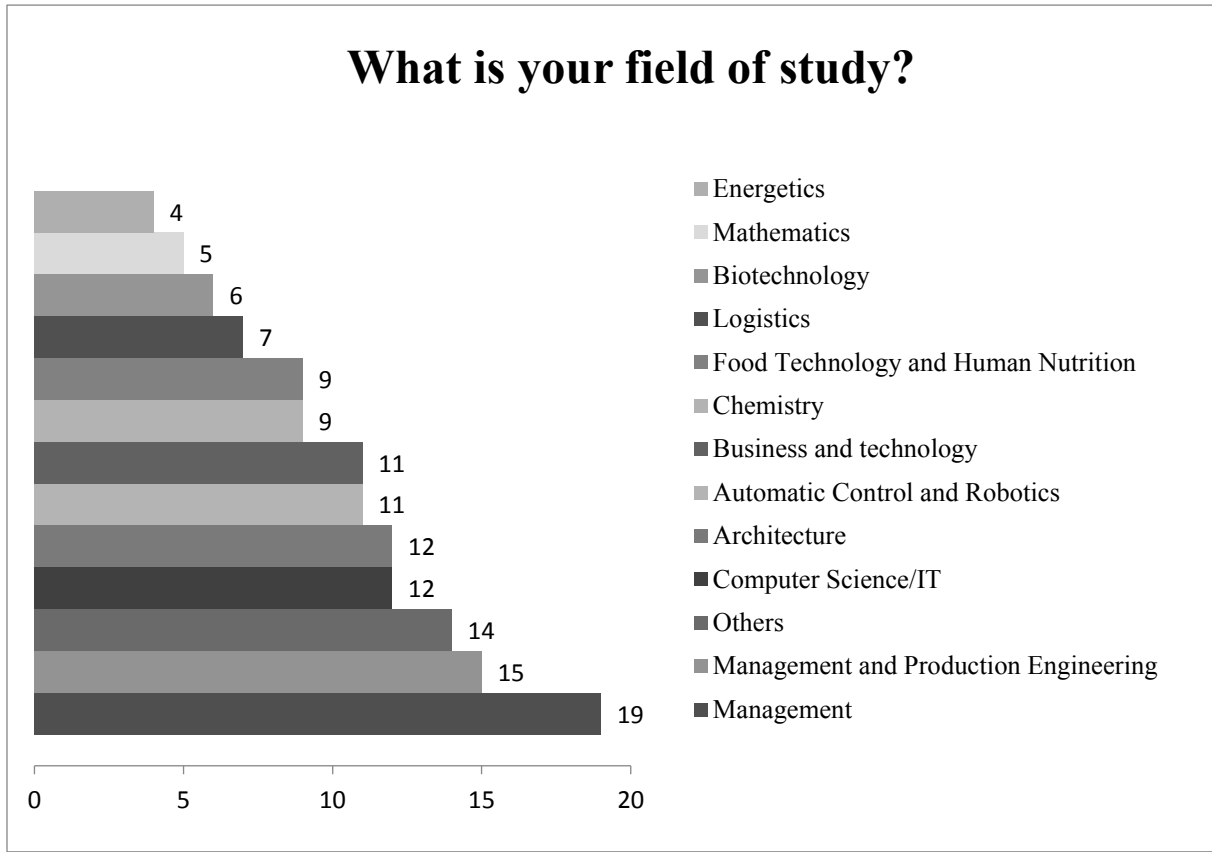
What is your field of study?

Legend:
- Energetics
- Mathematics
- Biotechnology
- Logistics
- Food Technology and Human Nutrition
- Chemistry
- Business and technology
- Automatic Control and Robotics
- Architecture
- Computer Science/IT
- Others
- Management and Production Engineering
- Management

Values (top to bottom): 4, 5, 6, 7, 9, 9, 11, 11, 12, 12, 14, 15, 19

Notes: Result shown in the number of students.

Source: own elaboration on the research conducted

In the conducted survey, there were 19 people studying Management, 15 students of Management and production engineering, 12 people studying Computer Science and subsequently smaller number of students of Architecture, Automatic Control and Robotics, Business and Technology, Chemistry, Food Technology and Human Nutrition, Logistics, Biotechnology, Mathematics, Energetics and many other fields of studies. These are students of different degrees which are as follows: 59 students at Master's degree, 56 students during their Engineering studies and 19 students at the Bachelor's degree. By reason of the diversity of studies, a whole general picture of students' knowledge can be obtained.

The first and foremost issue was to analyse the knowledge of the method among surveyed students. The result it satisfying because more than three fourth of students admit that they are acquainted with Design Thinking methodology. Only 28 students which are 21%, do not know what this term stands for. Taking into account students surveyed, it can be deduced that on average, majority of students in Lodz University of Technology are familiar with this terminology and know what it means. The result may be different if the questionnaire was made at another university which specializes in different fields of study, because DT tools have many possible adaptations depending on the needs, type of problem to be solved and team qualifications.

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The outcome is shown in the graph.

Figure 3. Students' knowledge on Design Thinking term
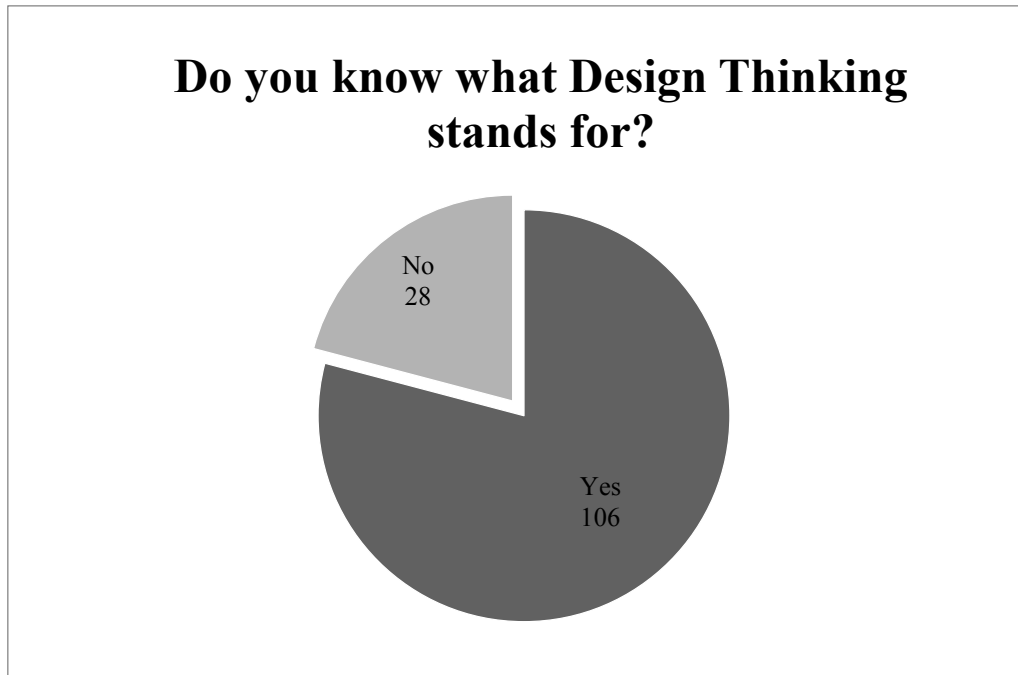
Notes: Result shown in the number of students.

Source: own elaboration on the research conducted

The explanation of this outcome can be found in the next question of the survey, which refers to Design Thinking tools used at the university. Design Thinking methodologies help to run projects more efficiently, categorize the hierarchy of tasks' importance, and help to orientate team to the right target groups. There are a number of design tools, however, all combine one feature - extraordinary flexibility in operation.

Tools and exercises are often modified even when they are carried out. Each project is unusual and project participants are also different, but tools used are the same. Concerning their universal application, they can be applied in various problems ranging from engineering to human resources management. As the questionnaire shows, students know what this methodology is and how to use it. This is because the majority of respondents was able to indicate particular tools of design thinking included in the questionnaire.

These are the most known, universal and malleable tools so that they can be used when solving many different problems. For example, the brainstorming method is worth using, because in this way various problems that often occur in the decision-making process can be avoided, especially when every idea is analysed and evaluated on a current basis. Brainstorming can be applied at any time, and its preparation does not require a lot of time and effort.

Another tool is the mind map, which is a non-linear, omnidirectional information record. It uses the natural feature of the human mind to create associations and this is what the idea of multi-directional thinking is based on. The method "5 why" is based on elimination of various types of errors that appear in training, personal and technical errors, and various types of failures by asking "why?" after receiving an answer. As a rule, it is assumed that on average after asking "why?" 5 times, the essence of the problem should be reached.

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Figure 4. Techniques of Design Thinking students are familiar with
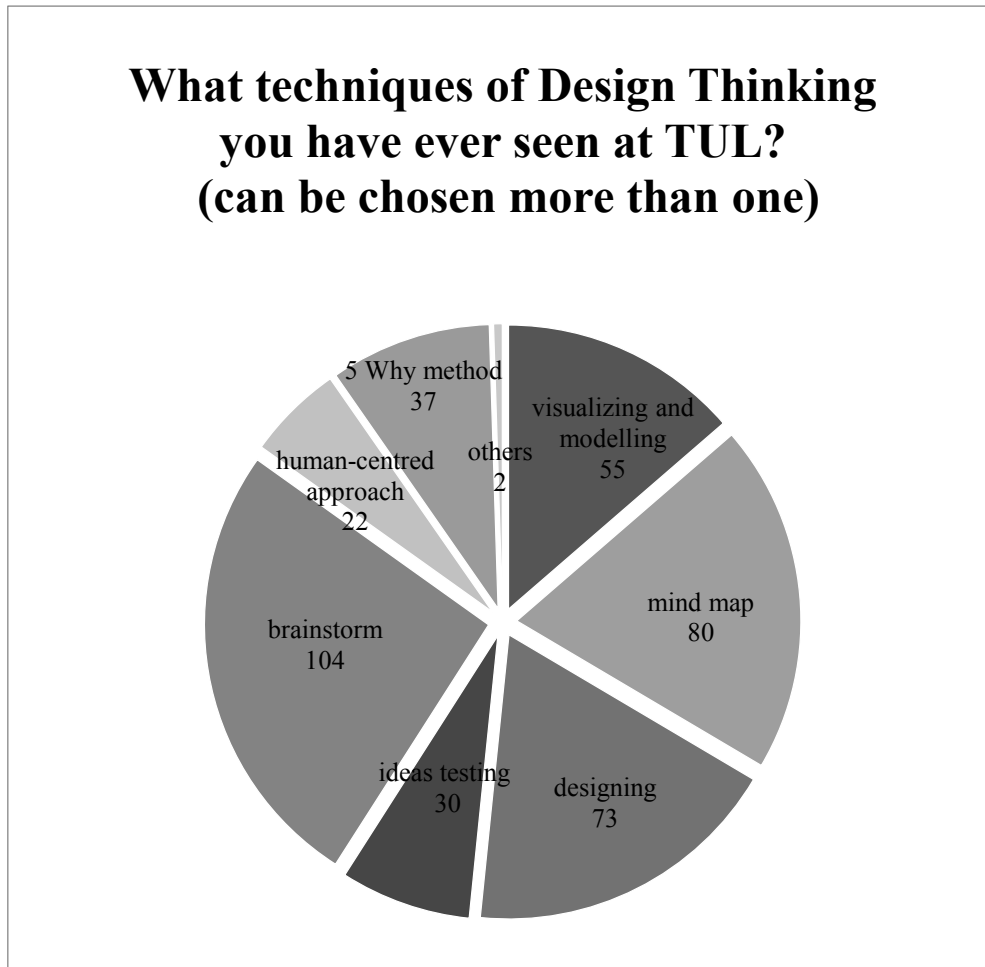
**What techniques of Design Thinking
you have ever seen at TUL?
(can be chosen more than one)**

5 Why method 37
human-centred approach 22
brainstorm 104
ideas testing 30
others 2
visualizing and modelling 55
mind map 80
designing 73

Notes: Result shown in the number of students.

Source: own elaboration on the research conducted

The graph illustrates that the generality of students represents knowledge of brainstorm, designing and mind mapping. This may be because those methods are very common and some people are even not aware that actually they are using design thinking tools. They are easy, popular, helpful and inexpensive. To perform them, team needs only pen and sheet of paper which makes these techniques very accessible and simple. Another tool which was chosen 55 times was visualizing and modelling. This tool takes much more time and is more challenging to perform. To carry this exercise through, some more effort it required. This is because to make visualizations and then models or prototypes, some materials are needed. Even if taking into consideration accessible and cheap materials, it needs more effort than doing a brainstorm or mind mapping, because such materials may not be available in the classrooms all the time. This means, to perform this technique it requires time to prepare and cannot be performed in stride which may be a disadvantage. Another tools, which gained less popularity were: 5 Why Method, ideas testing, human-centred approach and others.

Methods mentioned above are in general very universal, accessible and helpful in solving not only easy but also unconventional problems and queries. They can help students understand the core causes of issues during lectures and workshops so that they are able to solve them quickly and properly. Additionally, they strengthen team bounds and let people better know each other. But putting aside team advantages of using Design Thinking, an additional approach can be considered. Even though the best results are evidently then they are performed as a team, Design Thinking can be applied also in independent work.

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Creative tools stimulate mind and help to construct new ideas in every environment. Some tools like mind mapping might be very helpful when learning things by heart, especially for students who have visual memory and remember things as objects and pictures. Thanks to versatility of the tools, students were also asked whether they apply Design Thinking tools in their everyday learning process, and the results are in Figure 5.

Figure 5. Appliance of Design Thinking tools in learning alone
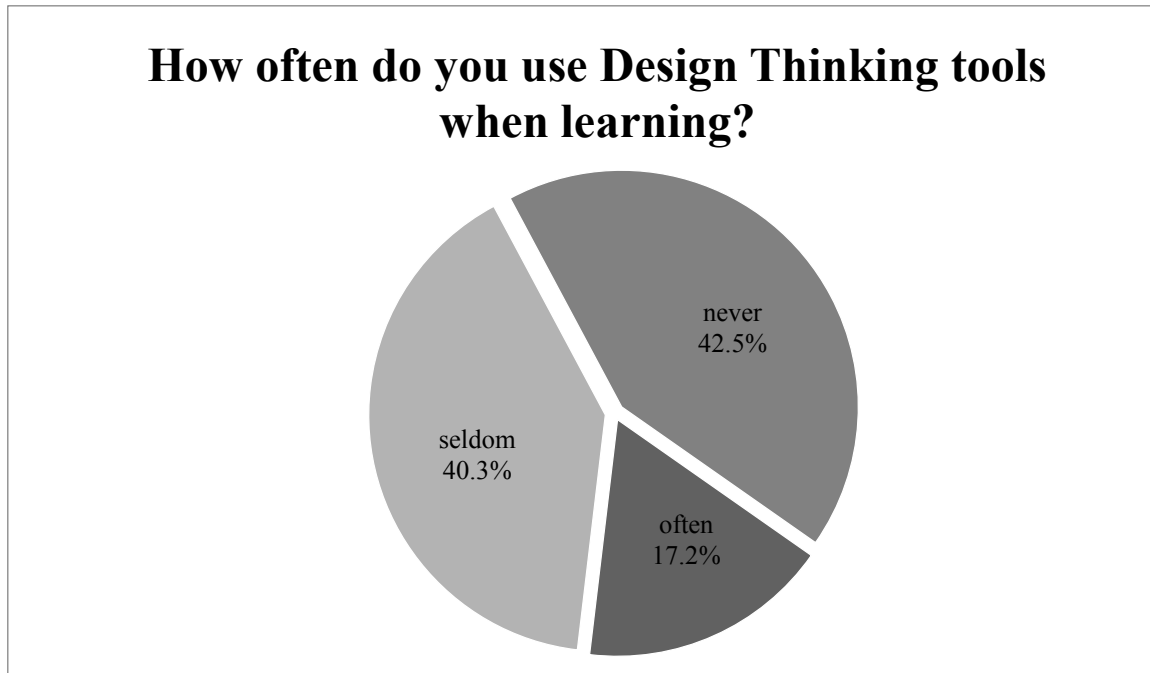
How often do you use Design Thinking tools when learning?

never
42.5%

seldom
40.3%

often
17.2%

Notes: Result shown in the number of students.

Source: own elaboration on the research conducted

Majority of students apply design thinking techniques on their own which shows how popular this methodology is among young academic. It also shows that design thinking can be easily used when learning alone, not only in a team. This high score may be influenced by university's effort as well, throughout introducing the method during lectures and workshops and teaching students how to use these tools properly and universally.

On the other hand, there is still 42,5% of students who do not use Design Thinking tools at all. This can indicate that they do not find this methodology useful, or they apply other tools which help them learn efficiently. Another conjecture on choosing this option may be that those students do not know Design Thinking at all. It should also be taken into consideration that applying DT and any other tool usually depends on student's character qualities, motivation, attitude, environment, routine, circumstances, and many others.

There are some possibilities to encourage students to start implementing DT. Maybe some of them do not use it, because they do not know the tools and instruments. This is why workshops could be introduced by the university, which should be carried out by specialists. Through their experience and results it may be a proper approach to young academics, showing how using creative problem solving can improve outcomes, be developing and team-building. Additionally, a cooperation between the university and a company could be introduced in order to demonstrate how Design Thinking works in real cases. It would also be a big opportunity to advance students' skills which would be useful on the job market they will be entering soon. It may also help students understand versatility of the methodology in many environments, learning how miscellaneous the design thinking mechanisms can be.

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Providing knowledge and tools to apply a method on daily basis may still be challenging if the attitude is inadequate. Perhaps some people are prejudiced against this method because they have heard unflattering opinions or after the first attempt they thought it was a laborious method that would take too much time. Like everything that attracts the public attention, design thinking has also gained a lot of sceptics and opponents who believe that this methodology is useless, consuming too much time and money to implement it. This is why students' opinion on Design Thinking was measured to provide wide perception of the concept and understand people's motivations. The results are presented in Figure 6.

Figure 6. Students' opinion on Design Thinking
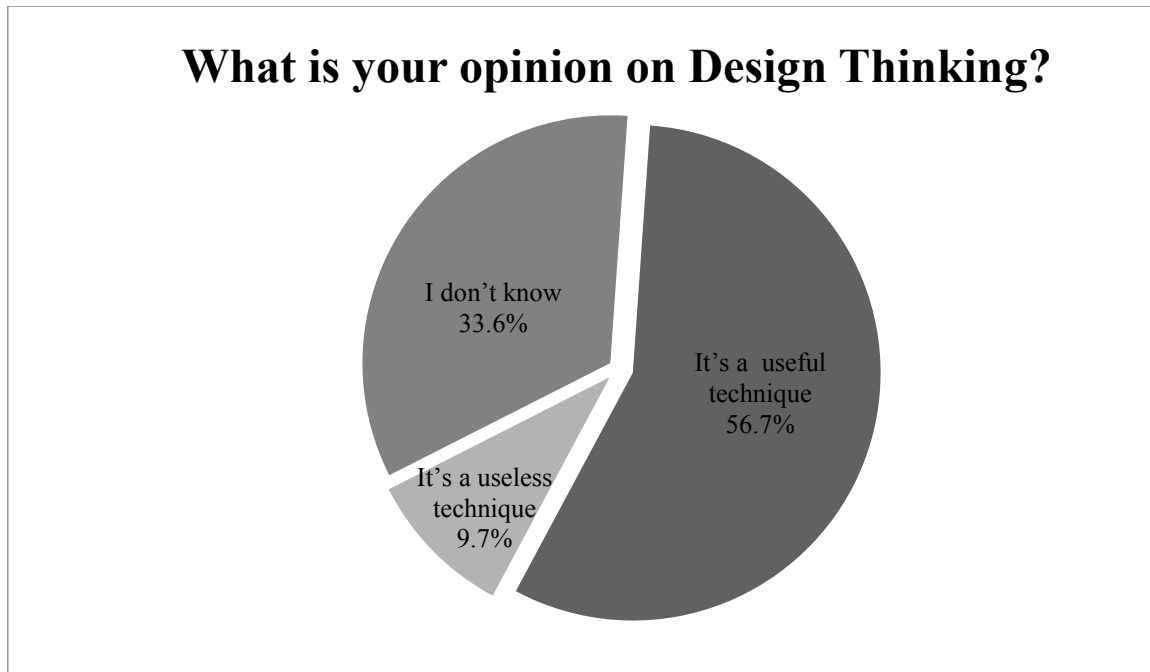
Notes: Result shown in the number of students.

Source: own elaboration on the research conducted

According to the graph, most of the respondents, which is 56,7% of all students surveyed, perceive Design Thinking as a useful tool. Only 9,7% which is 13 out of 134 students consider it as an unnecessary and inutile. The result demonstrates how needful and advantageous DT is for students and, what is more, it occurs to be practical for majority of them regardless their fields of studies.

Even though the result is satisfying, there is still much to work on the methodology perception and teaching young generation how to use it. Also, introducing it to more students communities may be crucial to help the idea grow.

5   Conclusion

The research conducted among students of Lodz University of Technology demonstrates huge interest in the topic and gives suggestions what can be done more to encourage more students to Design Thinking and its tools. The possibilities of using this method are huge and limited only by the imagination of group members. Even though great part of students is acquainted with the topic, there is still much to be done in promoting Design Thinking in academic society. University is the perfect environment to learn such tools, as they can be easily tested straightforward with other people, on advice of experienced professionals at the same time.

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Creative ways of problem solving commits not only to better results, but also stimulates people collaboration and team work. This methodology encourages students to cooperate, because cooperation means bigger number of ideas, advice and support. Partnership is a crucial feature not only at university or in workplace, but also in everyday life and social interactions.

Acknowledgement

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DERIVATION OF WEIGHTS IN A MULTI-CRITERIA DECISION MAKING PROBLEM USING DEAHP

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Abstract
There have been a lot of application-based papers developed in the field of an integrated method of Data Envelopment Analysis and Analytic Hierarchy Process. This integration of AHP and DEA is applied widely in the field of performance and efficiency measurement and optimization in the analytic hierarchy process, the weights of alternatives are derived by determining priorities of comparison matrices. In this paper, we have developed a pair-wise comparison matrix when the respondent has given their response in the interval for an investment problem. The geometric mean of the lower and upper value was taken for the purpose of a comparison matrix. The priorities for any comparison matrix developed by analytical hierarchy process are determined by the eigenvector method, integrating AHP and LP and subsequently integrating DEA and AHP. Hence, both the integrated approaches have been compared. It has been observed that AHP-LP has satisfied element dominance but resulted in the same priorities for most of the criteria. DEAHP has resulted in a better solution.

Keywords
Analytical hierarchy process; Data envelopment analysis; Investment problem

JEL Classification
G11

1   Introduction

DEAHP is applied widely in the field of performance and efficiency measurement and optimization (William Ho, 2008). Besides these, it also finds its application in quality measurement and ranking of different products or services in every sector namely education, engineering, manufacturing, government, management, industry, and social, political, personal and even in sports. For every organization, performance is a multi-dimensional phenomenon that addresses quality, efficiency, cost, delivery, flexibility aspects of the organization which relates to the better performance of an organization. Measurements of performance, efficiency, and ranks have been addressed using numerous methods by a number of different researchers for consideration.

Much before when DEA/AHP came into play, standalone AHP was sufficient enough for a wide variety of fields related to multi-criteria decision-making problems (Vaidya and Kumar, 2006). It was first introduced by Thomas L. Saaty in the 1970s and subsequently developed by many researchers. It is used to analyse qualitative criteria for the purpose of deriving weights for the importance of the decision criteria and the relative performance of the alternatives in terms of each individual decision criteria.

It is very clear that AHP is one of the most prevalent MCDM approaches (Pandey et. al, 2013; Tarun et al., 2017). On the other hand, DEA is a data-oriented approach which is based on linear programming.

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It was introduced by Charles et al. (Charnesetal.,1978) and is used for evaluating the relative efficiency of Decision-Making Units (DMUs).

2   Methodology

2.1   Analytic Hierarchy Process

The main source of complexity in decision making is the presence of actors and stakeholders with different and contradicting interests and objectives with other actors. For a decision to be successful, the objective, views, and interest of all stakeholders must be taken into consideration. As the current global situation has become uncertain, it is important for policy-makers and management to understand the broader consequences of their decisions. This is because such decisions are likely to have implications for the future situation. A good decision must, therefore, be a predictor of correct outcomes for a long period of time.

Organizations deploy the AHP technique in high stake situations where human resource decisions and judgments could have long-lasting consequences for their organizations. Today, decision making is not as complex as it used to be. It is more systematic and scientific. A decision choice is disintegrated into structures involving risks, benefits, costs, opportunities, and threats. Through the use of AHP, management is enabled to select the most feasible solution. The other advantage of the AHP is that it can be used in group decision making.

It operates a complete model, signifying the relations of importance dominance and preference among the aspect of the problem. The AHP is structured as a hierarchy where a decision is met by the decomposition of the goal into the most general and most likely and easily controlled factors. It requires an assessment of various criteria and it also requires the evaluation to attain relative rankings of the alternatives with reference to the original problem.

This process gets compounded further when several opinions from multiple numbers of experts are desired to be incorporated in the decision-making process. While applying the AHP, users have to recognize that the methodology has a deficiency of quantitative information and thus, it depends on experts qualities like intuition, experience, and judgment using a scale of relative importance to obtain weights which will in turn help them to order alternatives in such a way that the solution is realized objectively. This solidifies the basis of the multi-criteria decision making in AHP.

The multi-criteria decision making in AHP is applicable in various situations of decision making. Its application has assisted decision making in management and in many such fields including economic planning, selection of the best production techniques, conflict resolutions and resource optimization models.

The uniqueness of the AHP methodology is its flexibility and ease of integration into various techniques including linear programming. Another feature of the AHP is in determining choices. The determination of choices implies the availability of a set of choices from which a decision maker can choose. When a choice is made among different alternatives, it implies that other choices are left.

Successfully, AHP has been employed in a number of choice decisions. Indeed, the AHP is broader than just being a technique for determining choices. First and foremost, AHP is able to structure complexities. Saaty (2007) came up with the hierarchical structuring of complexities into a homogenous cluster of factors. In measuring on a ratio scale, he was convinced that the factors that are comprised in the hierarchy are being measured by the ratio scale priorities of elements. The hierarchy in AHP can be shown as in Fig 1.

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Figure 1. The hierarchical structure
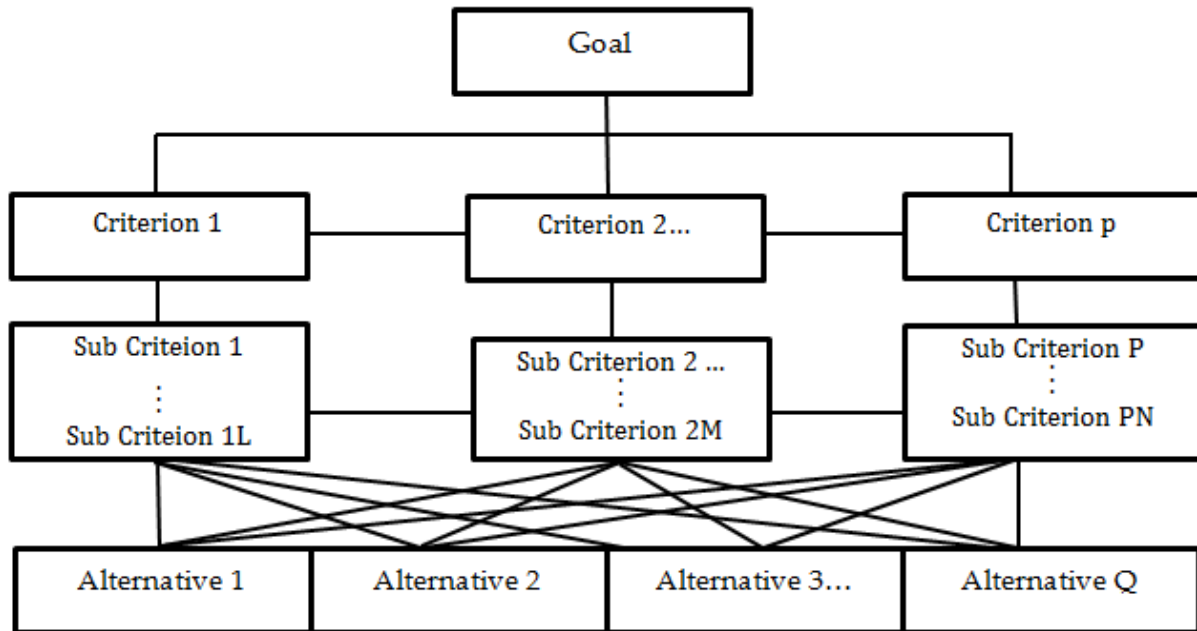
Secondly, AHP can be used in the resolving of the choice-problems in the multi-criteria environment. The methodology for the same involves comparison of objectives and alternatives with criteria or sub-criteria in a pair-wise manner. The scale ranges from 1/9 for 'least valued than' to 1 for 'equal' and 9 for 'absolutely more important than' while covering the entire spectrum of the comparison. The ratio-scale weights generated from individual preferences which are in-turn combined with linear additive weights for the associated alternatives.

The AHP is also used in prioritization or evaluation. Prioritization is the determination of relatively important alternatives among a given set of alternatives, which gets opposed to the phenomenon of selection of alternative as a choice of application. While alternatives are being prioritized in the order, the interval and ratios of the resultant priorities are of interest. Additionally, the alternative having the highest priority is also known. The priorities can be used for selection of a combination of alternatives or for allocation of resources as these priorities which have been derived from AHP are ratios-measures. A pairwise comparison matrix is developed based on the preference judgments of a decision maker where the inconsistencies are inherent. AHP, as a mathematical model, is a compositional methodology which synthesizes these preference judgments of a decision maker for each of the decision alternative under each criterion within a decision hierarchy. This type of assessment is done by a pairwise comparison which answers appropriately to a posed question for eliciting judgments.

2.2   Notations for pair-wise comparison matrix

Following notations have been used for a pair-wise comparison matrix:

Let $A = (a_{ij})$ for all $i, j = 1, 2, \ldots, n$ denot an $n \times n$ pair-wise comparison matrix, where a_{ij} is the importance of element i over the jth element. All the entries in matrix A are positive $(a_{ij} > 0)$ and reciprocal $a_{ij} = 1/a_{ji}$ for all $i, j = 1, \ldots, n$. In pair-wise comparison matrix A, a_{ij} can be a single number that estimates $\frac{w_i}{w_j}$ or an interval specified with a lower bound l_{ij} or an upper bound u_{ij} or a mixed of both. In case of interval, a_{ij} is the geometric mean of the interval bounds. So, the decision

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maker wants to compute a vector $w = (w_1, w_2, \ldots w_n)$ of weights associated to pair-wise comparison matrix A.

The matrix A is considered to be consistent when $a_{ij} = a_{ik} a_{kj}$ for all $i, j, k = 1, 2, \ldots, n$, which implies that the decision maker is coherent (no error) in his judgments to develop the comparison matrix .

Assuming A contains no error and w_i is the weight of the ith element, then we have

$$a_{ij} = \frac{w_i}{w_j}, \quad i, j = 1, 2, \ldots, n \tag{1}$$

Summing over all j, we obtain

$$\sum_{j=1}^{n} a_{ij} w_j = n w_i \quad i \in I = \{1, \ldots, n\} \tag{2}$$

which, in matrix notation, is equivalent to

$$Aw = nw. \tag{3}$$

The vector w is the eigenvector of the matrix A.W e say that the matrix A is consistent when $Aw = nw$. The priorities of the elements of the comparison matrix can be obtained by many methods.

2.3   Linear programming approach (LP)

The two-stage LP approach is described in the following two sub-sections, Chandran et .al, (2005) Patel et.al. (2016), Pandey et.al. (2013).

First stage: In this stage, we establish the consistency bound. In general, any estimate of relative preference a_{ij} can be written as

$$\frac{w_i}{w_j} = a_{ij} \varepsilon_{ij}, \quad i, j = 1, 2, \ldots, n$$

If the decision maker is consistent, then ε_{ij} is equal to 1. Defining three transformed decision variables for the model: $x_i = \ln(w_i)$, $y_{ij} = \ln(\varepsilon_{ij})$, and $z_{ij} = |y_{ij}|$.

The first stage LP can be written as:

$$Min \; z = \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} z_{ij} \tag{4}$$

$$s.t.$$
$$x_i - x_j - y_{ij} = \ln a_{ij}, \quad i, j = 1, 2, \ldots, n; \; i \neq j, \tag{5}$$
$$z_{ij} \geq y_{ij}, \quad i, j = 1, 2, \ldots, n; \; i < j, \tag{6}$$
$$z_{ij} \geq y_{ji}, \quad i, j = 1, 2, \ldots, n; \; i < j, \tag{7}$$
$$x_1 = 0 \tag{8}$$
$$x_i - x_j \geq 0, \; i, j = 1, 2, \ldots, n; \; a_{ij} > 1 \tag{9}$$
$$x_i - x_j \geq 0 \quad i, j = 1, 2, \ldots, n; \; a_{ij} \geq a_{jk}, \quad for \; all \; k$$
$$a_{ik} > a_{jk} \; for \; some \; k \tag{10}$$
$$z_{ij} \geq 0 \quad i, j = 1, 2, \ldots, n \tag{11}$$
$$x_i, y_{ij}, \; unrestricted \; for \; i, j = 1, 2, \ldots, n \tag{12}$$

The objective function (4) is $\sum_{i=1}^{n-1} \sum_{j=i+1}^{n} z_{ij}$. The objective function minimizes the sum of logarithms of positive errors in natural log-space, whereas the constraint (5) is defining the errors. Equations (6) and (7) are the degree of overestimation, (8) sets one of the weights w_1 to zero, (9) preserves element dominance and (10) for row dominance. For a perfectly consistent comparison matrix, z^* is equal to zero.

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Second stage: The first stage LP minimizes the product of all errors ε_{ij}, but multiple optimal solutions may exist. In the second stage LP, the solution that minimizes the maximum errors ε_{ij} is selected. The second stage LP can be presented as:

$$Min \; z_{max} \tag{13}$$
$$s.t.$$
$$\sum_{i=1}^{n-1} \sum_{j=i+1}^{n} z_{ij} = z^* \tag{14}$$
$$z_{max} \geq z_{ij}, \qquad i,j = 1,2,\dots,n; \;\; i < j \tag{15}$$

and all first stage LP constraints.

z^* is the optimal first stage solution value, z_{max} is the maximum value of error the z_{ij}.

Constraint (14) ensures that only those solutions that are optimal in the first stage LP are feasible in the second stage model.

2.4   Data Envelopment Analysis (DEA)

Constant Return to Scale (Charnes et.al, 1978): Suppose there are n Decision Making Units, DMU_j ($j = 1, \dots, n$), and each DMU using m inputs $x_j = (x_{1j}, \dots, x_{mj})$ produces s outputs $y_j = (y_{1j}, \dots, y_{sj})$. The following CCR model assesses the efficiency score of $DMU_{O\epsilon\{1\dots n\}}$, a unit under evaluation [4]

$$Max \; \theta = \sum_{r=1}^{s} u_r \, y_{ro} \tag{16}$$
$$s.t.$$
$$\sum_{i=1}^{m} v_i x_{io} = 1$$
$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0, \qquad j = 1, \dots, n$$
$$v_i \geq 0, \qquad\qquad i = 1, \dots, m$$
$$u_r \geq 0, \qquad\qquad r = 1, \dots, s$$

where v_i and u_r are the weights of ith input and r^{th} output, repectively. The CCR model involves n constraints in common, $\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0$ $j = 1, \dots, n$, and its feasible region differ only from the first constraint, $\sum_{i=1}^{m} v_i x_{io} = 1$. The first constraint of the model (1) ensures that the weights are relative.

Alternatively, in matrix notation we can write as follows:

$$Max \; uy_0 \tag{17}$$
$$s.t.$$
$$vx_o = 1$$
$$uY - vX \leq 0$$
$$u, v \geq 0$$

2.4 Linking of AHP and DEA

Both AHP and DEA are versatile tools in their own field. DEA has traditionally found in the measurement of performance of DMUs whereas AHP has been widely used in multi-criteria decision making (MCDM). An extensive literature survey on DEA and on AHP by William Ho (2008), William Ho and Xin Ma (2018) can be found. When we withdraw a criterion or insert a new criterion in AHP,

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there is a chance of rank reversal. It may also violate the property of element dominance. To avoid this, an AHP problem is linked with DEA as followed by Ramanathan (2006, 2007).

Traditional AHP View

	Element 1	Element 2	⋮	⋮	Element N
Element 1	1	a_{12}			a_{1N}
Element 2	$1/a_{12}$	1			a_{2N}
----			1		
----				1	
Element N	$1/a_{1N}$				1

Proposed DEA View

	Output 1	Output 2	⋮	⋮	Output N	Dummy Input
DMU 1	1	a_{12}			a_{1N}	1
DMU 2	$1/a_{12}$	1			a_{2N}	1
----			1		----	----
----				1	----	----
DMU N	$1/a_{1N}$	$1/a_{2N}$			1	1

DEA and AHP process was applied by Ramanathan (2007) on supplier selection, Wang et.al.(2008) for bridge risk assessment, Tsang and Lee (2009) in human resource practices on organisational performances, Lin, Lee and Ho (2011) on evaluating the economic performance of local governments of China, Aji and Hariga (2013) on vendor selection for online trading platform, Singh and Agrawal (2014) on human resource performance evaluation, Omid and Zegordib (2015) on efficiency of Iranian handmade carpet industry, Pakkar (2015) on multiplicative financial ratios.

3   Numerical Example

This subsection deals with determining priorities among five different investment criteria. Consumers postpone their consumption to meet their future needs. This is known as savings. Savings have to channelize in a proper way so that it multiplies and gives the targeted yield. This is called investments. Investors normally expect returns in proportion to the risk they undertake in investment. The time horizon to stay invested is also reasonable. The investment path depends on the goals which investors want to pursue. However, the investor is always concerned with the following factors which influence their decisions:

➢ Expected Return

➢ Risk

➢ Liquidity

➢ Tax Aspects

➢ Time Horizon

A sample of ten experts was asked to compare pair-wise all ten questions on a scale of 1 to 9. The pair-wise comparison matrix taking geometric mean is shown in Table 4.

Based on Eigen Vector Method, λ_{max}, consistency index (CI), random consistency index (RI), consistency ratio (CR) and weights of all are calculated shown in Table 1. It can be observed that the comparison between risk and time horizon is $a_{ij} > 1$, which implies the weight of risk be more than or equal to the weight of time horizon. But in this case weight of risk (0.150) is less than the weight of time horizon (0.205). With the same set of data, the weights using AHPLP, DEAHP is presented in table 2 and table 3 respectively. The weights derived from LPAHP are all same as 0.20. In DEAHP, neither element dominance is violated, nor all the weights are same.

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Table 1: Pairwise comparison matrix, weights and consistency check based on the eigenvector method

	Expected Return	Risk	Liquidity	Tax Aspects	Time Horizon	weight
Expected Return	1	2.773	2.289	1.644	1.260	0.321
Risk	0.361	1	0.794	1	1.022	0.150
Liquidity	0.437	1.260	1	1.387	0.669	0.167
Tax Aspects	0.608	1	0.721	1	0.843	0.156
Time Horizon	0.794	0.979	1.494	1.186	1	0.205
λ_{max}=5.088	CI=0.022	RI=1.188	CR=0.019	-------	-------	-------

Table 2: Weights based on LP approach

	x_1	x_2	x_3	x_4	x_5	z
LP Phase I						$z^* = 3.498$
LP Phase II	0	0	0	0	0	$z_{max} = 1.02$

The weights for all criteria of investments as discussed in section 3.2 are same as 0.20.

Table 3: Weights based on DEAHP Method

	Output 1	Output 2	Output 3	Output 4	Output 5	Dummy Input	Efficiency (CCR)	Weights (CCR)
Expected Return	1	2.773	2.289	1.644	1.260	1	1.000	0.243
Risk	0.361	1	0.794	1	1.022	1	0.811	0.197
Liquidity	0.437	1.260	1	1.387	0.669	1	0.843	0.205
Tax Aspects	0.608	1	0.721	1	0.843	1	0.669	0.162
Time Horizon	0.794	0.979	1.494	1.186	1	1	0.794	0.193

4   Summary and Conclusions

AHP can measure intangibles and LP proves to be effective in optimizing the resource allocation problem by considering tangible measurements. This paper has used both tangible and intangible measures. After converting intangibles by using the AHP technique, priority of each criterion, sub-criteria, and alternative are derived using the eigenvector method, integrated AHP and LP, integrated AHP and DEA on two different numerical problems. Element dominance, row dominance is inserted in the LP approach to avoid element dominance. Since we are using element dominance and row dominance as weak constraints, most of the cases we are getting the same priorities in AHPLP approach

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but DEAHP handles it properly. The relative weight of each factor, subfactor and the ratings of each alternative with respect to each subfactor, to give overall ratings is calculated. For the second example, we had obtained the priorities of different investments alternatives. In this example, it can be seen that element dominance property is violated between risk and time horizon. Though $a_{25} = 1.022$, we got the efficiency of risk as 0.150 and for time horizon as 0.205. On solving the problem using AHPLP, we found priorities as 0.20 for all. DEAHP is seem to be the better method than eigenvector or and AHPLP method.

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DOES NEW TECHNOLOGY FIT LEGAL REGULATIONS? INSURANCE BUSINESS PERSPECTIVE.

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Abstract
The new technology available to insurers and intermediaries is revolutionising the way they run their businesses. Artificial intelligence technology, such as robo-advisers and chatbots, can increase efficiency and improve customer experience. Drones have the potential to cut costs involved in inspections for claims purposes. As insurers amass more and more data, in particular from connected devices, data analytics tools allow insurers to use their data in a smart way and gain valuable insights into customer behaviour and trends. Often, cloud computing underpins the use of these other technologies. And not forgetting blockchain technology, which has the potential to transform the insurance industry, but which insurers and reinsurers are just beginning to consider seriously. These and even more technology solutions undoubtedly improve the insurance business on the one hand but on the other, they create a major challenge for the regulators. The aim of this paper is to present key legal concerns arising over selected new technology solutions applied in the insurance industry.

Keywords
Insurance Law, New Technologies, Smart Contracts, Automated Profiling, European Union's Law

JEL Classification
K12, K22, K23

1   Introduction

Technology-enabled innovation in insurance services (InsurTech) is developing rapidly. With its emergence, there will be both opportunities and risks to financial stability that policymakers, regulators and supervisors should consider. As many innovations are still newly applied or are just entering the market, and therefore there is no long-standing practice of how to deal with them, it is important to clearly identify potential risks in order to find workable solutions allowing to mitigate those risks and to adjust currently binding regulatory and legal framework to the era of digital transformation.

Undoubtedly, the burden of this adjustment process will be mainly carried by the international supervisory bodies and national authorities. Traditionally, the mission of the insurance supervisors was to maintain or develop fair, safe and stable insurance markets for the benefit and protection of policyholders and to contribute to financial stability. However, on the face of the approaching technology changes, it seems that it is rather keeping the balance between protection of policyholders, markets and stability and developments of technology, customer needs and markets that will be the future role of the regulators. Indeed, many national authorities have already considered taking InsurTech into account in their existing risk assessments and regulatory frameworks and have made regulatory changes to adapt to InsurTech activities (Financial Stability Board, 2017, pp. 1, 23).

The purpose of this paper is to highlight selected legal and regulatory concerns arising over certain aspects of application of the new technology tools, such as smart contracts or blockchain. The main focus will be put on the legal aspects of their functioning. Further, the regulatory approach and

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supervisors' initiatives planned or already taken towards the legal framework adjustment will be briefly presented in the final paragraphs.

2   Methodology

The analysis methods involved in the research are as follows: formal and dogmatic method as a leading method and empirical method as a supplementing one. Formal and dogmatic method has been used to analyze European and national legal acts, having regard in particular GDPR, IDD and Polish act on insurance and insurance activity. This method has been also applied while analyzing regulatory and industry reports and guidelines.

Application of the empirical method within this research is limited. Though, it has been used to present new technologies' impact on the insurance industry.

3   How new technologies are reshaping the insurance landscape?

By way of introduction to the main subject of the analysis, it is worth to take a closer look at the impact which the process of digitalisation make to the insurance business in the first place. The below figure shows growth of the investments in Insurtech, which in turn reflects that the demand for Insurtech is on rise and it continues to move fastly mainly on the part of the insurers. In turn, the solutions offered by Insurtech and applied by the insurers keep transforming the whole insurance industry. Examples such as mobile devices, the internet of things (IoT), Big Data, artificial intelligence (AI), chat-bots, distributed ledger technology (DLT), and robo-advisors *are vastly applied throughout the insurance value chain*, i.e. from the product design and development, pricing and underwriting, their sale and distribution, post-sale services and assistance, through to claims management.

Figure 1. Insurtech financing trend between 2011 and 2016
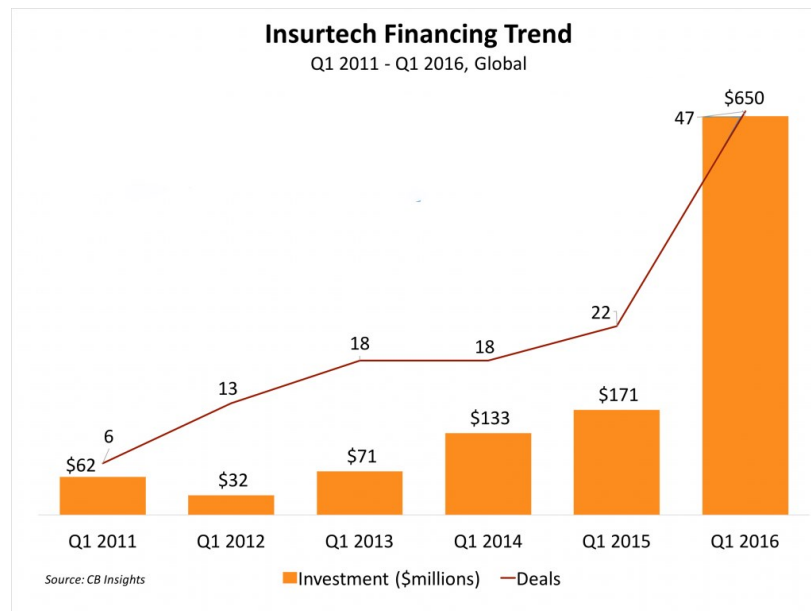
Source: CB Insights

In respect of product design, digitalisation may affect the nature of insurance coverage through, for example, on-demand insurance, usage-based insurance and insurance based on consumer-generated data from vehicles (telematics), homes (smart homes) or health wearables devices. Clearly, those tools change the method of creating insurance products. The accuracy and volume of the information which is at the disposal of insurer allows to limit the role and significance of policyholder's declaration which originally was a basis for the coverage design. On a separate note, speaking of the risk declaration of

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the policyholder, it is worth to pose a question of whether the relationship between the insurer and policyholder is still of "utmost good faith". If not, does it mean the new technologies put an end to the whole doctrine of *uberrima fides* which governs insurance contracts? Furthermore, an explosion of technology creates new risks, such as cyber attacks, which in consequence generates new insurance needs and enlarges range of insurance products.

More accurate data not only does affect the product design process, but it also improves *pricing and underwriting*. In terms of underwriting, special devices can detect and measure key features for commercial and residential structures including for example, roof quality and perimeter fencing. For flood detection, it can and will directly observe flood waters using both Optical and Synthetic Aperture Radar (SAR) satellites to derive and create comprehensive flood mapping. SAR or Synthetic-Aperture Radar is a form of radar that is used to create two- or three-dimensional images of objects, such as landscapes. In Marine Cargo-Specialty lines it monitors and tracks assets across the supply chain from port to port, to manage potentially costly and his risk scenarios and to refine and improve marine cargo insurance pricing models (R.Traub). In addition to the above-mentioned technology devices, it is worth to mention the example of Big Data which provides the insurers with more information to assess the risk. Consequently, it allows to base the risk assessment on more granular data and create tailor-made product and more accurate risk pricing. Such approach can be considered consumer friendly as it allows to fully individualize product, i.e. adjust it to the customer's demands and needs and prevent him from buying an 'empty coverage'. Although it seems that, indeed, it fulfills customer's expectations, it provokes a reasoned discussion over the individual's privacy issues which will be addressed further in this paper.

Once the product is designed, it is ready to be offered to the customers. Process of the insurance *distribution* enjoys the benefits of the digitization twofold. Firstly, the environment of social media undoubtedly facilitates to target the product thanks to a variety of information posted therein. Secondly, social media are also further used as a direct distribution channel where the products are sold using e.g. chat-bots (i.e. an interactive system that conducts a conversation via text or audio, often designed to simulate how a human would behave). A specially dedicated for the insurance industry chat-bot is better known as robo-adviser which is designed to provide a fully automated insurance advice. On the one hand, some advocate that robo advisers improve accessibility of products to the customers and enhance quality of such advice. The robo advisers may be helpful in overcoming cognitive bias or insufficient competence on the part of the human adviser. However, their ability to identify non-verbal behaviour of the customer or consequences of potential algorithm's flaws are questionable. Notably, it creates a risk that customers are persuaded into buying products or add-ons that are not in their best interest. Other interesting phenomenon invading the insurance domain is gamification - a concept of applying game-like elements and techniques in order to promote compliance, increase sales, simplify complex processes and promote innovative business models. Bearing in mind the fact that the insurance business has always required an involvement on the part of the policyholder (e.g. in case of an insurance event occurrence) and the way in which new technologies changed the level of engagement between insurance companies and policyholders, it is necessary to rebuild it. An illustrative example to explain the application of gamification in the insurance industry is provided by United Healthcare which created an app that tracks and rewards daily physical activities to promote a healthy lifestyle. The engagement of the customers is reflected in the use of app while the insurers enjoy benefits of underwriting efficiency and claims reduction thanks to tracking health and fitness activities through wearables and comparison dashboards.

Finally, digitization also affects *claims management* phase. Developments in artificial intelligence and machine learning facilitate to speed up claims processing and enhance fraud detection. This in turn leads to efficiencies that for instance drive down costs.

4   Legal and regulatory risks related to InsurTech

Having pictured the importance and potential of the new technologies within the insurance business, it is now worth taking a closer look at the legal and regulatory aspects of their application. As technological development is forging ahead at a furious rate the whole time, new doubts continue to arise. For instance,

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taking into consideration use of Big Data and devices generating detailed information about a consumer, academics and industry participants wonder who would take responsibility for data integrity issues or who should be at fault when new underwriting decisions fail. Furthermore, a series of questions regarding consequences of automated use of individual's personal data were posed in the light of Regulation 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (GDPR). And finally, a question of whether it is possible for Smart Contract to be considered traditional contract and substitute it eventually. Further analysis carried out in the following paragraphs will be focused on prohibition on solely automated profiling resulting from GDPR and Smart Contracts.

4.1   Prohibition on solely automated profiling

According to recital 71 of GDPR, the data subject should have the right not to be subject to a decision, which may include a measure, evaluating personal aspects relating to him or her which is based solely on automated processing and which produces legal effects concerning him or her or similarly significantly affects him or her, *such as automatic refusal of an online credit application*. GDPR explicitly indicates that one of the form of such processing is profiling and defines it as follows: any form of automated processing of personal data evaluating the personal aspects relating to a natural person, in particular *to analyze or predict aspects concerning the data subject's* performance at work, economic situation, *health, personal preferences* or interests, *reliability or behaviour, location or movements*, where it produces legal effects concerning him or her or similarly significantly affects him or her (recital 71 of GDPR). In effect, Article 22 of GDPR stipulates that the data subject shall have the right not to be subject to a decision based solely on automated processing, including profiling, which produces legal effects concerning him or her or similarly significantly affects him or her. This, however, will not apply if the decision to be taken fulfills the following requirements: (a) is necessary for entering into, or performance of, a contract between the data subject and a data controller, (b) is authorized by Union or Member State law to which the controller is subject and which also lays down suitable measures to safeguard the data subject's rights and freedoms and legitimate interests, or (c) is based on the data subject's explicit consent.

As it was mentioned in paragraph 3 above, the insurers already use consumer-generated data devices allowing to provide them with a variety of information concerning e.g. policyholder's *health*, driving *customs*, lifestyle *behaviours* or most frequently visited *locations*. The information received are subsequently processed and used to adjust an insurance premium or may served the insurer as a basis for making decisions on whether or not to grant the insurance coverage to the policyholder. Usually such decision are taken in a 'passive' human manner, i.e. no human factor is engaged (G. Malgieri, G.Comandé, 2017, pp. 243–265). On the face of it, it seems that, although the insurers apply prohibited automated profiling which produces legal effects concerning the policyholder, it is possible that they may benefit from the exclusion provided by the Article 22 of GDPR, in particular the exclusion (c), and continue such practice lawfully. If it is so, is there any problem left to be discussed?

Against all appearances, a few remarks can be made. First of all, in the era of growing consumer protection trend, which seems to be a leitmotif of recent European Union's legislation, it should be considered whether receiving of a mere policyholder's consent, even explicit, for profiling results from his well-informed decision, i.e. the policyholder should be well aware of the process and consequences of automated profiling.

Speaking of consequences, further to the policyholder's consent issue, it is worth to highlight the potential problem of discrimination. Profiling algorithms can use data which, at first sight, are not controversial, e.g. place of residence. It may though lead to at least indirect discrimination eventually. Literature indicates the examples of discrimination caused by such profiling - a US insurer was accused of discrimination against people coming from Afro-American and Latin American minorities. While creating and applying scoring processes, the insurer took place of residence as one of decisive factor. Places inhabited by minorities were less well-rated and, in consequence, people from these minorities automatically received offers of more expensive insurance policies (Niklas J., p. 8). Similarly,

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potentially nondiscriminatory factor may lead to discrimination on grounds of sex which is directly prohibited by Polish insurance law (Article 34 of the act of 11 September 2015 on insurance and reinsurance activity) and was recognized as unlawful by European Court of Justice (Judgment of the Court of 1 March 2011, Association Belge des Consommateurs Test-Achats ASBL and Others v Conseil des ministres, C-236/09).

4.2   Smart Contracts

Besides automated profiling, in order to facilitate understanding of the problems to be discussed, the concept of Smart Contracts will be briefly presented. There is no legal definition of Smart Contract in Polish law. The term is used though to describe a contract which terms are recorded in a computer language instead of legal language. Copy of the algorithm is entered into the blockchain register (e.g. Ethereum network) and represents the rules for making transactions between the parties. Insurance industry can exploit Smart Contracts technology to e.g. increase the speed of claim processing as well as to reduce the costs (and mistakes) associated with the manual processing of claims. From this perspective, a smart contract could encode the rules for enabling the transfer of refund from the company to the insured (Gatteschi V., *et. al.* 2018, p. 6). Although, the benefits are conceivable, the fact that provisions of Smart Contracts are enforced solely by technical code may raise certain doubts.

Firstly, it should be mentioned that smart contracts can be automatically executed by a computing system (UK Government Chief Scientific Adviser, 2016, p.18) and therefore, its execution is, in principle, independent from parties to such contract. Once all the provisions are enforced by technical code, there is no need for provisions having the purpose of regulating human interactions (Savelyev A., 2016, p. 129). The parties' engagement in the contract's execution is required only at the conclusion of the contract (parties need to express their will to enter into a contractual obligation) and at its termination (parties are bound by the result of their action and must bear the consequences of contract enforcement). It leads to the conclusion that none of the parties to the contract is able to amend it or breach if, for instance, circumstances change and a more profitable alternative to its performance appears. In order to do so, an intrusion with code is always required.

Another interesting point worth to be discussed is a situation in which smart contract cannot be executed due to technical malfunction caused by e.g. a hacker attack. A natural question follows: whether the 'obligations' of the parties expressed on computer code continue to exist regardless of the malfunction, with the result that such parties will have to perform them in some other way and face liability for non-performance, or whether the malfunction of the code of the Smart contract results in the termination of the Smart contract (Savelyev A., 2016, p. 129)?

Finally, as use of Smart Contract seems to be totally paperless, a question of whether recently introduced consumer protection measures would be effectively applied within smart contract technology should be posed. Notably, this doubt pertains to regulations of Directive (EU) 2016/97 of the European Parliament and of the Council of 20 January 2016 on insurance distribution (IDD). For instance, Article 23 of IDD sets out a default paper requirement, i.e. certain information to be obtained by customer should be provided on paper in the first place (Insurance Europe).

5   How do the supervisors react to the new technologies? Current regulatory approach.

Bearing in mind the above-mentioned remarks, it is now high time European and national supervisors of the insurance market responded. It is believed that one of the key challenges to supervisors will be to consider a balanced approach to facilitate innovations while maintaining the level of consumer protection stipulated in laws and regulations (International Association of Insurance Supervisors, 2018, p. 5). According to Insurance Europe insurance legislation, rules or guidelines should be *digital-friendly, technologically neutral and sufficiently future-proof* to be fit for the digital age and encourage digital innovation. Indeed, there is much room for improvement in this field - it is enough to see the example of IDD regulations mentioned in paragraph 4.2 above which definitely cannot be considered digital-friendly nor future-proof.

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However, it would be unfair to say that European and national authorities do not take any steps to adjust current legal and regulatory environment to the approaching digital era. Among the initiatives undertaken by the supervisors, it is worth to mention cybersecurity information campaigns, establishment of intragovernmental and Government/Private Sector Cooperation regarding Cybersecurity (e.g. MELANI in Switzerland), so-called regulatory sandbox tests in real life environment organized by British Financial Conduct Authority (FCA) and Polish Financial Supervision Authority (KNF) or establishment of cooperation between RegTech companies, financial institutions and regulatory bodies to help businesses comply with regulations efficiently and less expensively. Additionally, general availability of supervisors for dialogue while maintaining the goals of insurance regulations can be observed.

6   Conclusion

Drawing on the findings of the literature, discussions with academics and industry participants, the author highlighted selected concerns pertaining to the use of new technology solutions within the insurance business. As seen above, the problems to be considered are of different nature - individual (consumer) protection issues on the one hand, and general problem of applying basic contract law rules to newly invented solutions on the other. Although, as one may claim, some of the mentioned solutions are still in its infancy (e.g. smart contracts) and it is not possible to anticipate their impact on the legal environment, nature and importance of the indicated doubts suggest an immediate action on the part of the authorities and academics. New technologies are developing much faster than process of adjusting legal and regulatory frameworks. Therefore, it is recommended to address those problems as soon as possible.

It should be also underlined that the author does not intent to diminish the role of digitization or to discourage insurers from applying new technologies within their business. Benefits derived from their application are unquestionable and therefore, digitization processes should be fostered rather than hindered by clumsy regulation. On the contrary, this study is to serve as an incentive to search for the solutions which would allow to reconcile laws governing the insurance market with a natural market's development.

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THE PROJECT IMPLEMENTATION A PERFORMANCE REWARD STRATEGY USING PERT METHOD

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Abstract
The aim of this article is the network analysis of scheduling activities in the project about implementing employees´ performance measurement, evaluation and rewarding on the BalancedScorecard base. The BalancedScorecard system was selected as a transparent and integrated approach to measurement and performance management of the organization and also individual employees. As the statistical tool there was used the stochastic PERT method which shows the risk of the length of the project which is expected to change. The distributive function of the normal distribution is graphically represented by Gaussian curve which demonstrates the given probability density function and was used to calculate the probability determination of the planned completion date of the project. The result of the work is the information and data concerning the complete list of planned activities to be carried out, the expected duration of each activity including the expected duration of the whole project and calculations of probability determinations.

1 Introduction

Nowadays we can find the project management in all areas not only in the economic field. Project management is a process that coordinates individual components of a project implementation. Project management is nowadays very topical and necessary in various fields. The purpose of project management is to achieve the desired goal or changes that are set in the project as efficiently as possible. The reason for this project is to coordinate individual activities in implementing the new employees´ performance evaluation and rewarding in a manufacturing company on the Balanced Scorecard principles. The aim of this article is to plan and implement the Balanced Scorecard project as a strategic indicator measuring system for performance measurement with a link to the performance evaluation system and employee remuneration and to find the most appropriate arrangement of individual activities in order to reach the optimum time and to achieve the goal of the project at the minimum of idle time of follow-up activities and the minimization of all related costs. PERT (Program Evaluation and Review Technique) method was used as a statistical tool of a duration network analysis which is a stochastic method that takes into account the probability of the risk of changing the project length.

2 Methodology and Data

We have several project management methods to eliminate unnecessary prolongation and waste of resources. One of them is PERT method which is presented by network chart that is why is called as a network analysis method. The network graph is used to illustrate all partial and sequential activities of the project in which individual activities are represented by rated edges and nodes representing a start

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or a stop. Edge rating is the duration of the activity. The whole project is then represented as an edge-rated network chart. It is needed to perform several following steps before solving and analyzing the particular project: "to divide the project into individual activities, to estimate the duration or costs of implementing individual activities, to define the timeliness of individual activities and then build a network chart based on the information from the previous steps (Jablonský, 2007).

2.1 PERT Method (Program and Evaluation Review Technique)

This is a stochastic method that shows the duration of the whole project as a risk. This is a probabilistic extension of the deterministic CPM method. This method assumes the probability of changing the duration of the project. The procedure of the PERT method:

1. To determine the optimistic, the most probable and the pessimistic estimation of the duration of each activity and to calculate the mean values $\mu(t_{ij})$ and the variance $\sigma^2(t_{ij})$ of individual activities.

    The mean value (μ_{ij}) or the mean duration of the activity is obtained as:

    $$\mu_{ij} = \frac{a_{ij} + 4m_{ij} + b_{ij}}{6}$$ (4)

    The standard deviation of the activity duration (σ_{ij}) is determined from the following relation:

    $$\sigma_{ij} = \frac{b_{ij} - a_{ij}}{6}$$ (5)

    Duration of each activity is a continuous random variable. These are random variables whose probability distribution is not known in advance. However it turns out that this unknown distribution can be approximated by the β-distribution which for example has some advantageous properties compared to the normal distribution. The β-distribution has a finite span (defined in interval <a, b>) and is not generally symmetric (the mean value does not need to be in the middle of the interval <a, b>).
2. Determining the mean value of the earliest possible terms of nodes implementation and the total duration of activities.
3. Determining the variance of the earliest possible terms of nodes implementation.
4. Calculating the mean values of the time reserves and calculating the mean value of the critical reserve for each node and to determine its expected critical path. The calculation of critical path is calculated using mean values of the duration of individual activities. The result of the calculation is the critical path whose rating is called *M*. It is the sum of the mean duration of the critical activities. Therefore, *M* value indicates the mean duration of the whole project.

$$M = \sum_K \mu_{ij}$$ (6)

5. Calculating time reserves for each node and calculating their statistical characteristics.
6. Determining the probability of meeting the planned completion date of the project.
    The actual duration of the whole project is as well as the duration of its individual activities a continuous random variable whose mean value is *M* and the variance σ_{KC}^2 can be calculated as the sum of variances of all critical activities. It can be shown that under certain assumptions based on a central limit sentence the said continuous random variable has a normal distribution with a mean *M* value and a standard deviation σ_{KC}. Basic characteristics of continuous random variables include a probability density, a mean value and a variance σ_{KC}. The curve showing the probability density function of the normal distribution is called Gaussian curve (Kropáč, 2010). The characteristic features of Gaussian curve is that it is symmetrical about a vertical line passing through a point μ where the function f (x) has a global maximum and at the distances 3σ left and right of μ it almost touches the x axis (Jablonský, 2007). The probability of the project length is the distribution function

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of the normal distribution $N(M, \sigma_{KC})$ at the point T_S. Due to the fact that only values of the distribution function of the standardized normal distribution $N(0, 1)$ can be found in the mathematical tables the value of its distribution function can be calculated after the transformation on this distribution at point:

$$z = \frac{T_S - M}{\sigma_{KC}} \qquad (7)$$

For calculating the determination of time T_S in which the project will be terminated with a probable p it is sufficient to determine from the distribution tables $N(0, 1)$ what value z_p corresponds to the given probability p and then calculate the searched time value from relation 8 as:

$$T_S = M + z_p \sigma_{KC} \qquad (8)$$

3   Case Project

The essence of the project is to create and implement the Balanced Scorecard as a form of the development program for the business department of the analyzed company, mainly because of the need to mobilize this sales department to implement a new business strategy requiring significant changes in the structure and functioning of the department's operations and linking this Balanced Scorecard to the performance remuneration and evaluation of the employees concerned. The project is analyzed and illustrated by the network chart using PERT method.

4   Empirical Results

Within this project individual activities and at the same time their estimated duration in weeks was defined. The information, the description of the activities, the estimation of their duration and the determination of which activities must be made before are contained in the Table 1.

Table 13. The individual activities of the project and the activities which must be made before

	Activity	Previous activity
A	Evaluation of company readiness, formulation and approval of project assignment, analysis and completion of basic strategic documents.	--
B	Deriving key strategic goals for individual BSC perspectives, designing measure values - indicators, setting target values for indicators and designing the level of rewards for meeting them.	A
C	Creating an organizational, personnel and information security project.	A, B
D	Ensure full integration of the BSC into strategic and operational planning in order to continuously adapt the new strategy and accurately translate operational objectives and strategic operations into annual plans.	B, C
E	Ensuring strategic controlling following the consistent implementation of the strategic operations set out in the BSC.	B, C, D
F	Integrate BSC into the reporting system for continuous tracking of goals.	D, E
G	Integration of the BSC into the human resource management system to anchor operative goals into the agreed personal goals.	D, E, F

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| H | Integration of the BSC into the system of employee evaluation and remuneration. | F, G |

Source: Poláková (2018)

Figure 11. Network Chart of the Project
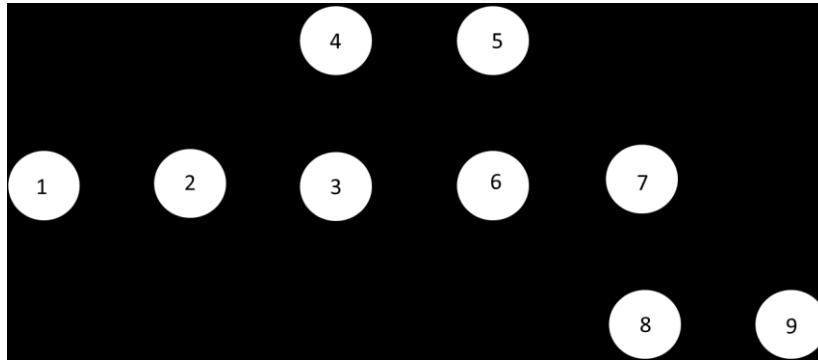
Source: Poláková (2018)

Based on the information contained in the Table 1 it is possible to build a network chart Figure 1 which respects above all defined connections for the implementation of individual activities. In the following Table 2 there are defined pessimistic, most probable and optimistic estimates of the duration of each activities including calculations of their mean time and their standard deviation according to the given relationships in the Equation 4 and 5 including variance calculations.

Table 2. Input Data For PERT

Activity	Estimation of Duration			Mean	Standard Deviation	Variance
	Optimistic	Most Probable	Pesimistic			
	a_{ij}	m_{ij}	b_{ij}	μ_{ij}	σ_{ij}	σ^2_{ij}
A	**0,6**	**1**	**2**	**1,1**	**0,2333**	**0,0544**
B	0,6	1	2	1,1	0,2333	0,0544
C	**2**	**3**	**4**	**3,0**	**0,3333**	**0,1111**
X1	0	0	0	0,0	0,0000	0,0000
D	6	7	9	7,2	0,5000	0,2500
E	**6**	**8**	**10**	**8,0**	**0,6667**	**0,6112**
X2	0	0	0	0,0	0,0000	0,0000
F	3	3,5	5	3,7	0,3333	0,1111
G	**4**	**6**	**7**	**5,8**	**0,5000**	**0,2500**
X3	0	0	0	0,0	0,0000	0,0000
H	**3**	**4**	**5**	**4,0**	**0,3333**	**0,1111**

Source: Poláková (2018)

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Figure 2. The Network Chart with the Average Soonest Possible Implementations of the Nodes of the Determined Critical Path
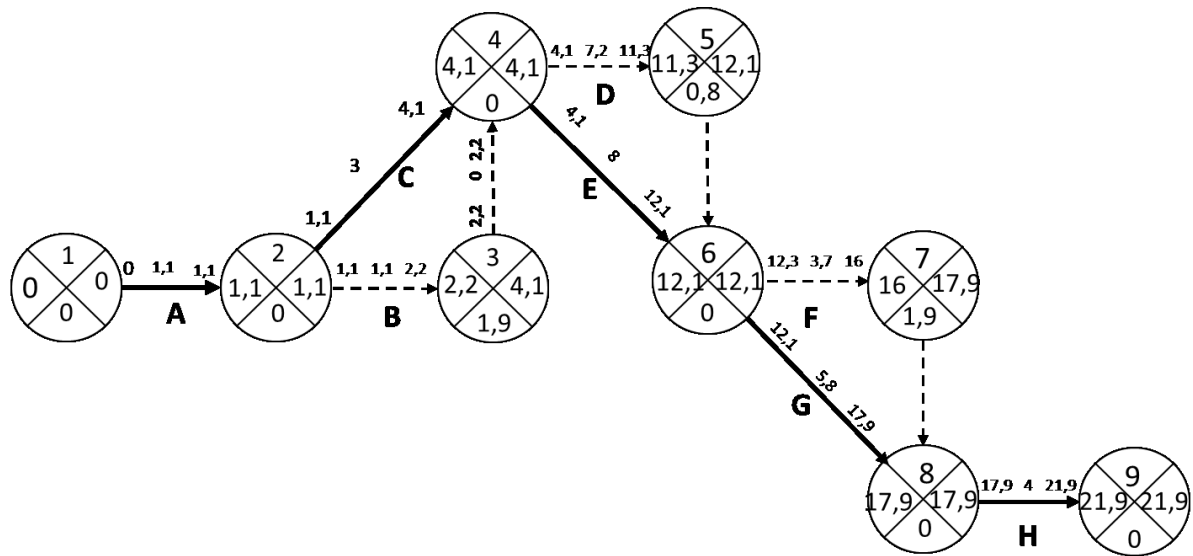
Source: Poláková (2018)

The PERT critical path calculation is calculated using the mean values of the duration of the individual activities. The critical path consists activities with zero total time reserves. It is thus formed by the sequence of edges A → C → E → G → H. In the Table 2 critical activities are highlighted in bold and in the network chart the edges of critical activities are highlighted also in bold. The result of the calculation is the critical path whose evaluation is denoted by *M* and is based on relation in the Formula 6. The duration of the whole project including the critical path are stochastic quantities. This means that there is a probability that this value will be smaller and the project will be shorter or bigger and the project will be longer than the scheduled date.

The mean time of the duration of the whole project is according to the Formula 6 following:

$$M = 1,1 + 3 + 8 + 5,8 + 4 = 21,9 \; weeks$$

The variance of the duration of the whole project is then

$$\sigma_{KC}^{2} = 0,0544 + 0,1111 + 0,6112 + 0,2500 + 0,1111 = 1,1378$$

And the standard deviation is

$$\sigma_{KC} = \sqrt{1,1378} = 1,0667$$

The duration of the whole project is therefore a random variable with a normal distribution with the mean value *M = 21,9* and the standard deviation $\sigma_{KC} = 1,0667$.

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The calculation of the probability density function and the cumulative distribution function of the normal distribution for the values x for which this distribution is determined is calculated in the following Figure 3.

Figure 3. Calculation f(x) and F(x) of the normal distribution

x	f(x)	F(x)
17,9	8,84586E-05	0,000330693
18,4	0,000516928	0,001718209
18,9	0,002458573	0,00716649
19,4	0,009547356	0,023994787
19,9	0,030400392	0,064492203
20,4	0,079831473	0,139148156
20,9	0,174258243	0,241005876
21,4	0,319629407	0,335087121
21,9	0,5	0,3739967
22,4	0,680370593	0,335087121
22,9	0,825741757	0,241005876
23,4	0,920168527	0,139148156
23,9	0,969599608	0,064492203
24,4	0,990452644	0,023994787
24,9	0,997541427	0,00716649
25,4	0,999483072	0,001718209
25,9	0,999911541	0,000330693

Source: Poláková (2018)

To determine the probability of the project completion at the time $t_1 = 20$, $t_2 = 21$ and $t_3 = 23$ weeks then the following values are calculated according to the Formula 7:

$$z_1 = \frac{20 - 21,9}{1,0667} = -1,78$$

$$z_2 = \frac{21 - 21,9}{1,0667} = -0,84$$

$$z_3 = \frac{23 - 21,9}{1,0667} = 1,03$$

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The values of the distribution function of $N(0,1)$ in points z_1, z_2, z_3 indicate directly the searched probability. From the mathematical tables of the distribution function $N(0,1)$ it can be read that at 20 weeks the probability of the project completion is approximately *0.03754*, at 21 weeks this probability is approximately *0.20045* and at 23 weeks this probability is *0.84850*.

If we wanted to determine the time at which the project will be completed with the probability $p_1 = 0.95$ and $p_2 = 0.99$ then the corresponding values of $z_{0.95} = 1.645$ and $z_{0.99} = 2.326$ are found in the mathematical tables. Putting the data into the formula 8 we calculate the following values:

$$T_{S1} = 21{,}9 + 1{,}645(1{,}0667) = 23{,}65 \; weeks$$

$$T_{S2} = 21{,}9 + 2{,}326(1{,}0667) = 24{,}38 \; weeks$$

The above calculations show that with the probability of 95 % the project will be completed in time *23,65* weeks and with the probability of 99 % the project will be completed in time *24,38* weeks.

5   Conclusion

The aim of this article was to make a duration and network analysis of the project whose intent is to introduce employees´ performance bonuses and evaluation on the Balanced Scorecard base so that the optimum time is reached and that the project goal is met with a minimum time span of follow-up activities and minimizing all related costs. The network analysis is done by the stochastic PERT method.

The result is the creation of a methodological framework and procedures for implementing the project as a set of co-ordinated parallel and sequential activities which is a time-bound effort to create a new system of employees´performance measurement and evaluation and rewarding.

The network analysis was processed by the stochastic PERT method which is a probability extension of the deterministic CPM method and represents the time analysis of the risk. The calculation of the critical path which gives the sum of the mean duration of critical activities has shown that the total duration of the project is 21,9 weeks. This means that using PERT method the duration of the whole project is the stochastic random variable with the normal distribution with the mean value of the whole project of 21,9 weeks. The next calculation was to determine the directly wanted probability of completing the project before and after the scheduled date for which the distribution functions of the normal distribution were used. The probability density function of the normal distribution is represented by Gaussian curve. Probability determinations show that the project will be completed at 23.65 weeks with the probability of 95 % and at 24.38 weeks with the probability of 99 %.

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INTERNATIONALIZATION OF ENTERPRISES IN KAZAKHSTAN AS AN EXAMPLE OF INTERNATIONALIZATION PATTERNS IN THE AREA OF THE EURASIAN ECONOMIC UNION.

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Abstract
The article aims to show the specificity of the internationalization of Kazakh enterprises, in particular, the pace, scope, intensity, and forms of their internationalization in the Eurasian Economic Union (EEU). The EEU is a relatively young grouping that was established in 2015 by the Republic of Armenia, the Republic of Belarus, the Republic of Kazakhstan, the Kyrgyz Republic and the Russian Federation. EEU creators try to give the Eurasian integration process a different direction in contrast to the structures that were created in the post-Soviet space, namely, they want use experience form European Union integration. In this paper is shown the most important effects of international economic integration, and in particular the functioning of the Eurasian Economic Union (EEU) and characterizes the economy of Kazakhstan. Furthermore, the research conducted on exporters operating on the territory of the Republic of Kazakhstan, were shown. The research sample is 108 companies including 32 small & micro (<100 employees), 33 medium (101-250 employees) and large (>250 employees), resulting in median transnationalization index at 13.3. This shows still poor internationalization, however it is growing year to year.

Keywords
Internationalization, Eurasian Economic Union, Kazakhstan, export

JEL Classification
F15, F45

1   Introduction

The Eurasian Economic Union is an economic union established in 2014, within which the free movement of goods, services, capital, and labor is ensured.. From 1 January 2015, a new stage in the development of Eurasian economic integration began. The introduction of the state of full functioning of the Eurasian Economic Union allows not only to consolidate a de facto deeper level of economic integration in the Eurasian space but also confirms the legitimacy of the strategy for the further development of integration on different levels - social, cultural etc. The main objective of EEU is to the internal market comprises an economic area free movement of goods, persons, services, and capital is was ensured.

At present, the customs boundaries between the Member States have been abolished in the EEU. Unified norms of the Customs Code, customs tariff, foreign trade system, customs regulations, and technical regulations have been introduced (Eurasian Economic Union (2018) access: 20.10.2018). Integration within the scope introduced by the EEU eliminated the existing barriers between economies, which allows the expansion of enterprises in new markets. In connection with the above activities, trade turnover and capital flows between enterprises are expected to increase. One of the effects of the formation of an integration group is to strengthen the internationalization of enterprises that take advantage of the opportunities to expand into new markets due to the elimination of existing barriers

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between economies. We can, therefore, expect an increase in trade turnover and capital flows (Daszkiewicz, 2016), (Suchkova, 2018).

2   Eurasian Economic Union

The Eurasian Economic Union is an regional economic area that ensures freedom of movement of goods, services, capital, and labor, as well as coordinated and unified policy in economic sectors. The member states of the Eurasian Economic Union are the Republic of Armenia, the Republic of Belarus, the Republic of Kazakhstan, the Kyrgyz Republic and the Russian Federation. The creation of the Eurasian Economic Union was aimed at creating a bloc that would also be a partner and a rival to the European Union and China (Michalik, 2015). The initiator of the creation of the Eurasian Union in 1994 was the President of Kazakhstan, N. Nazarbayev, who asked Russia to take over leadership in the economic union. It was only W. Putin He became an appropriate partner for N. Nazarbayev to implement the integration project of the region (Gostomski and Michałowski, 2015). On the other hand, in the first years of the EEU operation confirmed that it was not possible to find a balance on economic and political issues because Russia was the beneficiary of integration.

The main objectives of the EEU are:

- creating conditions for the stable development of Member States' economies to improve the living standards of their inhabitants;

- striving to create a single market for goods, services, capital and labor resources in the Union;

- comprehensive modernization, cooperation and increasing the competitiveness of national economies in the global economy.

For Kazakhstan, integration with Russia poses a certain threat in the aspect of the growing dependence on Russia in this situation. At the same time, this integration is also of a strategic nature, as Kazakhstan, adjacent to two powerful countries - Russia and China, is forced to balance between them (Wiśniewska, 2013, p. 29). Forecasts regarding the further integration process of the regions are different. China is strategic partner for Kazakhstan in economic point of view however, Russia is barrier which not allowing China to overtaking Kazakhstan.

2.1   Characteristics of Kazakhstan's economy.

The economy of Kazakhstan is the largest economy in Central Asia with gross domestic product (GDP) at 174 billion USD, and population nearly 18.5 mln. The GDP is growing year to year, however an exchange rate fluctuation may likely be responsible for difference between 2014 and 2018 year. The country has huge reserves of oil, as well as minerals and metals, as well as high agricultural potential. Unfortunately, the economics of the Republic of Kazakhstan shows unstable economic growth and is still oriented mainly on the mining industry (Kurmanov et al., 2016). It also has a developed space infrastructure that allows you to send a spacecraft to the International Space Station. Until 2015, the main priority of the implemented policy of forced industrialization was the implementation of large investment projects in traditional export-oriented economy sectors and the creation of new business opportunities for small and medium-sized enterprises.

Kazakhstan is a country with stable politics and a favourable business climate, located in the heart of Eurasia. Since the time of ancient Kazakhstan, it was a kind of logistic centre in which the car chains of the Great Silk Road are intertwined. It was on this land that the strategically important cargo passed from China to Russia, from India to Europe, and it was here that the most important contracts and trade agreements were concluded global significance. Three of the six BRICS countries are located close to Kazakhstan; these are Russia, China, and India. In 2010, Kazakhstan joined the customs union with Russia and Belarus, resulting in the total number of 170 million consumers of goods and services. Kazakhstan is the 9th largest country in the world measured by area (2.725 mlm km^2), with many areas where you can find a huge wealth - so far 99 chemical elements from the Mendeleev table were discovered in the land; also developed programs for deep drilling and discovering new resources. When

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it comes to uranium mining, Kazakhstan ranks first in the world, ahead of Canada and Australia. The most important macroeconomic indicators are presented in Table 1 (Source 1).

Table 1. Kazakhstan's macroeconomic indicators

Indicator	Unit	2014	2015	2016	2017	2018
GDP growth (at constant prices	%	4.3	1.2	1.0	3.4 [2]	3,1 [2]
GDP	$ bln	227.4	184.4	135.0	157.9	173.9
Assets of the National Fund	$ mln	73.187	63.392	61.218	-	-
The average inflation rate	%	6.7	6.65	14.5	8.0	7.2
GDP per capita in terms of PPP	$	24.727	24.920	25.145	25.942	27.022
Foreign trade turnover	$ bln	120.8	76.5	62.0	36.7[3]	
Exports	$ bln	79.5	46.0	36.8	23.2[3]	
Imports	$ bln	41.3	30.5	25.2	13.5[3]	

Source 1: Investors Guide Republic of Kazakhstan - 28.12.2018
[2]Ministry of the National Economy of the RoK
[3]First half of 2017

3 Methodology and Data

The article presents the functioning of the Eurasian Economic Union, and the economy of Kazakhstan was characterized. On this basis was focused on the process of internationalization of enterprises - exporters. The study covered the territory of the Republic of Kazakhstan and was carried out from 12 August to 28 September 2016. The base of the output included 731 companies - exporters, located in the KazNext Inwest catalog. At the creation of the database also was used the websites www.kaznexinvest.kz and www.kz24.net. A questionnaire was sent to companies with 20 questions. The research was carried out using the CATI interview. Ultimately, 108 responses were received from export-exporting companies operating in the area of the Republic of Kazakhstan. Based on a review of the literature, a research hypothesis was formulated: export is the most used internationalization instrument in Kazakhstan. (Suchkova, 2017)

4 Characteristics of the research sample

The analyzed sample of exporters (108 enterprises) included companies from all size classes, ie micro, small, medium and large. Detailed classification of companies typical of the Republic of Kazakhstan in the size account is presented in Table 2.

Table 2. Size of the surveyed enterprises according to the Kazakhstan classification

Company size	Number of enterprises	Share (%)
Small and micro (up to 100 employees)	34	31.5
Medium (101-250 employees)	33	30.5
Large (over 251 employees)	41	38.0
Sum	108	100.0

Source: study based on own test results (N = 108).

The nature of exports. Among the sample surveyed, most enterprises (66.7%) declared that they would conduct exports on a regular basis, almost 1/3 described it as irregular, while four companies did not comment on the nature of exports in their operations. These results are interpreted as the result of strong

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demand in the markets of the EUG countries and competitive production. The above information is shown in Table 3.

Table 3: Nature of exports among the surveyed enterprises

Nature of exports	Number of enterprises	Participation (%)
Irregular	32	29.6
Regular	72	66.7
No answer	4	3.7

Source: study based on own research results (N=108)

Over half of the surveyed enterprises started to operate on foreign markets during the first 3 years of operation, hence according to the applied nomenclature, we can include these companies in the born global group (Daszkiewicz, 2015). On the other hand, about 43% of enterprises recorded the first foreign trade contacts after a period of three years from their creation.

Table 4: Speed of internationalization among the surveyed enterprises

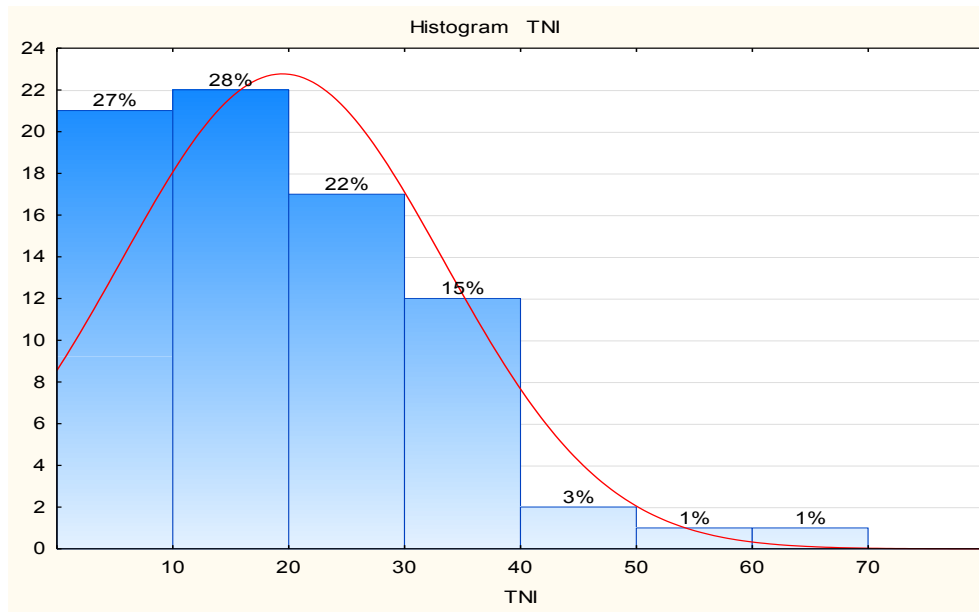| Rate of internationalization	Number of enterprises	Share (%)
In first 3 years	60	57.7
Over 3 years	44	42.3
Sum	104	100

Source: study based on own research results (n=104)

Transnationalization index (TNI)

The next stage of the research was to calculate the level of TNI internationalization. This indicator was composed of the following elements:

• a share of foreign assets in total assets,

• a share of foreign sales in total sales,

• a share of foreign employment in total employment,

• a share of foreign branches and branches in the total number of branches and branches.

The average value of the TNI internationalization index for the whole sample (N = 108) is 20.6; the median is at 13.33; while the standard deviation is 19.48. The above results indicate that on average (on a scale from 0 to 100) the level of internationalization of the surveyed enterprises is at a low level; which means that the vast majority of companies are poorly internationalized. The analysis of the distribution of the TNI index values indicates that in the sample, over 42% of enterprises achieve an internationalization grade lower than 0.1, and nearly 75% less than 0.3, which means that 75% of the surveyed enterprises are poorly or very poorly internationalized. The distribution of the internationalization index value is extremely right-sided asymmetric, as shown in the histogram below (Figure 1).

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Figure 12.**Index TNI**

Sourse: study based on the results of the own research (n=79)

4 Conclusion

The most important limitation of the conducted study is the lack of representativeness of the sample. Therefore the results of the study cannot be generalized to other exporting enterprises. Nevertheless, the research attempt should be considered as large as the conditions of Kazakhstan and the problems that the doctoral student encountered during the research (e.g. problems with obtaining a database). It should be emphasized that over 13% of enterprises from the exporters' database made available participated in the research. This share, as compared to similar surveys conducted in Poland, can be considered satisfactory (Daszkiewicz, 2016)

The obtained results allow to formulate the following general conclusions:

- As many as 66.7% of the surveyed enterprises export regularly.
- As many as 57.7% of the surveyed enterprises made the first expansion into foreign markets within 3 years of its inception. Therefore, these companies can be included in the born global group.
- As many as 75% of the surveyed enterprises are poorly or very poorly internationalized.

The survey was conducted despite large problems in reaching a representative group of enterprises. In the conditions of Kazakhstan, the participation in surveys of over 13% of companies from among the available exporters' database should be considered as a large sample. However, the results carried out on this size sample are indicative and cannot be generalized for the country.

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COMPARISON OF PROBABILITY DISTRIBUTIONS

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Abstract
This paper is focused on modelling claim count in vehicle insurance. These models are typically used in valuation process of the part of insurance risk. Claim counts models are usually estimated using the two types of probability distribution Negative-binomial and Poisson, but the problem of these estimations is overdispersion. The objective of the paper is to compare these two distribution and show in a practical example in vehicle insurance portfolio. Estimated frequency of claims presents on component of the insurance premium calculation. Calculations are computed in statistical software STATA. Regression analysis allows the identification of the risk factors and the prediction of the expected frequency of claims given the characteristics of policyholders. It depends on many individual rating factors (e.g. based on individual characteristics of vehicle and driver). All empirical models are estimated on the real-world sample data of czech insurance company collected during the years 2005-2010.

Keywords
Motor Hull insurance, Poisson distribution, Negative-binomial distribution, non-life insurance

JEL Classification
C13, G20, G22

1 Introduction (Style Heading 1)

Actuarial modelling in non-life insurance may be divided into on indivudual claim size and claim frequency. Sometimes, frequency modelling is neglected to the extend of Poisson distribution or Negative-binomial for the number of claims. The motivation for this paper is to describe and compare the most used probability distribution in the case of vehicle insurance.

Claim number probability distributions are used in non-life insurance for forecasting an unknown future number of claims, whether for pricing and reserving purposes. For these purposes, the probability distribution should include all sources of uncertainty, otherwise risk-margins in premium calculation will be distorted. As the most suitable method for the analysis of non-normal data is Generalized linear models (GLM).

2 Literature Review

Generalized linear modelling is a methodology of descriptions possibilities of relationships between variables. This methodology have been find out by great scientists Nelder and Wedderburn in 1972. Nowadays, these models generally deals with many of the authors as Gray and Pitts (2012), Hardin and Hilbe (2012), Long and Freese (2008) etc. Practical example using negative binomial distribution is demonstrated in Hilbe (2011). The above mentioned titles are aimed more generally. The work focused on pricing process using non-life insurance data is well described in Ohlsson and Johansson (2010). General part about the insurance risk is possible to find out in Cipra (2006 and 2012). Pretty well application paper is written by Valecký (2015).

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3   Methodology and Data

Generalized linear modeling is a methodology for modelling realionships between variables. In this part the GLM model is introduced, as well as commonly used parameter estimation techniques. Finally, the tools for diagnosting and evaluating the goodness of fit are mentioned. Regression analysis allows the identification of the risk factors and the prediction of the expected frequency of claims given the characteristics of policyholders. It depends on many individual rating factors (e.g. based on individual characteristics of vehicle and driver). All empirical models are estimated on the real-world sample data of czech insurance company collected during the years 2005-2010.

3.1   Generalized linear models

Generalized linear models have been formulated by John Nelder and Robert Wedderburn as the way of others regression statistical models, including linear that permit for independent variable utilize other than normal distribution. The basic of these models are defined as an extentions of the Gaussian linear predictor derived from the exponential family. The main purpose of theese models is to estimate random explanation variable (denoted y), depending on certain number of explanatory variables (X_i).
Generally, GLM includes three main assumptions:
- A probability distribution have to be from an exponential family
- A linear predictor is transform by link function, such as:$n = x'\beta$
- A link function $g\left(\frac{\mu}{n}\right) = x'\beta$,

where g is a link function, μ is mean, n is called the exposure.
Link function can be diverse, but for the purposes of this paper the logarithm link function is selected (Jong, Heller (2008) and Gray and Pits) .
Thus, link function g is log, that becomes:

$$\ln\left(\frac{\mu}{n}\right) = x'\beta = \ln\mu = \ln n + x'\beta \tag{1}$$

where $\ln n$ is called an „offset". This offset is another variable x , where the coeficient β is equal to one. Offsets are usualy used to correct differing time period of observation.

All probability distribution can be decribed of the general form:

$$f(y) = c(y,\phi)\exp\left\{\frac{y\theta - a(\theta)}{\phi}\right\} \tag{2}$$

where θ is the canonical parameter and ϕ is called the dispersion parameter. $a(\theta)$ and $c(y,\phi)$ are functions determining the actual probability function such as normal, gamma, binomial etc.

For the purposes of this paper the poisson and negative binomial distribution are choosen. Description of exponencial family parameters is shown in Table 1.

Table 14. Parameters distributions in exponential family framework

Distribution	θ	$a(\theta)$	ϕ	$E(y)$	$V(\mu) = \dfrac{Var(y)}{\phi}$
Negative-binomial (μ,κ)	$\ln\dfrac{\kappa\mu}{1+\kappa\mu}$	$-\dfrac{1}{\kappa}\ln(1-\kappa e^{\theta})$	1	μ	$\mu(1+\kappa\mu)$
Poisson(μ)	$-\dfrac{1}{\mu}$	$-\dfrac{1}{\kappa}\ln(1-\kappa e^{\theta})$	1	μ	μ

source: Jong and Heller(2008)

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3.2 Maximum likelihood estimation

The standard method of estimation parameters β is maximum likelihood estimation. This method is based on selecting parameter estimates and maximize the likelihood of the observed sample:

$$\ell \qquad \sum_{i=1}^{n} \ln f(y_i; \theta, \phi) \tag{3}$$

where $f(y_i)$ is a probability function depends on the canonical parameter θ and the dispersion parameter ϕ If the maximum likelihood estimation is the exponential family probability function:

$$\ell \qquad \sum_{i=1}^{n} \ln f(y_i; \beta, \phi) = \sum_{i=1}^{n} \left\{ \ln c(y_i, \phi) + \frac{y_i \theta_i - a(\theta_i)}{\phi} \right\} \tag{4}$$

Maximalization of likelihood called the log-likelihood is a logarithm of the likelihood with respect to β_j:

$$\frac{\partial \ell}{\partial \beta_j} = \sum_{i=1}^{n} \frac{\ell}{\partial \theta_i} \frac{}{\partial \beta_j} \tag{5}$$

where the parameters are folowing:

$$\frac{\partial \ell}{\partial \theta} = \frac{\quad}{\phi} = \frac{\quad - \mu_i}{\phi} \tag{6}$$

$$\frac{\partial \theta_i}{\partial \beta_j} = \frac{\partial \theta_i}{\partial \eta_i} \frac{\partial \eta_i}{\partial \beta_j} = \frac{\partial \theta_i}{\partial \eta_i} x_{ij} \tag{7}$$

x_{ij} is a component i of x_j.

If the equation (5) is equal to zero, that estimation equations for β is:

$$\sum_{i=1}^{n} \frac{\partial \theta_i}{\partial \eta_i} x_{ij} (y_i - \mu_i) = 0 \Leftrightarrow X'D(y - \mu) = 0 \tag{8}$$

According to the equation (8) it is clear, that parameter β is implicit and working throught μ and D.

Generalized linear models are estimated using Newton-Raphson method, or the method of IRLS (method of iteratively weighted least squares). Using the algorithm Newthon-Rapson can obtain the observed information matrix (OIM), on the contrary, the method of IRLS we obtain the expected information matrix (EIM) see GRAY, Roger J. a Susan M. PITTS (2012).

3.3 Claim frequency models

Claim frequency model (or observed number of claims) is a situation, where the random dependent variable is discrete and conditioned by vector of explanatory variables (characteristic of risk based on individual characteristic of shareholders). According to the purposes of this paper, the Negative-binomial and Poisson distribution is selected. The Negative-binomial probability of random variable *Y* fitting into the exponential family framework (2) is given:

$$\ln\{f(y)\} = y \ln \frac{\mu}{1 + \kappa\mu} - \frac{1}{\kappa} \ln(1 + \kappa\mu) = \frac{y\theta - a(\theta)}{\phi} \tag{9}$$

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where the dispersion parameter is $\phi = 1$ and canonical parameter $\theta = \ln \dfrac{\kappa\mu}{1 + \kappa\mu}$

Mean and variance function is denoted:

$$E(y) = \ddot{\iota} \qquad \frac{^{\frown}\theta}{1 - \kappa e^\theta} = \mu \tag{10}$$

$$Var(y) = \phi \ddot{} \qquad \frac{e^\theta}{(1 - \kappa e^\theta)^2} = \mu(1 + \kappa\mu) \tag{11}$$

where $\ddot{\iota}$ and $\ddot{}$ are first and second derivates of $a(\theta)$ with respect to θ.

The Poisson probability of random variable Y fitting into the exponential family framework (2) is given:

$$\ln\{f(y)\} = -\mu + y \ln \mu - \ln y! = -\ln y! \frac{y\theta - a\theta}{\phi} \tag{12}$$

where the dispersion parameter is $\phi = 1$ and canonical parameter $\theta = e^\theta$ (see table of parameters 1), see JONG, Piet de a Gillian Z. HELLER (2008).

Mean and variance function is denoted:

$$\dot{\iota} \qquad\qquad \ddot{} \tag{13}$$

where $\dot{\iota}$ and $\ddot{}$ are first and second derivates of $a(\theta)$ with respect to θ.

3.4 Models´ goodness of fit

The goodnes of fit of a model to a data is natural question arises with every statistical modelling. The literature presents many statistic tools, that can be used to select and to assess the performance of count data models. As discussed in Jong and Heller (2008) one way how to assess the fit of given model is to compare with the model with the best possible fit.

Likelihood ratio test

LR test is a statistical method used for comparing a godness of fit of two models. In this regard, a standard method of comparison between Poisson and Negavive-binomial model is the likelohood ratio , given by following expression:

$$LR = -2(LL_P - LL_{NB}), \tag{14}$$

where LL_P and LL_{NB} are the values of log-likelihood determined Poisson and Negative-binomial distributed models.

This type of statistic follows the χ^2 distribution with one degree of freedom.

Akaike and Bayesian information criteria

The basic of these criteria is the comparison of models among themselves and in the most suitable model is considered to be such a model, the value of which AIC and BIC is the lowest. Akaike information criterion is following:

$$AIC = 2k - 2\log(L) \tag{15}$$

where k is number of predictors of a model including constants and *log(L)* means log-likelihood model.

Bayesian information criterion is:

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$$BIC = -2\log L + k \log(n) \tag{16}$$

n is the number of observations.

Deviance residuals

By using residual analysis is possible to find out the information about the suitability of the model. The deviance residuals can be used for assessing the quality of the model, e.g. for the detection of remote observation and verification of the assumption about the variance.

The general form of deviance residual is:

$$r_i^D = sign(y_i - \hat{\mu}_i) \cdot (\sqrt{d\left(y_i \cdot \mu_i\right)}) \tag{17}$$

where $(\sqrt{d\left(y_i \cdot \mu_i\right)}$ denotes the distance function, which represents the remoteness from the estimated mean values to observed.

4   Empirical Results

In this part are going to be estimated one model with different probability distribution and the results are going to be compared. For the purposes of this paper a random selection of real data in vehicle insurance is used and collected during the years 2005-2010 in the Czech Republic teritory. The file contains 18 111 contracts.

Figure 13. Summarize count

Variable	Obs	Mean	Std. Dev.	Min	Max
count	18,111	.0637182	.2646554	0	3

```
. di r(Var)
.07004247
```

The mean number of count is 0,064, Variance is 0,070 it is a bit more than mean, it can mean that data are overdispersed. Negative-binomial regression can be used for overdispersed count data, that is when the conditional variance exceeds the conditional mean. It can be considered as a generalization of Poisson regression with the same mean structure but with an extra paremater to model the over-dispersion.

Both models are going to be estimated with these seven following predictors, because each vehicle insurance contract includes this following individual characteristic of the policyholders:

Table 2. Variable description

variable	description
agecar	Age of car
gender	Drivers gender
volumkw	Engine power
fuel	Type of fuel
ageman	Age of driver
price	Vehicle price
district	District area

Source: Špačková (2018)

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The following fig. shows histogram of empirical frequency:

Figure 14. Empirical claim frequency

Source: Spačková (2018)
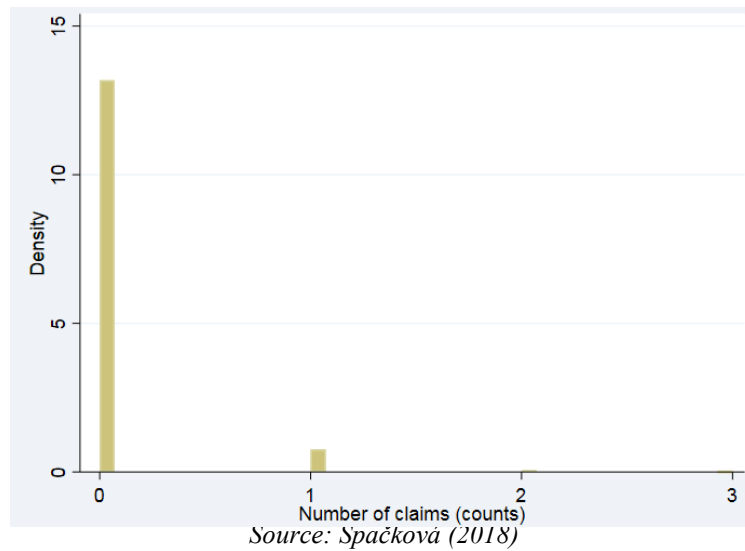
According to the histogram, it is obvious positive skewness. In the following table is shown observed and predicted claim frequency by Poisson and Negative binomial.

Table 3. Observed vs. predicted frequency

Claim frequency	Observed	Poisson	Negative-binomial
0	**17 045**	**17 422,47**	**17104,88**
1	984	582,02	897,14
2	76	49,69	75,21
3	6	2	2,66

Source: Spačková (2018)

According to the table it is obvious, that in 17 045 suffered no claim. One claim was occurred in 984 cases, two in 76 cases, three in 6 cases. Estimated claims by Poisson model is shown, that "zero claims" is over estimated and the remaining claims are underestimated. The table provides, that Negative-binomial fits better to our insurance data. In following table we can see the β parameters estimated by maximum likelihood methods in both cases.

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Table 4. Analysis of parameters

variable	Poisson		Negative-binomial	
	parameter	St. error	parameter	St. error
agecar	-0.113	0.122	-0.129	0.012
gender	0.306	0.344	0.267	0.089
volumkw	0.569	0.004	0.006	0.004
fuel				
2	0.465	4.91	0.398	0.089
3	-8.708	502.54	-10.303	890.294
4	0.753	0.58	0.560	1.05
ageman	-0.133	0.002	-0.013	0.002
price	5.39e-07	2.99	5.81e-07	1.95e-07
district				
2	-0.421	-1.36	-0.421	0.319
3	-0.448	-1.37	-0.428	0.319
4	-0.181	-0.8	0.192	0.2347
5	-0.307	-1.29	-0.296	0.239
6	-0.368	1.6	0.365	0.246
7	-0.410	-1.4	-0.440	0.320
8	-0.338	-1.14	-0.328	0.295
9	-0.306	-0.96	-0.303	0.327
10	-0.203	-0.88	-0.188	0.221
11	-0.141	0.87	0.156	0.192
12	-0.086	-2.89	-1.082	0.382
13	-0.016	-0.10	-0.011	0.263
14	-0.096	-0.56	-0.113	0.204

Source: Špačková (2018)

Both models are based on the same explanatory variables. The results of both models are quite similar, but the Negative-binomial fits our data better. The standard errors in Negative-binomial model is slightly lower that in Poisson. The two adjusted models do not provide further detail in comparison, these enhance models could make a difference in terms of adjusting the Poisson overdispersion in the data. Based on the regression coefficients, the profile of the policyholders with the higher risk can be obtained. This profile corresponds to policyholder from the "young age", having a fuel type group 3 etc.
The comparisons between those two analysed models is summarizes in table 5.

Table 5. Criteria for assessing goodness of fit

	Poisson	Negative-binomial
Log Likelihood	**-2692.247599**	**-2704.994906**
AIC	0.4337	0.4317
BIC	-114413.5	-114970.7

Source: Špačková (2018)

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Preferred model is still Negative-binomial, because the Log-likelihood is higher. According to the results of AIC a BIC, the better model is Negative-binomial again, because the value of AIC and BIC is lower. The Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) provide a method for assessing the quality the model through comparison of related models. It's based on the Deviance, but penalizes you for making the model more complicated. Eventually, it was proved, that the NB model is better.

The models is also possible to compare with variance, but both models has a different variance function, so it cannot be compared directly, but it is possible to compare by calibration plot. In the figure is comparison of observed variance count and predicted variance count by each model. For the simplification, observed variance is grouped to twenty observations.

Figure 2. Observed vs. predicted Variance trend by Poisson and Negative-binomial distribution
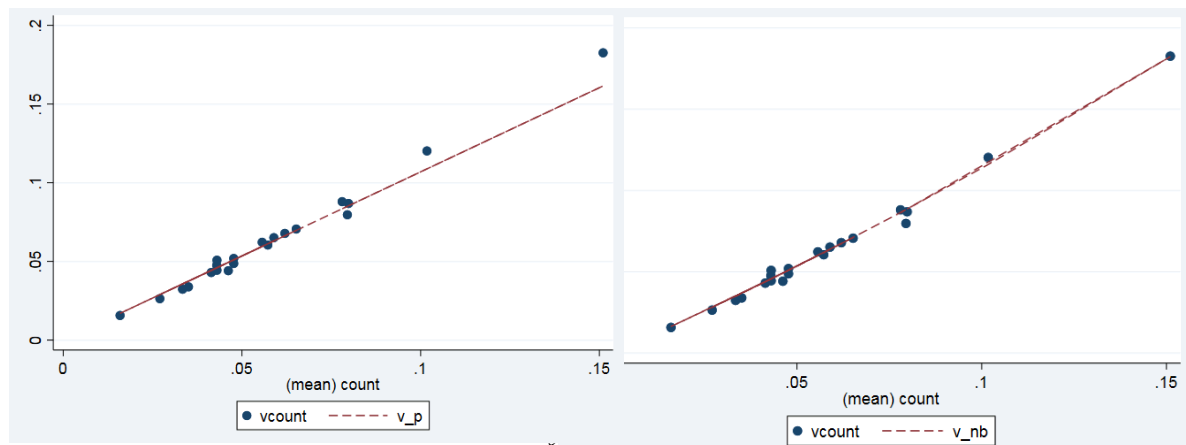
Source: Špačková (2018)

The observed vs. predicted variance by Poisson is shown on the left. Obtained results proved that, Negative Binomial model fits better to our data. The following picture shows a sample of deviance residuals. Deviance is a measure of goodness of fit of a generalized linear model. Or rather, it's a measure of badness of fit–higher numbers indicate worse fit.

Figure 3. Deviance residual – Poisson and Negative-binomial
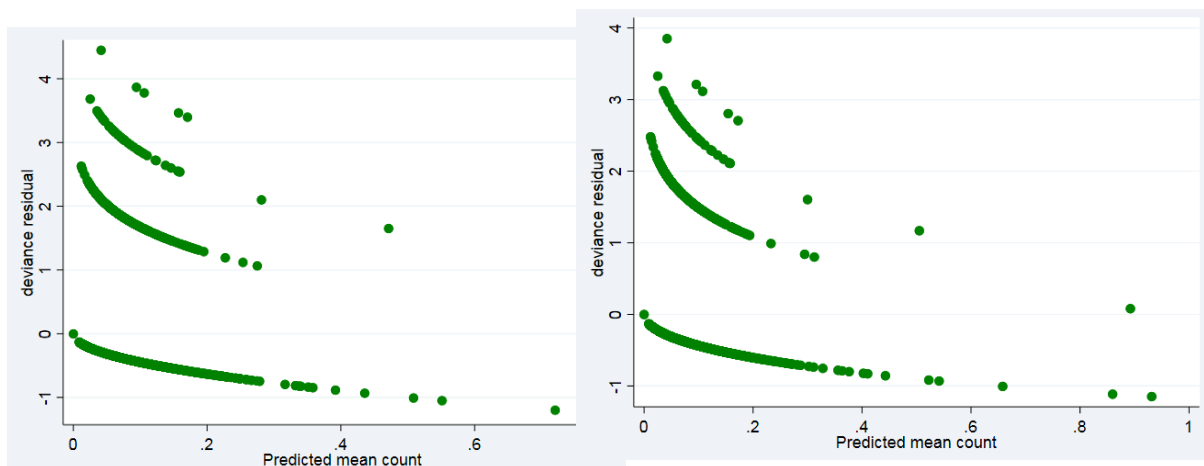
Source: Spačková (2018)

According to the figure 3 is clear, that deviance residuals of both models are similar, but in previous tests it was proved, that the Negative binomial distribution fits data better.

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5   Conclusion

The first step of vehicle insurance pricing is the modelling of claim frequency, where the main objective is to find out suitable model. The objective of the paper was to compare these two distribution and show in a practical example in vehicle insurance portfolio. All empirical models were estimated by GLM with log-link function. In the insurance practise, the most used probability for Count models is Negative-binomial and Poisson distribution.

In this paper it was considered the analysis of mentioned distributions. In the first step, the overdispersion was tested and overdispersion was found out. In the second step the frequency was predicted by both models and it was confirmed again, that the Negative-binomial distribution fits better. And then both models was tested by methods called goodness of fits, especially LR test, by AIC and BIC and by Deviance residuals. According to this results, it can be argued, that the Negative-binomial distribution is better. The difference between mentioned models wasn't obvious, because it was not detected high overdispersion.

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THE IMPORTANCE OF STATE TERRITORIAL SOVEREIGNTY

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Abstract
Sovereignty in international law occurs both in a positive and negative sense. A positive aspect is expressed in the scope of competences resulting from sovereignty, while the negative aspect is constraints that define them. It should be emphasized that both aspects complement each other. Territorial sovereignty then acquires a special meaning, in particular when the state territory is annexed or the process of leaving international organizations is initiated. The author will base her arguments on three cases which were (by some) considered as a violation of the foundations of sovereignty. The author will present the basics on which the sovereignty of the state should be based. The scope of sovereignty in the context of the powers of the authorities to decide on important aspects of the sovereign's life will also be taken into account. The analysis will be supplemented by a discussion on recent events taking place in the international space.

Keywords
Key words: sovereignty, state, international law, territory

JEL Classification
K3, International Law

1. Introduction

There is no unanimity as to the relationship between the notion of a state and sovereignty in the study of international law, especially in the Polish study of the field. L. Antonowicz (2012) distinguishes three approaches applicable to the relationship:

1) in terms of international law, sovereignty is an indispensable attribute of each state,

2) sovereignty is a standard characteristic of the state. It is, however, not mandatory for sovereign countries coexist alongside non-sovereign ones. The existence of non-sovereign states has been first acknowledged by the Charter of the United Nations. Despite the lack of a strict definition of a non-sovereign state, it can be defined by way of negation.

3) total negation of sovereignty defined as a key attribute of a state. There is a growing demand for the replacement of sovereignty with a more pronounced attribute.i

Sovereignty is undoubtedly an inherent attribute of a state. And, despite other characteristics, the state cannot be treated subjectively without establishing its independence in internal and external relations. Sovereignty has allowed to distinguish a state from other subjects of international law (e.g. international organizations.) Sovereignty expresses: firstly, the character of competencies of a state as an independent subject in its internal and external relations, executing its full territorial control; secondly, the character of these state-created relations. Sovereignty is based on the presence of territory. It is actually impossible for a legal entity to obtain a state's status in the international arena without its own territory.ii Sovereignty is not merely the system of exercising power free from foreign interference, but the defence of its own territory-based integrity; defence of its own institutional, legal and cultural identity. J. Makowski (1934) has advanced a thesis that a state can either be sovereign or it cannot be a country at all.iii Etymology of the word 'sovereign' is related to the Latin word superanus meaning 'supremacy',

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derived from the word 'super' meaning 'over'. In the Middle Ages a 'sovereign' was an independent ruler, not subordinate to anyone's control. Such an approach to the issue of sovereignty was already known in ancient Greece and Rome.

In terms of international law, the basis of sovereignty is established by the rule of equality. Equality is a fundamental principle for states' existence. The adjective 'equal' refers to two or more subjects of the same class, distinguished on the basis of identical characteristics. The classification is based on the criteria of aims and values pursued by the subjects. Interestingly, in one aspect there can be no differences between states, whereas in other areas they can differ enormously.

The concept of territorial sovereignty has been formed on the notion of property in Roman private law. A. Verdoss (1976 et al) claims that '[t]erritorial sovereignty manifests itself in states' mutual recognition of one's right to territorial control over state territory'.iv No unanimous approach has yet been formed to the relation between territorial sovereignty and territorial control in international law doctrine. Sovereignty means a lawful title of a state to its territory, comprising the source of the control and the proofs of the law's existence. Territorial control, on the other hand, consists in exercising actual authority over the territory by the state.v A majority of the exponents of Polish doctrine in international law recognize the two notions. L. Antonowicz (2002b) indicates that '[s]overeignty or territorial control is the relation of a state to its territory. The core of this control being subordination of all persons and items within the state territory to its law and jurisdiction'.vi W. Góralczyk(2007 et al) indicate that 'the state's authority on its territory is described as its sovereignty or territorial control. Consequently, a proponent of the limitation of territorial control i.e. total control and competencies of a state, has to prove that this limitation is due to a particular rule of international law'vii R. Bierzanek (2005 et al), on the other hand, argue that '[t]erritorial control is a form of execution of a state's sovereignty on its territory. It is not only a rule of law, but a recognized and protected attribute, a characteristic of a state, stemming from its sovereignty […].'viii While J. Gilas (2000), performing his analysis of a state territory, found distinguishing five theories of law: objective, subjective, concerning space, competence-based and geopolitical, insufficient to form a good definition of sovereignty. He then suggested addressing the theory of territorial control and thus territorial sovereignty because 'in other words, territorial control is identical with territorial sovereignty.ix W. Czapliński (2004 et al) are of the few who distinguish the two notions and indicate that '(…) sovereignty i.e. independence from any authority of another subject of international law constitutes an element of statehood. Thereby, as a legal concept corresponding to a political notion of sovereignty, sovereignty relates to independence […].'x Gaining sovereignty is thus correlated with independence of the state'.

Basic attributes of sovereignty include: exclusive jurisdictional competence over its own territory and citizens, foreign policy competencies, deciding over peace and war, recognizing newly created countries, deciding over military alliances and membership in international organizations.xi In its judgement of 7 September 1927 the Permanent Court of International Justice (PCIJ) noted that the core of sovereignty lies in exercising independence by a state without infringing sovereignty of another country.xii On 2 August 1926 at open sea at the level of the town of Mytilene (Greece) carelessness of the French captain led to the collision of the S.S. Lotus, a French steamer with a Turkish steamer, the S.S. Bozkurt,. As a result of the accident, eight Turkish nationals aboard the Bozkurt died and the S.S. Lotus sank.xiii A Turkish court sentenced the French captain to eight days in prison and a fine. This immediately caused a doubt as to the Turkish court's legitimacy for the action. The countries in dispute decided to take the case to the PCIJ. The subject of the dispute was Turkey's right to exercise penal jurisdiction in respect of an act committed outside its territory. The basic question was whether Turkey infringed Article 15 of the Treaty of Lausanne. According to France, there was no rule of law which would permit Turkey to exercise penal jurisdiction. Turkey defended its opposite stance as completely legitimate, arguing that its actions resulted from international and legal subjectivity of the country.xiv The PCIJ shared the view by expressing the idea that the state does not have to establish legal grounds of its activity while undertaking actions in international relations.xv The PCIJ ruling was criticized, among others, by J.L. Brierly (1958) in 'The Lotus Case'xvi , L. Cavarer (1930) in 'L'arret du 'Lotus' et le positivisme juridique'xviiand A. Steiner in 'Fundamental Conceptions of International Law in the Jurisprudence of the Permanent Court of International Justice'.xviii Despite the criticism, the PCIJ

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unwaveringly stood by its ruling in its judicature. In its opinion, the fact that states have freedom of action and can take any measures they find appropriate or necessary in a specific situation stems from the sovereignty of this state. Restrictions of this freedom can only result from sovereign rights of other states and norms of international law.xix

Sovereignty is indivisible. In terms of international law, there is no question of its divisibility. As previously indicated, sovereignty and territorial control are rarely distinguished in international law doctrine. Such a differentiation was made in the PCIJ's judgement in 'Lighthouses Case' in 1937. The dispute concerned the question whether in 1913 the islands Crete and Samoa had been under Turkey's sovereignty or granted such great independence that Turkish sovereignty over them had already terminated. The PCIJ pronounced that despite its considerable autonomy, Crete was still part of the Ottoman Empire. Although with some limitations, the sultan still used sovereignty for his purposes.xx

The concept of a 'state's sovereignty' is used in at least three meanings in international law.

Firstly, it indicates a state's status in international relations. The status is determined on the basis of all bilateral and multilateral international agreements, taking into account the independence i.e. no necessity to listen to 'anyone's advice' as to the ways in which a state's position is shaped.

The second meaning of a state's sovereignty is linked with the scope of state's competency as an entity recognized by international law. Significantly, since state competencies largely depend on volatile situation on international arena, the full scope of state competencies has not yet been and will not probably be defined. Each time it stems from the norms of international law, including competencies of other countries, which, on the basis of limitation, will also be determining the scope of a state's competencies.

Thirdly, sovereignty is perceived as a relation of domestic and international law. No country has a right to interfere in internal and external affairs of the third country in this respect. According to the principle par in parem non habet imperium, xxi state laws generally are not the subject of scrutiny of international bodies (constitutional, judiciary or administrative).

Moreover, 'state sovereignty' can also be defined basing on negative assumptions i.e. through the withdrawal of competencies of other countries to execute laws and duties on the territory due to the state executing sovereign control over this territory.

All this considered, both positive and negative meaning can be attributed to sovereignty in international law. The scope of competencies resulting from sovereignty can be seen as a positive aspect, while limitations defining these competencies as a negative one. It should be underlined, however, that both aspects are complementary. The notion of 'sovereignty' could not be fully understood without taking both perspectives into account, as they both result from the coexistence of the state and international law. The norms of international law cannot violate state sovereignty and vice versa. In its judgement on the case of S.S. Lotus the PCIJ concluded: 'everything that should be expected of a state is that it did not breach the limits outlined by international law. It is so because this law determines this state's competencies and what is below these limits is the state's sovereignty, i.e., control over the country.xxii

2. SOVEREIGNTY AS a FOUNDATION OF THE STATE

There is a diversity of approaches as to the relation between the concept of the state and the concept of sovereignty in the study of international law. In this respect, one can distinguish three coexisting views which were put forward by L. Antonowicz:

In terms of international law, sovereignty is an indispensable attribute of a state.

Sovereignty is a standard, yet not mandatory attribute of a state for sovereign states coexist alongside non-sovereign ones.

The notion of sovereignty as a state's attribute is inappropriate and should be replaced with another concept, or concepts.xxiii

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In his attempts to define a state's foundations in terms of sovereignty, J. Makowski claimed that 'a state is sovereign or it is not a state at all'xxiv. It is due to the fact that there is no other entity in the study of international law that can be called sovereign, than a state. Likewise, Grocjusz argues, sovereignty is inseparably related to the subjectivity of a state. A state is a community who have supreme power which is independent of anyone and anything and not subordinate to the law or will of any other subject.

'Granting subjectivity' to the state's community resulted in interlinking sovereignty with the state. Consequently, the people became entitled to be called the sovereign who holds all the power or from whom all the power stems. However, if it had been agreed that power comes exclusively from the sovereign, they would have lost the previously granted primacy of the sovereign during elections e.g. while voting. Hence, e.g. in the Republic of Poland power belongs to the Nation and thus there is no risk of losing it during voting.

The will to enter into commitments and accept laws on the international plane is yet another reason for recognizing sovereignty as the state's foundation. For the first time this was formally expressed in 1648 in the settlements of the Peace of Westphalia where it was concluded that nationality was an important attribute of the state and the plans to introduce the principle of legal equality between countries into European politics were put forward.xxv

Pan-American Convention on Rights and Duties of States, concluded at Montevideo on 26 December 1933 was of major importance for the legal status of states on the international plane because it emphasized states' equality and capability of each state to exercise the rights contained in its status.xxvi What was especially significant was the pronouncement of the independence of the rights of each state. The sovereignty of the state and thus its independence constituted and still constitutes an exclusive basis for these rights. Sovereignty had then a 'dual role'. On the one hand, it served as a source of rights and duties for states in the international sphere. On the other hand, as a characteristic 'umbrella' to protect their rights and duties. A sovereign state is a state exercising the protection e.g. against interference from another subject of international law.

The important role of sovereignty, as the state's foundation, was also emphasized in the Charter of the United Nations, where it was indicated that the Organization (UN) is based on the principle of sovereign equality of all its members. Only states could be members of the organization.xxvii The UN Charter defines sovereign equality as:

Equality of states under law, equal rights, the right of nations to self-determination, the right of the state for the respect of its territorial integrity and independence.xxviii Right to use all the improvements resulting from the possessed autonomy, right to political independence of the state, having effective opportunity to enter into international commitments, a duty to fulfil in good faith all the obligations assumed under international agreements. An obligation to settle disputes by peaceful means, to refrain from the threat and other hostile means of settling disputes including the use of force, an obligation to provide any assistance in every action taken in fulfilment of the provisions of the UN Charter.xxix

The guideline that sovereignty constitutes the state's foundation was again emphasized in two resolutions adopted at the 17th UN General Assembly on the principles of international cooperation in the field of international law. The resolutions assumed that states should apply the principles of international law, which lead to the gradual development of international law and greater respect for international law regarding amicable relations and international cooperation concluding:

a principle of the sovereign equality of states, a principle of equal rights, right of nations to self-determination, an obligation to refrain from intervening in the areas of internal competence of another state.xxx

States are recognized as civilised due to their sovereignty attribute as it normalizes relations between independent subjects of international law. Besides the UN Charter, the issue of sovereign equality was also addressed in international law documents setting up new international organisations. Among others, this refers to American States Organization. The organization is based on the international order which respects states' identity, sovereignty and independence as well as on proper fulfilment of obligations under treaties and other international sources.xxxi

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Despite the passage of time and rapid development of civilization, which, as it could be assumed, does not leave room for 'outdated' rules, international law provisions remain current. This proves how solid and permanent the foundations on which the state is established in international law are. For example, it can be found in Warsaw Declaration entitled 'Towards Community of Democracies' adopted on 27 June 2000, in which representatives from 107 countries declared their will of cooperation towards consolidation and reinforcement of democratic institutions with respect for the principles of sovereignty and non-interference in internal affairs.xxxii

Analysing the above, it is worth emphasizing that although time goes by, sovereignty, as a fundamental principle of international law, has not become outdated and still forms the state's foundation. In view of the unwavering stance held by present and operating subjects on legal international plane, which refer to 'sovereign equality' as to the basis for states' coexistence, significance of sovereignty is undeniable.

Sovereignty is then a natural and 'inherent' attribute of the state, it being an intrinsic existence, independent and non-subordinate to anyone's power. E. de Vattel (1958) noted that 'sovereignty provides a foundation for the natural law of nations'.xxxiii The foundation stems from the freedom of a nation, from which the nation derives its existence. Interestingly, sovereignty as a foundation for the state's existence has never been criticized. E. de Vattel (1958), argued: 'if humans are equal by nature and their rights and duties also resulting from nature are the same, thus also nations built of humans and recognized as free, living in nature individuals are equal and have the same rights and duties.'xxxiv What comes with freedom is the fact that what is allowed to one nation, is also allowed to any other nation. And, on the contrary, what is not allowed to one, is not allowed to the other. E. de Vattel (1958) equated the nation with the state.xxxv The state is only an instrument for organizing life and functioning of the nation. As regards chronological order, the nation undoubtedly forms itself before the state. Only after the nation is formed and a characteristic bond between members of a specific community arises, people take measures to set up and constitute the state. Each nation, and therefore every state has the freedom to decide about its actions, yet certainly this freedom is limited by the freedom of another state. Consequently, the state is free to decide upon its actions as long as it does not infringe the freedom of another state. It is due to the fact that nations are free, independent and equal, and therefore states as well are free, independent and equal.

Hegel, on the other hand, argued that sovereignty is a consequence of the approach to the concept of the state as an autonomous unit. In his view, 'relations between independent states, based on their independent, freely expressed will, are the starting point for external international law.'xxxvi So expressed will notwithstanding, the state can alter it any time despite the fundamental principle pacta sunt servanda saying that agreements must be kept. 'A sovereign state has the full ability to self-determine the boundaries of its actions and in this way to limit its own competence'xxxvii e.g. by acceding to international organizations or other treaties on the international plane, which then act on behalf of a group of states. From this point of view, sovereignty is a specific legal condition built up out of two factors: first, independence from other states and, second, the highest power in the state. Both of these factors determine that the state is able to freely conduct its external policies through building relations with other countries and run internal policies free of interference from any other subject. This all means that the attribute of sovereignty becomes the foundation of the state's existence. In this very aspect, sovereignty is unlimited and no one apart from the highest authority has the legitimacy to decide upon its legal order.

Sovereign equality brings thus equality for all states, irrespectively of the time of their establishment, size of territory, population, GDP or other indexes that could be used for their classification and categorization.

Being sovereign leads to the fact that the state generally evaluates appropriateness of its actions by itself. States can apply to an international tribunal for arbitration only in case of dispute. To do so, however, the state is required to freely express its wish to submit the dispute for arbitration of an independent body.

The sovereignty of one state is limited solely by the sovereignty of another state.

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There are critical, although scarce, evaluations of sovereignty as a foundation for the state's existence in literature. Kelsen (1920) put forward two fundamental theses which critically evaluate the theory of sovereignty. The former addressed the argument that sovereignty belongs only to a logical category, not to a historical one. The latter, on the other hand, concerned the statement that the state is identical to its legal order and that the issue of sovereignty is in fact about the relation of internal law of the state to international law.xxxviii In Polish studies a similar point of view to Keller's is held by W. Sukiennicki (1939).xxxix The overall scale of disapproving opinions on the essence of sovereignty is so small that it does not merit further attention.

Summing up the above analysis, a few noteworthy views on sovereignty as a state's foundation are the following:

Sovereignty is conditio sine qua non to function as a full-fledged state in international legal relations. The mentioned approach has become a peculiar source of the law of nations. Perceiving sovereignty as an indispensable attribute for the state's existence has become an element of philosophy and theory of international law. The concept of sovereignty is inseparable from the concept of international law. Therefore, presumably shaping of both phenomena was happening simultaneously at the beginning of statehood. Sovereignty as the foundation of a state reflects the autonomy of states in international law.

3. METHODOLOGY

To achieve the goal, legal-empirical research, both initial hypotheses and the effects of the study, were formulated with the intention of better understanding of legal phenomena treated as a relatively autonomous category of social phenomena.

The result of the research is to deepen the knowledge about law, but also most often to contribute to the improvement of positive law by giving an assessment of the positive law used in social practice, and, therefore, making proposals to modify this law.

4. CONCLUSIONS

Thus far, formation of a state in international law has seemed to be a continual process. This is primarily due to the ongoing changes among members of international community as well as from the relation between states. Since the Second World War the UN and actual attention of states to the observance of the UN Charter's provisions have been of great significance in the process of establishing relations between states.

Respect for adopted by states fundamental principles of international law, such as the principle of self-determination of nations, sovereign equality, subjectivity, non-interference etc., is an absolute prerequisite for the state of affairs.

It has been indicated that sovereignty is a formal criterion of subjectivity in terms of international law.

It has been proved that sovereignty manifests itself in the ability to maintain relations with other states. Their maintenance, in turn, proves the execution of the sovereignty principle.

Moreover, it has been proved that sovereignty is not an unlimited law of the state but determined by the freedom of other states. The boundaries of sovereignty are marked by the prohibition of the violation of laws of other states.

Creation of the state is an objective fact. No person has the right to examine 'legality', 'system' or 'the authority' of the newly created state. Legitimacy to create a new subject on the international plate results from the right to self-determination.

Sovereignty of the state is then expressed in non-transferable competencies of state authorities, which determine the constitutional identity of the state.

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COMPARISON OF GAUSSIAN COPULA EXTENSIONS FOR CDO PRICING

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Abstract
The topic of the paper is comparison of Gaussian copula extensions for CDO pricing. CDO is widely applied to the risk management of banks and other financial institutions as one of most popular credit derivatives in the financial market. The study of CDO pricing models usually focuses on the probability of defaults of the obligors and the default correlations between the obligors. The goal of the paper is to compare three extensions of Gaussian copula, including normal inverse Gaussian (NIG), Gaussian copula with stochastic correlation, and Gaussian copula with random factor loadings (RFL). The conditional default probability and the distribution of the portfolio loss under the large homogeneous portfolio approximation (LHP) of each advanced copula model will be derived as well. We consider the Dow Jones iTraxx Europe tranches with 5-year maturity. The recovery rate and the risk-free interest rate are fixed to be 40% and 5%. Different copula models are compared in terms of their ability to fit the market quotes and correlation skew.

Keywords
Copula models, CDO, cumulative loss distribution, credit risk, LHP

1 Introduction

The modelling of the portfolio credit risk has become an active research area in recent years because of the rapid development of the credit derivatives market. Collateralized debt obligation (CDO), as a popular portfolio credit derivative, is a structural financial product that pools together credit risky assets, which are called collaterals, and then repackages the asset pool into varying tranches. CDO combines the advantage of asset securitization and credit derivatives as an innovative financial derivative. The key factors of pricing a CDO are the probability of default and the default correlation, and thus the portfolio cumulative loss distribution. Typically, CDO is priced in the framework of reduced-form models associated with the copula functions. The one factor Gaussian copula has been proven a benchmark for CDO pricing. However, the Gaussian copula is inadequate to fit the spreads of different CDO tranches simultaneously due to its thin tails. Therefore, the paper aims to compare three extensions of Gaussian copula, including normal inverse Gaussian (NIG), Gaussian copula with stochastic correlation, and Gaussian copula with random factor loadings (RFL), in terms of their ability to fit the market quotes and correlation skew.

2 Pricing of CDO under Gaussian copula framework

Consider a CDO of n underlying assets with default times τ_i, loss given default δ_i, and notional amount A_i. Generate n uniformly distributed random variables U_i based on the selected copula first and then

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transform U_i into default times τ_i in ascending order. Compute the default intensity $\lambda(t)$ and default times τ_i is given by $\tau_i = -\frac{\ln U_i}{\lambda}$. The cumulative loss of the portfolio up to time t is given by:

$$L(t) = \sum_{i=1}^{n} \delta_i A_i \mathbf{1}_{\{\tau_i \leq t\}}, \forall i = 1,2,\cdots,n. \tag{1}$$

Assume that there is a tranche γ and the attachment/detachment points are denoted by $\left(K_L^{\gamma}, K_U^{\gamma}\right)$, then the cumulative loss of the tranche is:

$$L\left(K_L^{\gamma}, K_U^{\gamma}, t\right) = \max\{\min\left[L(t), K_U^{\gamma}\right] - K_L^{\gamma}, 0\} = \{\min\left[L(t), K_U^{\gamma}\right] - K_L^{\gamma}\}^{+}. \tag{2}$$

The expected value of the cumulative tranche loss with the continuous portfolio loss distribution function $F_{\infty}(x)$ is:

$$\mathrm{E}\left[L\left(K_L^{\gamma}, K_U^{\gamma}, t\right)\right] = \frac{1}{K_U^{\gamma} - K_L^{\gamma}} \int_{K_L^{\gamma}}^{1} \left[\min\left(x, K_U^{\gamma}\right) - K_L^{\gamma}\right] \mathrm{d}F_{\infty}(x). \tag{3}$$

The expected value of the default leg and the premium leg can be computed respectively by:

$$DL = \mathrm{E}\left[\int_0^T \mathrm{B}(0,t)\mathrm{d}L\left(K_L^{\gamma}, K_U^{\gamma}, t\right)\right], \tag{4}$$

$$PL = \mathrm{E}\left[\sum_{i=1}^{n} s\Delta t_i \, \mathrm{B}(0,t)\min\{\max\left[K_U^{\gamma} - L(t_i), 0\right], K_U^{\gamma} - K_L^{\gamma}\}\right], \tag{5}$$

where $T = t_n$ is the maturity, $\mathrm{B}(0,t)$ is the discount factor until time t, s is the par spread of the tranche, $\Delta t_i = t_i - t_{i-1}$, and $L(t_i) = \delta_i A_i \mathbf{1}_{\{\tau_i \leq t\}}$.

Based on the general semi-analytic approach, each tranche conducts a premium so that the premium leg equals the default leg, namely $PL = DL$. The par spread s^* is therefore:

$$s^* = \frac{\mathrm{E}\left[\int_0^T \mathrm{B}(0,t)\mathrm{d}L\left(K_L^{\gamma}, K_U^{\gamma}, t\right)\right]}{\mathrm{E}\left[\sum_{i=1}^{n} \Delta t_i \, \mathrm{B}(0,t)\min\{\max\left[K_U^{\gamma} - L(t_i), 0\right], K_U^{\gamma} - K_L^{\gamma}\}\right]}. \tag{6}$$

It is clear that the key issue for pricing CDO is to determine the cumulative loss distribution function $F_{\infty}(x)$, which is the important element of the expected value of the cumulative tranche loss $\mathrm{E}\left[L\left(K_L^{\gamma}, K_U^{\gamma}, t\right)\right]$. However, it is not easy to derive $F_{\infty}(x)$ because of influences of the default correlation between the reference entities. Thus, the remaining introduce factor copula model to derive the portfolio cumulative loss distribution $F_{\infty}(x)$.

3 Methodology of the advanced copula models

In order to better measure the portfolio cumulative loss distribution $F_{\infty}(x)$, there are three extensions of the one factor Gaussian copula model, namely normal inverse Gaussian (NIG), Gaussian copula with stochastic correlation, and Gaussian copula with random factor loadings (RFL).

3.1 Normal inverse Gaussian

Normal inverse Gaussian (NIG) distribution is a mixture of normal and inverse Gaussian distributions and is a special case of the generalized hyperbolic distribution by Barndorff-Nielsen. Kalemanova et al. (2005) proved that NIG distribution fits the market data well.

The value of the i-th asset in NIG copula looks identical to Gaussian representation:

$$V_i = \rho_i Y + \sqrt{1 - \rho_i^2} Z_i, \forall i = 1,2,\cdots,n, \tag{7}$$

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where $\rho_i \in [0,1]$ is the correlation coefficient between the i-th asset and the systematic factor. Note that Y and Z_i are independent normal inverse Gaussian random variables, satisfying $Y \sim NIG\left(\alpha, \beta, \frac{-\alpha\beta}{\sqrt{\alpha^2-\beta^2}}, \alpha\right)$ and $Z_i \sim NIG\left(\frac{\sqrt{1-\rho_i^2}}{\rho_i}\alpha, \frac{\sqrt{1-\rho_i^2}}{\rho_i}\beta, -\frac{\sqrt{1-\rho_i^2}}{\rho_i}\frac{\alpha\beta}{\sqrt{\alpha^2-\beta^2}}, \frac{\sqrt{1-\rho_i^2}}{\rho_i}\alpha\right)$ with parameters $\alpha > 0$ and $\beta > 0$. Then V_i are also normal inverse Gaussian distributed, namely $V_i \sim NIG\left(\frac{\alpha}{\rho_i}, \frac{\beta}{\rho_i}, -\frac{1}{\rho_i}\frac{\alpha\beta}{\sqrt{\alpha^2-\beta^2}}, \frac{\alpha}{\rho_i}\right)$.

Denote the probability distribution function by $F_{NIG}\left(x; \frac{\alpha}{\rho_i}, \frac{\beta}{\rho_i}, -\frac{1}{\rho_i}\frac{\alpha\beta}{\sqrt{\alpha^2-\beta^2}}, \frac{\alpha}{\rho_i}\right)$ with $F_{NIG\left(\frac{1}{\rho_i}\right)}(x)$ for simplification. Similarly, the probability distribution functions of Y and Z_i are $F_{NIG(1)}(x)$ and $F_{NIG\left(\frac{\sqrt{1-\rho_i^2}}{\rho_i}\right)}(x)$. The conditional default probability of the i-th asset under NIG copula is:

$$p_i(y) = F_{NIG\left(\frac{\sqrt{1-\rho_i^2}}{\rho_i}\right)}\left[\frac{F_{NIG\left(\frac{1}{\rho_i}\right)}^{-1}(Q_i(t)) - \rho_i y}{\sqrt{1-\rho_i^2}}\right]. \tag{8}$$

There exists a so-called large homogeneous portfolio approximation (LHP) that allows to derive an analytical situation for the portfolio loss distribution and the then the expected value of the cumulative tranche loss. The approximation, proposed by Vasicek (1987), assumes that the number of the obligors n in the portfolio is extremely large. All obligors are homogeneous, which means they are identical in notional amounts, recovery rates, and unconditional default probabilities. Thus, the approximating distribution of the portfolio loss under NIG copula can be given by:

$$F_\infty(x) = F_{NIG(1)}\left[\frac{\sqrt{1-\rho_i^2}F_{NIG\left(\frac{\sqrt{1-\rho_i^2}}{\rho_i}\right)}^{-1}(x) - F_{NIG\left(\frac{1}{\rho_i}\right)}^{-1}(Q_i(t))}{\rho_i}\right]. \tag{9}$$

3.2   Gaussian copula with stochastic correlation

Stochastic correlation model is also an extension of Gaussian copula introduced by Andersen and Sidenius (2005) and Burtschell et al. (2007). In stochastic correlation model, the i-th asset value is:

$$V_i = \widetilde{\rho_i}Y + \sqrt{1 - \widetilde{\rho_i}^2}Z_i, \forall i = 1,2,\cdots,n, \tag{10}$$

where $\widetilde{\rho_i}$ are random variables and $\widetilde{\rho_i} \in [0,1]$ and Y and Z_i. Y and Z_i are Gaussian random variables, so V_i follow Gaussian distribution. Assume that $\widetilde{\rho_i}$ can only take two values, ρ and η, with probabilities p and $1 - p$:

$$\widetilde{\rho_i} = B_i\rho + (1 - B_i)\eta, \tag{11}$$

where B_i are Bernoulli random variables and also independent from Y and Z_i. Thus, the value of the i-th asset can be rewritten as:

$$V_i = [B_i\rho + (1 - B_i)\eta]Y + \sqrt{1 - [B_i\rho + (1 - B_i)\eta]^2}Z_i. \tag{12}$$

The conditional default probability of the i-th asset under stochastic correlation model is:

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$$p_i(y) = p\Phi\left(\frac{\Phi^{-1}(Q_i(t)) - \rho y}{\sqrt{1-\rho^2}}\right) + (1-p)\Phi\left(\frac{\Phi^{-1}(Q_i(t)) - \eta y}{\sqrt{1-\eta^2}}\right). \tag{13}$$

The approximating distribution of the portfolio loss under Gaussian copula with stochastic correlation is:

$$F_\infty(x) = p\Phi\left(\frac{\sqrt{1-\rho^2}\Phi^{-1}(x) - \Phi^{-1}(Q_i(t))}{\rho}\right)$$
$$+(1-p)\Phi\left(\frac{\sqrt{1-\eta^2}\Phi^{-1}(x) - \Phi^{-1}(Q_i(t))}{\eta}\right). \tag{14}$$

3.3 Gaussian copula with random factor loadings

Random factor loading (RFL) model was introduced by Anderson and Sidenius (2005) to better fit the correlation skew observed. The main idea of RFL model is to make factor loadings a function of the systematic factors. The value of the i-th asset can be given by:

$$V_i = \rho_{ij}(Y_j)Y + v_i Z_i + m_i, \forall i = 1,2,\cdots,n \text{ and } j = 1,2,\cdots,d, \tag{15}$$

where Y and Z_i are independent standard normal random variables, Y_j is a random variable with d-dimension, and ρ_{ij} are factor loadings with a two-point distribution:

$$\rho_{ij}(Y_j) = \begin{cases} \alpha_{ij}, & Y_j \le \theta_{ij} \\ \beta_{ij}, & Y_j > \theta_{ij} \end{cases}, \tag{16}$$

where α_{ij}, β_{ij} are positive constants and $\theta_{ij} \in \mathbb{R}$. Define that loading j takes value α_{ij} with probability $\Phi(\theta_{ij})$ and value β_{ij} with probability $1 - \Phi(\theta_{ij})$. Parameters m_i and v_i are chosen to ensure that V_i has zero mean and unit variance distribution:

$$m_i := -\mathrm{E}[\rho_i(Y)Y] = -\sum_{j=1}^{d}\left(-\alpha_{ij}\varphi(\theta_{ij}) + \beta_{ij}\varphi(\theta_{ij})\right), \tag{17}$$

$$v_i := \sqrt{1 - \mathrm{Var}[\rho_i(Y)Y]} = \sqrt{1 - \sum_{j=1}^{d}\mathrm{Var}[\rho_{ij}(Y_j)Y_j]}, \tag{18}$$

where $\mathrm{Var}[\rho_{ij}(Y_j)Y_j] = \alpha_{ij}^2\left(\Phi(\theta_{ij}) - \theta_{ij}\varphi(\theta_{ij})\right) + \beta_{ij}^2\left(\theta_{ij}\varphi(\theta_{ij}) + 1 - \Phi(\theta_{ij})\right) - \left(-\alpha_{ij}\varphi(\theta_{ij}) + \beta_{ij}\varphi(\theta_{ij})\right)^2$.

Assume the dimension of Y to be 1, then the conditional default probability of the i-th asset under Gaussian copula with random factor loadings is:

$$p_i(y) = \Phi\left[\frac{\Phi^{-1}(Q_i(t)) - \rho_i(y_j)y - m_i}{v_i}\right]$$
$$= \Phi\left[\frac{\Phi^{-1}(Q_i(t)) - (\alpha_i 1_{y<\theta_i}y + \beta_i 1_{y>\theta_i}y) - m_i}{v_i}\right]. \tag{19}$$

The approximating distribution of the portfolio loss under Gaussian copula with random factor loadings is:

$$F_\infty(x) = \Phi\left[\min\left(\frac{\Omega(x)}{\alpha_i}, \theta_i\right)\right] + 1_{\frac{\Omega(x)}{\beta_i}>\theta}\left[\Phi\left(\frac{\Omega(x)}{\beta_i}\right) - \Phi(\theta_i)\right], \tag{20}$$

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where $\Omega(x) := \Phi^{-1}\big(Q_i(t)\big) - v_i \Phi^{-1}(x) - m_i$.

4   Empirical Results

Consider the Dow Jones iTraxx Europe tranches with 5-year maturity from 4th of May 2005 to 10th of May 2006. Dow Jones iTraxx Europe is based on a reference portfolio of 125 European investment grade credits. The equity tranche is quoted as a market stand upfront premium plus 500 bps running. The recovery rate and risk-free interest rate are fixed to be 40% and 5% respectively. LHP assumption is applied.

By the simplex downhill solver and the gradient method, we can calibrate the parameters to fit the equity tranche and minimise the absolute error sum between the model implied spreads and the market spreads across all tranches. Annex 1 presents the ability of different copula models to fit the market quotes and correlation skew.

Figure 1. Minimum absolute error for different tranches
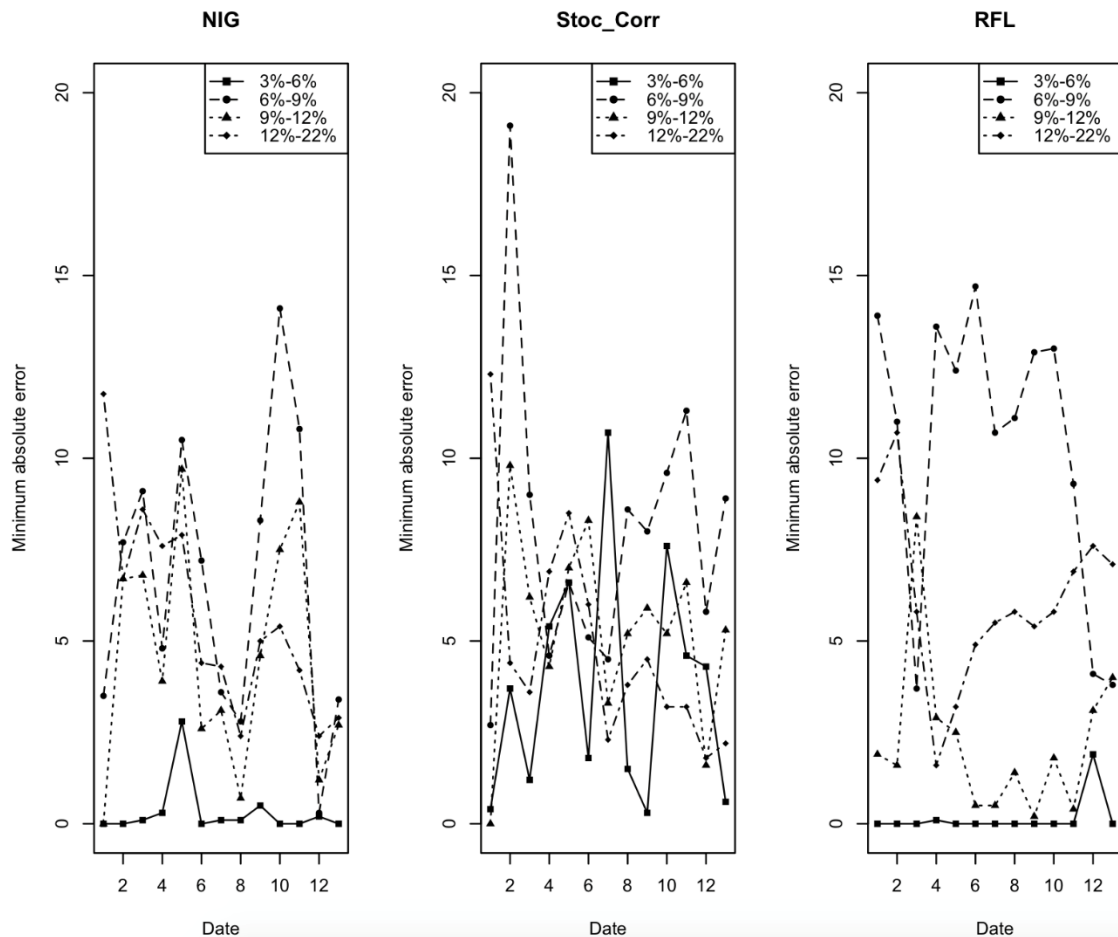
Table 2. Minimum absolute error for different tranches

Model	Average			
	3%-6%	6%-9%	9%-12%	12-22%
NIG	0.3	6.6	4.5	5.7
Stoc. Corr.	3.7	8.0	5.3	4.8
RFL	0.2	10.3	2.2	6.1

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Figure 1 and Table 2 summarize the minimum absolute error of three advanced copula models for different tranches. The equity tranche spreads are well fitted because the models are calibrated by the equity tranche. For the mezzanine tranches, three advanced copula models provide good matchings on the 3%-6% tranche, especially the NIG model and the RFL model. The minimum absolute error of the RFL model for the 3%-6% tranche ranges from 0 to 1.9 bps with an average of 0.2 bps, while the minimum absolute error of the RFL model for the 3%-6% tranche ranges from 0 to 2.8 bps with an average of 0.3 bps. The NIG model and the RFL model usually underestimate the 6%-9% tranche, and the RFL model fails to well estimate the 6%-9% tranche.

The senior tranches are difficult to price and related to the shape of the distribution in the upper tail. The RFL model fits the market quotes of the 9%-12% tranche best with an average minimum absolute error of 2.2 bps. The tranche spreads of the super senior tranche of 12%-22% are best estimated by the stochastic correlation model with an average minimum absolute error of 4.8 bps.
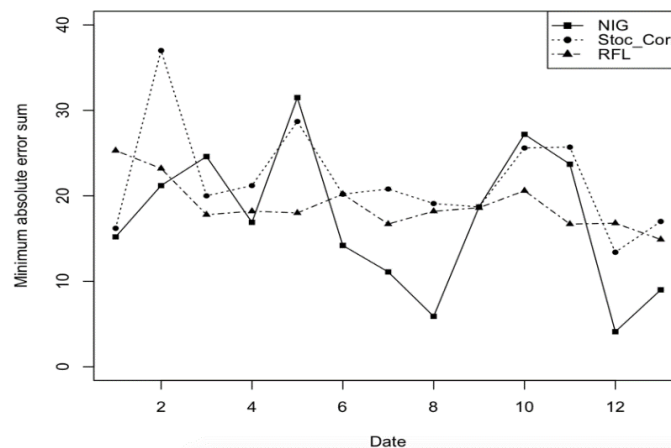
Figure 2. Minimum absolute error sum

Figure 2 summarizes the minimum absolute error sum of three advanced copula models. The minimum absolute error sum of the NIG model ranges from 4.1 bps to 31.5 bps with an average of 17.2 bps, and the 4.1 bps is the best fit to the market quotes among three models. The highest minimum absolute error sum, provided by the stochastic correlation model, is 37.0 bps. Compared with other two models, the minimum absolute error sum of the RFL model is relatively stable, ranging from 14.9 bps to 25.3 bps with an average of 18.9 bps. In summary, the NIG model provides the best fit as well as the lowest average minimum absolute error sum, while the RFL model provides relatively stable estimations.

5   Conclusion

The paper presents and compares three extensions to Gaussian copula for CDO pricing, including normal inverse Gaussian (NIG), Gaussian copula with stochastic correlation, and Gaussian copula with random factor loadings (RFL). Although the one factor Gaussian copula has been proven a benchmark for CDO pricing, the Gaussian copula is inadequate to fit the spreads of different CDO tranches simultaneously because of its thin tails, and then leads to the so-called implied correlation smile. The empirical results illustrate three advanced copula models outperform the one factor Gaussian copula model in terms of the ability to fit the market quotes and correlation skew. Three advanced copula models all provide good matchings on the mezzanine tranche of the 3%-6% tranche but fail to close fit the market quotes for the senior tranches, especially the 12%-22% tranche. Besides, the NIG model and the RFL model consistently produced the lowest minimum absolute error sum and are able to replicate the spreads on the equity tranche and junior mezzanine tranche.

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Annex

Annex 15. Tranche spreads for 5-year iTraxx Europe

Date	Model	iTraxx Europe 5 Year Tranche spread					Abs. Err.
		0%-3%	*3%-6%*	*6%-9%*	*9%-12%*	*12-22%*	
4.5.2005	Market	21.7%	176.5	53.0	25.5	16.8	-
	Gaussian	21.7%	316.0	111.8	43.7	8.7	224.6
	NIG	21.7%	176.5	56.5	25.5	5.04	15.2
	Stoc. Corr.	21.7%	176.1	50.3	25.5	4.5	16.2
	RFL	21.7%	176.5	39.1	27.4	26.2	25.3
1.6.2005	Market	13.4%	118.3	39.5	25.0	14.5	-
	Gaussian	13.4%	275.1	65.2	16.4	1.7	204.1
	NIG	13.4%	118.3	31.8	18.3	7.8	21.2
	Stoc. Corr.	13.4%	114.6	20.4	15.2	10.1	37.0
	RFL	13.4%	118.3	28.5	26.6	25.2	23.2
6.7.2005	Market	14.5%	82.8	31.8	18.3	11.6	-
	Gaussian	14.5%	208.4	46.3	11.3	1.2	157.6
	NIG	14.5%	82.9	22.7	11.5	3.0	24.6
	Stoc. Corr.	14.5%	84.0	40.8	24.5	15.2	20.0
	RFL	14.5%	82.8	28.1	26.7	17.4	17.8
3.8.2005	Market	16.3%	79.8	27.5	14.8	9.9	-
	Gaussian	16.3%	187.5	44.5	11.8	1.4	136.1
	NIG	16.3%	79.5	22.7	10.9	2.3	16.9
	Stoc. Corr.	16.3%	85.2	32.1	19.1	16.8	21.2
	RFL	16.3%	79.7	13.9	11.9	11.5	18.2
7.9.2005	Market	11.8%	81.0	25.8	14.3	8.2	-
	Gaussian	11.8%	159.4	25.8	4.5	0.3	96.1
	NIG	11.8%	78.2	15.3	4.6	0.3	31.5
	Stoc. Corr.	11.8%	87.6	32.4	7.3	16.7	28.7
	RFL	11.8%	81.0	13.4	11.8	11.4	18.0
5.10.2005	Market	12.7%	91.0	28.0	11.8	6.0	-
	Gaussian	12.7%	197.6	38.5	8.0	0.7	126.1
	NIG	12.7%	91.0	20.8	9.2	1.6	14.2
	Stoc. Corr.	12.7%	89.2	33.1	20.1	12.0	20.2
	RFL	12.7%	91.0	13.3	11.3	10.9	20.2
2.11.2005	Market	12.4%	93.0	24.0	12.0	5.8	-
	Gaussian	12.4%	201.3	38.3	7.8	0.6	132.0
	NIG	12.4%	92.9	20.4	8.9	1.5	11.1
	Stoc. Corr.	12.4%	103.7	28.5	15.3	8.1	20.8
	RFL	12.4%	93.0	13.3	11.5	11.3	16.7
7.12.2005	Market	15.0%	77.0	23.8	10.0	5.3	-
	Gaussian	15.0%	197.5	44.5	11.0	1.2	146.4
	NIG	15.0%	76.9	21.0	10.7	2.9	5.9
	Stoc. Corr.	15.0%	75.5	15.2	4.8	1.5	19.1
	RFL	15.0%	77.0	12.7	11.4	11.1	18.2
4.1.2006	Market	13.1%	81.7	26.3	11.5	5.8	-
	Gaussian	13.1%	177.7	32.9	6.6	0.5	112.7
	NIG	13.1%	81.2	18.0	6.9	0.8	18.7
	Stoc. Corr.	13.1%	81.4	18.3	5.6	1.3	18.7
	RFL	13.1%	81.7	13.4	11.7	11.2	18.6
1.2.2006	Market	10.7%	75.5	26.0	10.0	5.5	-

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	Gaussian	10.7%	144.8	19.7	2.9	0.2	88.1
	NIG	10.7%	75.5	11.9	2.5	0.1	27.2
	Stoc. Corr.	10.7%	67.9	16.4	4.8	2.3	25.6
	RFL	10.7%	75.5	13.0	11.8	11.3	20.6
	Market	10.9%	70.0	22.0	11.3	4.3	-
	Gaussian	10.9%	143.7	19.8	2.9	0.2	88.3
1.3.2006	NIG	10.9%	70.0	11.2	2.5	0.1	23.7
	Stoc. Corr.	10.9%	65.4	10.7	4.7	1.1	25.7
	RFL	10.9%	70.0	12.7	11.7	11.2	16.7
	Market	14.9%	62.3	16.5	8.3	3.5	-
	Gaussian	14.9%	164.8	35.3	8.4	0.9	124.2
5.4.2006	NIG	14.9%	62.1	16.2	7.1	1.1	4.1
	Stoc. Corr.	14.9%	66.6	22.3	9.9	5.3	13.4
	RFL	14.9%	64.2	12.4	11.4	11.1	16.8
	Market	14.2%	51.0	15.5	7.0	3.3	-
	Gaussian	14.2%	137.5	26.4	5.7	0.5	101.5
10.5.2006	NIG	14.2%	51.0	12.1	4.3	0.4	9.0
	Stoc. Corr.	14.2%	51.6	24.4	12.3	5.5	17.0
	RFL	14.2%	51.0	11.7	11.0	10.4	14.9

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OPTIMIZATION OF PORTFOLIO COMPOSED FROM NASDAQ 100 STOCKS

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Abstract
In this paper the naive strategy and Markowitz model are applied in the portfolio optimization problem. We choose the historical data of weekly closing prices of 92 component stocks of Nasdaq 100 in the empirical analysis. The 522 observations are divided evenly into in-sample part and out-of-sample part. We find 10 efficient portfolios based on Markowitz model in the in-sample part, and we apply these 10 portfolios as well as naive strategy in the out-of-sample part to verify whether the strategies work efficiently. At the same time, we also generate 50,000 random weights portfolios and make hypothesis tests to compare the results. From the empirical analysis, we find that the naive strategy and Markowitz model do not perform good in the optimization of portfolio composed from Nasdaq 100 stocks in the analysis period.

Keywords
Portfolio optimization, Naive strategy, Markowitz model, Random-weights portfolio, Sharpe ratio, Hypothesis tests.

JEL Classification
C12, G11.

1   Introduction

In finance, the investment in the form of a portfolio of assets is named as a *portfolio investment*, which includes transactions in equity securities, debt securities, etc. Optimizing the investment portfolio according to the investors' attitude to risk is an important issue, and in this paper, the analysis is based on the assumption that the investors are risk averse.

The goal of this paper is to verify the efficiency of chosen strategies in the optimization of portfolio composed from Nasdaq 100 stocks based on specific dataset.

In this paper, we make the description of strategies applied, which include the naive strategy and Markowitz model, and we also show the method of generating random weights, as well as the basic logics of hypothesis tests. The dataset of the empirical analysis consists of weekly closing prices of 92 component stocks from Nasdaq 100, and we divide the data evenly into in-sample part and out-of-sample part. We assume the initial wealth to be 1 dollar in all portfolio investments. We measure the performances of the strategies portfolios, and we also generate 50,000 random-weights portfolios and measure their performances, after that, the hypothesis tests are made to compare the performance form strategies portfolios with that from random-weights portfolios. At last, we make the conclusion of the empirical analysis.

2   Methods of Portfolio Optimization Problem

In the security trading activities, due to the influence of a series of uncertain factors, people usually cannot accurately predict the return of security, which makes the asset market always full of risks and opportunities. Therefore, on the premise of liquidity and security of investment funds, people always try to diversify the funds into assets with different returns and risks. In finance, we call the investment in

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the form of a portfolio of assets as a *portfolio investment*, which includes transactions in equity securities, debt securities, etc.

A portfolio investment is a kind of passive investment, because the investment is made with the expectation of earning a return while investors do not take active management of the issuing company. However, the expected return is correlated with the investment's risk. So, optimizing the investment portfolio according to the investors' attitude to risk is an important issue. In this section, we describe two methods of portfolio optimization problem, they are naive strategy and Markowitz model.

2.1 Naive Strategy

Naive strategy is the most straightforward solution comparing with other strategies in the portfolio problems, because when we apply it in the assets investments, we simply invest the assets at same weight *1/N* (where *N* is the number of all assets) in a specified period, that's why naive strategy is also named as *1/N* strategy.

Naive strategy is easy to implement because it does not rely neither on estimation of the asset returns nor on optimization. And assets allocation error caused by using the *1/N* weights can turn out to be smaller than the error caused by using the weights from an optimizing model. Because the effect of estimation error on the weights is so large, even the models designed explicitly to reduce the effect of estimation error achieve only modest success, Demiguel et al. (2009).

2.2 Markowitz Model

Return and Risk are two important aspects considered by investors in a portfolio investment. In the Modern Portfolio Theory (hence forth MPT), which states that a portfolio investment's return and risk should not be viewed alone, moreover, a higher degree of risk means a higher potential return, Markowitz (1952). In Markowitz model, we assume that investors are risk averse, so they need to balance the expected returns and risks in the investments.

Markowitz model, which is also named as mean-variance model, is a framework for analysis of the inter-relationships of return and risk in a portfolio optimization problem. In the Markowitz model, we denote x_i as the weight of asset i in the investment of a portfolio, and in our case, we exclude short sales, so the values of x_i satisfy $x_i \geq 0$ for all assets. We suppose that the expected stock return is identical to the average of the real returns within historical period, Zmeškal et al. (2004). If we denote $E(R_i)$ as the expected return of asset i in the sample period, then we can calculate the expected return of a portfolio $E(R_p)$ as follow,

$$E(R_p) = \sum_{i=1}^{N} x_i \cdot E(R_i) = x^T \cdot E(R) \tag{1}$$

where $x = [x_1, x_2, \ldots, x_N]^T$, $E(R) = [E(R_1), E(R_2), \ldots, E(R_N)]^T$, the sum of x_i in the portfolio equals to 1, and the expected return of portfolio $E(R_p)$ is the weighted average of $E(R_i)$.

As we mentioned above, in the Markowitz model, we should consider the risk of the portfolio at the same time. Markowitz model regards portfolio's variance or standard deviation as risk, and they are calculated by the covariance $\sigma_{i,j}$ of the component assets for all asset pairs (i, j), we denote a $N \times N$ matrix as Q, and $Q = [\sigma_{i,j}, i = 1, 2, \ldots, N, j = 1, 2, \ldots, N]$, we show the calculations of variance and standard deviation of a portfolio separately in equation (2) and equation (3),

$$\sigma_p{}^2 = \sum_{i=1}^{N} \sum_{j=1}^{N} x_i \cdot \sigma_{i,j} \cdot x_j = x^T \cdot Q \cdot x \tag{2}$$

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$$\sigma_p = \sqrt{{\sigma_p}^2} \tag{3}$$

where the standard deviation is the square root of variance.

From the MPT, we know that if an investor requires higher expected return, it means he or she must take on higher risk. In Markowitz model, based on the assumption of risk aversion, if investors meet the situations when the values of expected returns are different while the risk level is fixed, investors prefer to choose the portfolio with the maximum expected return. In order to achieve this goal, the efficient frontier is applied.

The efficient frontier is the set of efficient portfolios that shows the highest expected return for a given level of risk or the lowest risk for a given level of expected return, to satisfy these conditions, we can construct an efficient frontier by following steps with particular constraints, Kresta (2015). Firstly, we have to find the portfolio with minimum risk,

$$\left\{ \begin{array}{l} min\ {\sigma_p}^2 \\ \sum_{i=1}^{N} x_i = 1 \\ x_i \geq 0, i = 1, \dots, N \end{array} \right. \tag{4}$$

secondly, we have to find the portfolio with maximum expected return,

$$\left\{ \begin{array}{l} max\ E(R_p) \\ \sum_{i=1}^{N} x_i = 1 \\ x_i \geq 0, i = 1, \dots, N \end{array} \right. \tag{5}$$

for finding the internal points of the efficient set, we can do it as follows,

$$\left\{ \begin{array}{l} min\ {\sigma_p}^2 \\ E(R_p) \geq R_{j,generated} \\ \sum_{i=1}^{N} x_i = 1 \\ x_i \geq 0, i = 1, \dots, N \\ R_{j,generated} = R_{p,min} + j \cdot \frac{R_{p,max} - R_{p,min}}{9} \end{array} \right. \tag{6}$$

we minimize the risk while the expected return is equal or higher than the j_{th} predefined value $R_{j,generated}$, which is computed by equidistant intervals between the return of minimum-variance portfolio $R_{p,min}$ and the return of maximum-return portfolio $R_{p,max}$. And in our analysis, we find 10 efficient portfolios under the Markowitz model, so we divide the difference between $R_{p,max}$ and $R_{p,min}$ by 9.

2.3   Performance Measures

To evaluate the performance of the investments portfolios, in our case, except for the average and standard deviation of the returns of the portfolios, we also calculate the wealth evolution, the maximum drawdown (hence forth *MDD*) of wealth, Sharpe ratio (hence forth *SR*) and average annual return (hence

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forth AAR) as the performance measures, and we show the calculations of them in the following equations. Wealth evolution can be calculated as follow,

$$W_{t+1} = W_t \cdot (1 + R_{p.t}) \tag{7}$$

where W_{t+1} is the ex-post wealth at time $t + 1$, $R_{p.t}$ is the portfolio's expected return for period from t to $t + 1$.

$$MDD_{0,T} = \max_{\tau \in (0,T)} [1 - \frac{W_\tau}{\max_{t \in (0,\tau)} W(t)}] \tag{8}$$

$MDD_{0,T}$ is the maximum loss from a peak to a trough of a portfolio up to time T.

$$SR_{R,R_{RF}} = \frac{E(R_p) - R_{RF}}{\sigma_p} \tag{9}$$

where R_{RF} is the risk-free rate, in our case, we regard the weekly United States 10-Year Bond Yield as the weekly risk-free rate, which equals to 0.0606%[19],

$$AAR = (1 + E(R_p)_w)^{52} - 1 \tag{10}$$

where $E(R_p)_w$ is the average of the weekly portfolio's returns.

2.4 Hypothesis Tests and Random Portfolios Generation

As we know, the applied strategies are committed to optimize the portfolios, however, even though these strategies are based on powerful theories, we still need to verify whether they work efficiently or not. So, not only the performance of the strategy portfolio (P_s) is evaluated independently, the random-weights portfolios are also generated to make the hypothesis tests by using their performance (P_r), and in this step, we can verify the efficiency of the strategies based on the comparisons of P_s with P_r.

Random-weights portfolio, as it literally means, the weights of assets in the investment of a portfolio are generated randomly, in our case, we set up 50,000 random portfolios, in each portfolio, the sum of the weights x_i is equal to 1. For the generation of random weights, we choose $y \in [0,1]^{N-1}$ uniformly by means of $N - 1$ uniform reals in the interval $[0,1]$, and sort the coefficients so that $0 \leq y_1 \leq \cdots \leq y_{N-1}$, and then,

$$x_i = (y_1, y_2 - y_1, y_3 - y_2, \ldots, y_{N-1} - y_{N-2}, 1 - y_{N-1}) \tag{11}$$

because we can recover the sorted y_i by means of the partial sums of the x_i, the mapping $y \to x$ is $(N - 1)!$ to 1.

We know that a hypothesis test relies on the method of indirect proof, Arson (2007). That is, to prove the hypothesis that we would like to demonstrate as correct, we show that an opposing hypothesis is incorrect. As we mentioned, the strategies applied in the portfolios optimization problem are more likely to be demonstrated as efficient, so, according to the rule of hypothesis test, we can make the null hypothesis and the alternative hypothesis as below:

null hypothesis—H_0: $P_r = P_s$,

alternative hypothesis —H_A: $P_r < P_s$.

In our hypothesis test, the *p-value* is the proportion of the random-weights portfolios which meet $P_r > P_s$. We set the significance level at 5%, and then,

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[19] https://www.investing.com/rates-bonds/u.s.-10-year-bond-yield

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if *p-value* < 5%, we reject H_0,

which means the performance of strategy portfolio is better than that of the random-weights portfolio, so, the strategy is efficient;

if *p-value* ≥ 5%, we fail to reject H_0,

which means the performance of strategy portfolio is the same as that of the random-weights portfolio, so, the strategy is inefficient.

3   Empirical Analysis

In this section, we make the empirical analysis. We first describe the data used in our analysis. The dataset is weekly closing prices of 92 component stocks from Nasdaq 100, the Nasdaq 100 is a stock market index made up of 103 equity securities issued by 100 of the largest non-financial companies listed on the Nasdaq, there are 11 component stocks which are not included in our analysis due to the incomplete data in the analysis period, they are stocks of Alphabet Inc. Class C, American Airlines Group, Broadcom Inc., Charter Communications, Inc., Facebook, Inc., JD.com, Kraft Heinz Co, PayPal Holdings, Inc., Tesla, Inc., Tesla, Inc. and Workday, Inc..

The time duration in our analysis is 10 years, which is from October 5, 2008 to September 30, 2018. There are 522 weekly observations in total, and we divide the data evenly into two parts, they are in-sample part and out-of-sample part, the in-sample period is from October 5, 2008 to September 29, 2013, the out-of-sample period is from October 6, 2013 to September 30, 2018. In the application of Markowitz model, we choose 10 efficient portfolios based on the in-sample data and then make the back-test to verify these 10 portfolios based on the out-of-sample data. For the naive strategy and the analysis of random-weights portfolios, we only use the out-of-sample data. We assume the initial wealth to be 1 dollar in all portfolio investments.

The Historical price evolutions of Nasdaq 100 of the in-sample part and the out-of-sample part are shown in Figure 1. We can see the price of Nasdaq 100 keeps increasing in the whole sample period, there is no fall neither crisis.

**Figure 15. Historical Price Evolutions of Nasdaq 100**

Source: https://www.investing.com/indices/nq-100-historical-data
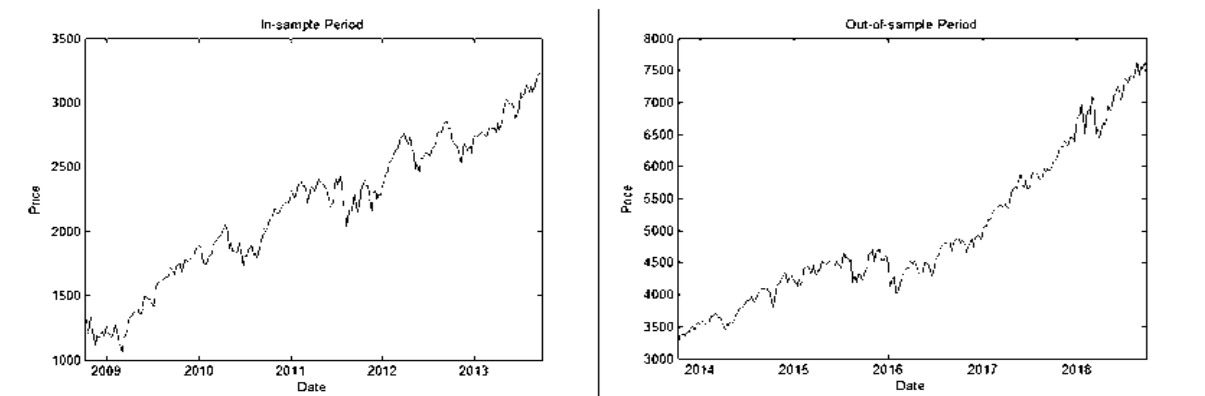
3.1   Portfolio Optimization of Naive Strategy

First of all, we calculate the weekly returns of all the 92 stocks based on the out-of-sample data. As we mentioned before, in the naive strategy, all the assets are invested at same weight *1/N* (here *N=92*). According to the returns of stocks and the weights, we calculate the weekly returns of the *1/N* weight portfolio according to equation (1).

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Next, based on the weekly portfolio returns, we calculate the wealth evolution by equation (7), and the result is shown in Figure 2. We can see that there are some fluctuations in the wealth evolution in the out-of-sample period, but it still keeps increasing in a general trend.

Figure 2. Wealth Evolution of *1/N* Weight Portfolio under Naive Strategy
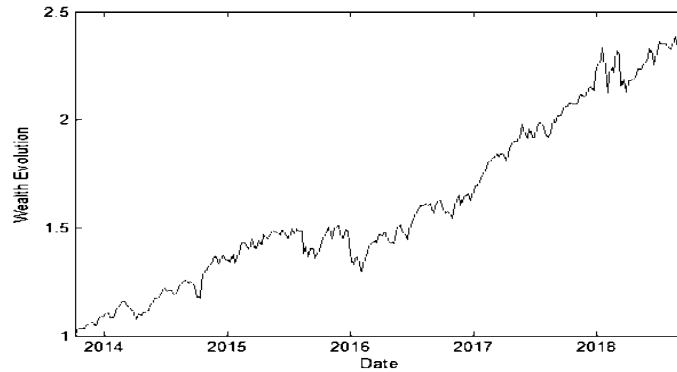
Source: own calculation

In Table 1, we show the performance of naive strategy in the out-of-sample period. On the one hand, we find that the final wealth is $2.31, which has more than doubled the initial wealth; on the other hand, the *SR* is 14.36%, which means this portfolio is reliable.

Table 16. Performance of *1/N* Weight Portfolio under Naive Strategy
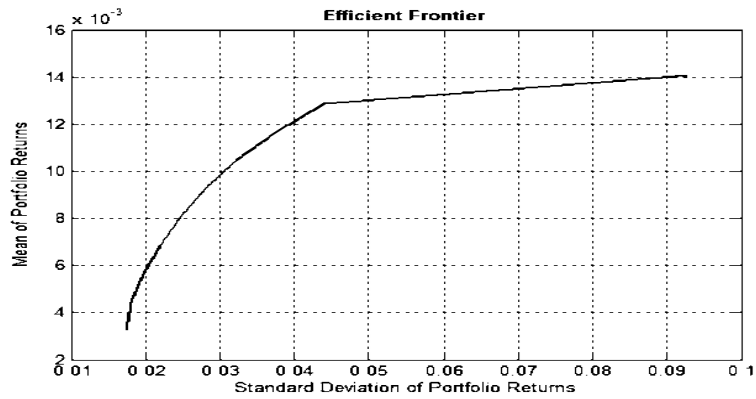
Final wealth (dollar)	2.31
Mean of weekly portfolio returns	0.34%
Standard deviation of weekly portfolio returns	1.96%
AAR	19.39%
SR	14.36%
MDD	14.16%

Source: own calculation

3.2   Portfolio Optimization of Markowitz Model

Markowitz model is firstly applied in the in-sample period to find out the efficient portfolios. By using the method mentioned in section 2, the efficient frontier is constructed in Figure 3 based on the in-sample data.

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Figure 3. Efficient Frontier

Source: own calculation

From Figure 3, we can see the means of weekly portfolios returns on efficient frontier are between 0.32% and 1.41%, and the standard deviations of weekly portfolio returns are between 1.74% and 9.29%.

Figure 4. Wealth Evolutions of Efficient Portfolios under Markowitz Model
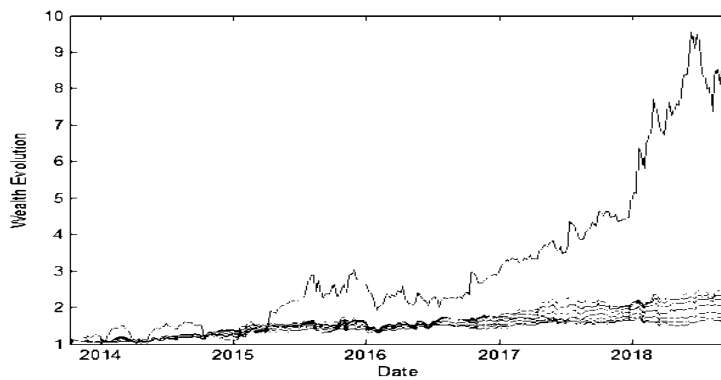
Source: own calculation

Secondly, we choose 10 efficient portfolios on the efficient frontier, and we make the back-test of these 10 portfolios under Markowitz model in the out-of-sample period, we show the wealth evolutions of these portfolios in Figure 4., and the portfolios' performances are shown in Table 2.

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Table 2. Performance of efficient portfolios under Markowitz model

| Portfolio	Final wealth (dollar)	Mean of weekly portfolio returns	Standard deviation of weekly portfolio returns	*AAR*	*SR*	*MDD*
1	1.61	0.20%	1.73%	10.86%	7.98%	13.26%
2	1.71	0.22%	1.77%	12.20%	9.09%	12.15%
3	1.83	0.25%	1.88%	13.87%	10.10%	12.09%
4	1.95	0.28%	2.04%	15.49%	10.65%	12.99%
5	2.06	0.30%	2.22%	17.08%	10.96%	14.18%
6	2.12	0.32%	2.29%	17.84%	11.16%	14.06%
7	2.20	0.33%	2.34%	18.78%	11.56%	16.01%
8	2.28	0.35%	2.49%	19.83%	11.56%	19.72%
9	2.38	0.37%	2.82%	21.40%	11.10%	24.94%
10	8.17	1.01%	6.35%	68.23%	14.89%	36.77%

Source: own calculation

Figure 4 shows the increasing trends of these portfolios' wealth evolutions, and that's also reflected in Table 2, we can see the values of final wealth in each portfolio are higher than the initial wealth, especially the final wealth in the portfolio which matched the maximum standard deviation even reached 8.17 dollar, that's as the same as the key thought of MPT, the higher the risk, the higher the return. The *AAR* and *SR* also show good performances of these portfolios. Portfolio 3 in Table 2 has the lowest value of maximum drawdown, which means the maximum loss from historical peak to trough is 12.09% in the out-of-sample period.

3.3   Hypothesis tests

In this part, we make the hypothesis tests to compare the performance of the strategies portfolios with the performance of random-weights portfolios. In the first step, we set up 50,000 random-weights portfolios, and we generate the random weights based on the equation (11). We show the out-of-sample performances of these 50,000 random-weights portfolios in Figure 5.

Figure 5. Performances of Random-weights Portfolios
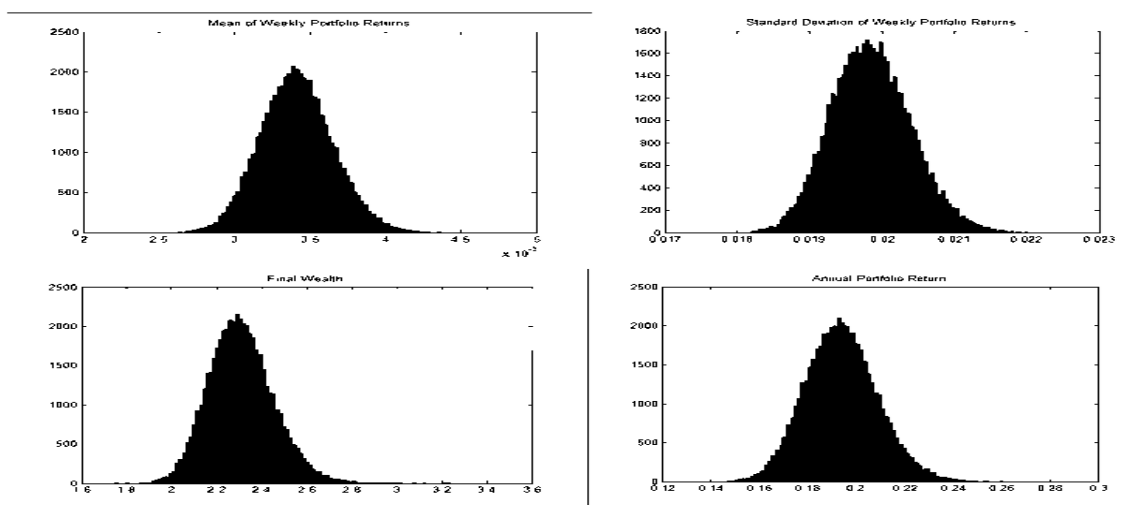
Source: own calculation

From Figure 5, we know the mean value of weekly portfolio returns' means is 0.34%, and the mean value of weekly portfolio returns' standard deviations is 1.99%. In these 50,000 portfolios, for the final

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wealth, the maximum value is 3.23 dollar and the minimum value is 1.75 dollar; for the AAR, the maximum value is 28.11% and the minimum value is 13.05%, so, to sum up, we find that these 50,000 portfolios are profitable in the out-of-sample period, and the main reason of this result is the increasing market price of Nasdaq 100 in this period which is referred to Figure 1.

In the next step, we make the hypothesis tests to compare the performances of strategies portfolios with the performances of random-weights portfolios.

1) Naive strategy

The P_r is the performance of random-weights portfolio, the P_n is the performance of naive strategy portfolio. The *p-value* is the proportion of the random-weights portfolios which meet $P_r > P_n$. In the tests, we choose *SR* as the portfolio performance measure, and the calculation results are shown in Figure 6.

Figure 6. Random-weights Portfolios Sharpe Ratio
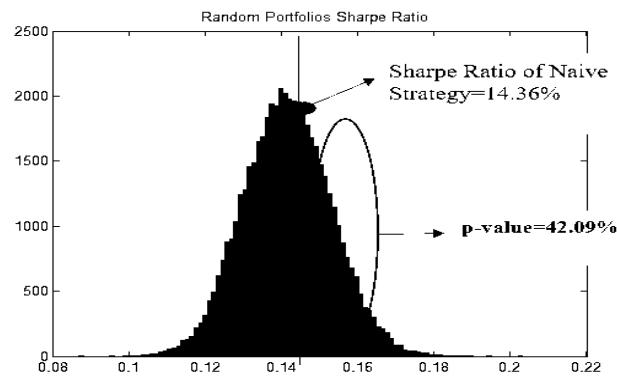
Source: own calculation

Figure 6 shows the frequency distribution of random-weights portfolios' *SR*, we mark the point of the value of *SR* from naive strategy, the area on the right of this point includes all the random-weights portfolios which have better performance than that of the naive strategy, and this part accounts for 42.09% (*p-value*) of the total random-weights portfolios. However, we also find that even though more than half of random-weights portfolios have smaller *SR* than that of naive strategy portfolio, the *p-value* is still much higher than the significance level, so we fail to reject H_0, which means the performance of naive strategy portfolio is the same as that of the random-weights portfolio in the out-of-sample period, so, the naive strategy is inefficient.

2) Markowitz model

Table 3. Hypothesis Tests-Markowitz Model

Portfolio	P-value	Result
1	100%	Fail to reject H0
2	100%	Fail to reject H0
3	99.99%	Fail to reject H0
4	99.90%	Fail to reject H0
5	99.75%	Fail to reject H0
6	99.57%	Fail to reject H0
7	98.88%	Fail to reject H0
8	98.89%	Fail to reject H0
9	99.63%	Fail to reject H0
10	25.53%	Fail to reject H0

Notes: H_0 is the null hypothesis: random performance (P_r) = Markowitz performance (P_m)

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Source: own calculation

The P_m is the performance of Markowitz strategy portfolio. In this test, the p-value is the proportion of the random portfolios which meet $P_r > P_m$. We show the calculation results in Table 3. We can see that based on the hypothesis assumed, for all portfolios under Markowitz strategy, the conclusions are the same, that's we fail to reject H_0, which means the performance of Markowitz strategy portfolio is the same as that of the random-weights portfolio in the out-of-sample period, so, the Markowitz strategy is inefficient.

4   Conclusion

The objective of this paper is to verify the efficiency of chosen strategies in the optimization of portfolio composed from Nasdaq 100 stocks based on specific dataset. Firstly, we apply naive strategy and Markowitz model in the portfolio optimization problem, and then we make the performance measures of the efficient portfolios we get, in this sense, we find that all the chosen portfolios under the strategies earn profits in the out-of-sample period, the final wealth in each portfolio times the initial wealth, and the average annual returns of the portfolios are also considerable.

Secondly, in the hypothesis tests, we make the null hypothesis and alternative hypothesis, which are aimed to verify whether the performance from strategy portfolio is better than that from random-weights portfolio. However, the results show that the strategies portfolios do not perform better than random-weights portfolios, because both under the Naive strategy and Markowitz strategy, the proportion of the random-weights portfolios which meet $P_r > P_s$ (*p-value*) is greater than the significance level (5%), it tells us that the situation when $P_r > P_s$ is more to be true rather than by luck. So, the Naive strategy and Markowitz strategy are inefficient, if people invest in the 92 stocks with random weights, there are quite high probabilities they can get higher profits than make the investments by applying the chosen strategies.

Throughout the whole analysis, we know that the main reason which leads to the profits of strategies portfolios is the increasing market price of Nasdaq 100 in the target period, however, nevertheless, the chosen strategies portfolios do not perform better comparing with the random-weights portfolios.

Based on all results of the empirical analysis, in a conclusion, the naive strategy and Markowitz model are not efficient in the portfolio optimization problem based on the chosen dataset.

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RESEARCH ON EVALUATION INDEX SYSTEM OF ENTERPRISE KNOWLEDGE INNOVATION ABILITY FROM THE PERSPECTIVE OF KNOWLEDGE HETEROGENEITY

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Abstract

Under the new economic situation, relying on technological progress and knowledge innovation to obtain economic development has become the key to China's economic transformation. From the perspective of knowledge heterogeneity, this paper specifically studies the connotation and classification of enterprise knowledge innovation ability, and based on this, constructs a set of scientific and complete enterprise knowledge innovation ability evaluation index system. It provides a theoretical basis for the comprehensive evaluation and optimization research of modern enterprise knowledge innovation ability.

Keywords

Knowledge heterogeneity， knowledge innovation， enterprise innovation ability, evaluation index system

After more than 30 years of rapid growth, China's past extensive growth has been difficult to sustain. China's economic development has reached another turning point. The economic development model must once again undergo a fundamental strategic transformation. Today is the era of knowledge economy, China's economy. The key to structural transformation is to improve the ability of enterprises to innovate knowledge. Knowledge innovation comes from the recombination of existing knowledge, information and experience, and the reasonable prediction of future knowledge information. Therefore, access to heterogeneous information and knowledge constitutes the basis of knowledge innovation. This article is based on this, from the perspective of knowledge heterogeneity to specifically study the ability of enterprise knowledge innovation.

Knowledge innovation is a process of colliding, spreading, integrating, and generating new methods and new ideas through existing knowledge, and this process will add value. The enterprise knowledge innovation based on the enterprise's intellectual assets aims to realize the organic combination of knowledge and economy by using and creating knowledge to undertake the knowledge field and the economic field. In the knowledge economy society, knowledge resources have become one of the most important resources of enterprises, and knowledge innovation has gradually become an important way for enterprises to gain competitive advantage.

1 The Connotation of Enterprise Knowledge Innovation Ability

Enterprise knowledge innovation is an important part of the enterprise innovation process. Then knowledge innovation comes from the acquisition of new knowledge inside and outside the enterprise, that is, the heterogeneous knowledge acquired by the enterprise constitutes the main body of enterprise knowledge innovation. Therefore, the author believes that the ability of enterprise knowledge innovation mainly refers to the ability of enterprises to discover, identify and acquire heterogeneous knowledge resources inside and outside the enterprise under the premise of knowledge heterogeneity. Innovation, the core driving force for sustainable growth.

First of all, the ability of enterprise knowledge innovation has dynamic characteristics. The ability of knowledge innovation of enterprises is not fixed. This ability is adjusted in combination with the changes

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of internal and external environment. Especially in the dynamic environment where modern enterprises are located, the knowledge innovation ability of enterprises has Dynamic features that are adjusted in real time.

Secondly, heterogeneous knowledge resources are the goal of enterprise knowledge innovation ability. Heterogeneous knowledge is the basis for realizing enterprise knowledge innovation. Therefore, the understanding of enterprise knowledge innovation ability lies in how to discover, identify and acquire heterogeneous knowledge resources. Therefore, effectively determine various explicit and implicit differences of enterprises. Qualitative knowledge is the key to improving the ability of enterprises to innovate.

Finally, the ability of enterprise knowledge innovation is difficult to imitate. The ability of enterprise knowledge innovation lies in the continuous discovery of various heterogeneous information and knowledge. Identification and acquisition are an attribute that enterprises gradually form and develop in the long-term practice process. They are difficult to imitate by other enterprises and are the core competitiveness of enterprises.

2   Literature Review

The division of knowledge heterogeneity dimensions. Dimensional division of knowledge heterogeneity is rarely involved. The more representative ones are Wang Xing yuan and Ji Zhi heng (2013). The knowledge heterogeneity is divided into 3 kinds: explicit knowledge heterogeneity, pseudo-hidden knowledge heterogeneity and true recessiveness. Some scholars also divide the heterogeneity from the team level. Jackson, Stone, and Alvarez (1993) simply divide team heterogeneity into external heterogeneity and internal heterogeneity. Jehn (1997) divides team heterogeneity into information heterogeneity, social category heterogeneity, and value heterogeneity. Susan and Apama (2003) divide team heterogeneity into task-oriented heterogeneity and heterogeneity of relationship orientation. Knight (1999) divides the individual diversity attributes of organizational members into two categories: dominant features and recessive features.

At present, a large number of scholars are engaged in the research of knowledge innovation. Li Qian and others built the enterprise knowledge innovation model based on tacit knowledge sharing and established the guarantee mechanism of knowledge innovation; Han Rong et al. used self-organization theory to analyse the behaviour law of knowledge innovation system and discussed the self-organization structure. The self-organized criticality of the knowledge innovation system constructs the innovative entropy of the knowledge innovation distribution of the measurement system. On the basis of expounding the connotation of tacit knowledge, Zhang Shu zhong analysed the SECI model of knowledge innovation and discussed the key elements of knowledge innovation; Yang Feng qiang et al. proposed the basic method of modularization of knowledge innovation service and knowledge innovation service. Functional decomposition method. It can be seen that the research on knowledge innovation at this stage mainly stays at the theoretical stage, mostly qualitative research. The evaluation of knowledge innovation ability, especially the evaluation index of knowledge innovation ability is less. Mainly because the evaluation index of knowledge innovation ability is ambiguous and the indicators are cumbersome, it is difficult to accurately construct an evaluation index system for the evaluation of knowledge innovation ability.

3   Establishment of Evaluation Index System of Enterprise Knowledge Innovation Capability

Combining the connotation of enterprise knowledge innovation ability and the related research results of predecessors, we believe that the enterprise knowledge innovation ability can be divided into the following four aspects: knowledge stock level, knowledge sharing level, knowledge absorption ability and network heterogeneity level. Taking these four aspects as the first-level indicators, a set of enterprise knowledge innovation capability evaluation index system including 14 secondary indicators and 32 third-level indicators was established.

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Table 1: Evaluation Index System of Enterprise Knowledge Innovation Capability

	Primary indicator	Secondary indicators	Third level indicator
Enter-prise Knowl-edge Innovation Capab-ility Evalu-ation Index Syste-m	knowledge stock level	Human stocks	Employee working years
			Employees' years of education
			Employee professional and technical qualification level
		Knowledge-based stock	Number of technological achievements
			Technical level of equipment
			Informatization level
		Knowledge stock based on organization	Management costs as a percentage of sales revenue
			Organizational effectiveness
			Organizational identity
		Market-based knowledge stock	Customer satisfaction
			Market research level
			The fitness of the marketing network
	knowledge sharing level,	Degree of trust between members	Knowledge sharing among employees
			Degree of supervisor being respected
		Transfer tendency between members	Frequency of knowledge sharing
			The degree of perfection of sharing measures
			Willingness of employees to transfer knowledge
		Teaching and absorptive capacity	Employees absorb knowledge cycles
			Employee communication skills
		Knowledge sharing	Invisibility of knowledge
	knowledge absorption ability	Knowledge collection ability	Knowledge acquisition ability
			External knowledge value judgment ability
		Knowledge self-processing ability	Employee understanding
			Employee turnover
		Knowledge creation ability	The ability to enhance the competitive advantage of enterprises
			Improvement of original products and services
	network heterogeneity	Material resources	Market value of the resources provided

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	level		Irreplaceability of the resources provided
		Network relationship	Closeness of relationship with other companies
			Closeness of relationship with the government
			The closeness of the relationship with the intermediary
		Organizational status	Position in the network

3.1 Knowledge stock level

The enterprise's knowledge innovation activities are based on the acquisition and mastery of the original knowledge in the field. Therefore, its existing knowledge level directly affects its ability of knowledge innovation. The level of knowledge stock of an enterprise is the sum of all the knowledge resources owned by a period, and it accumulates growth with the development of the enterprise, which is a direct reflection of the organization and knowledge innovation ability of the enterprise. The knowledge stock is mainly carried in four types of carriers. The first is the knowledge and experience stored in the human brain. It is mainly measured by the working years of the employees, the years of education and the professional qualifications of the employees. The second is the object as the carrier. The knowledge is mainly for a variety of recordable and definable information, which can be measured by the quantity of enterprise technology achievements, the technical level of equipment and the level of informationization. The third is the knowledge of the organization structure of the enterprise to ensure that the enterprise can Efficient and safe operation can be measured by the proportion of enterprise management costs in sales revenue, organizational effectiveness and organizational identity. Fourth, the market knowledge stock is all that enterprises can help the market to compete and gain competitive advantage. All market related knowledge. It can be measured by customer satisfaction, market research level and the fitness of the marketing network.

3.2 Knowledge sharing level

In any organization, exclusive knowledge is an important source of better personal value for employees and more personal gain. Therefore, employees with exclusive knowledge often lack the will to share their knowledge. However, there is a significant positive correlation between the strength of employees' knowledge sharing intentions and the results of enterprise knowledge innovation ability. Therefore, improving employees' sharing willingness is an effective way for enterprises to improve their knowledge innovation ability. Research shows that the level of knowledge sharing is determined by three factors: knowledge sharing premise, sharing motivation and sharing ability. The degree of mutual trust between employees, the tendency of knowledge transfer, the ability to share knowledge and the ability to teach and absorb are among them. The most important factor.

3.3 Knowledge absorption capacity

In addition to the accumulation of internal knowledge, another important way to obtain the information external to the enterprise is to obtain information external to the enterprise. Knowledge absorptive capacity refers to the ability of enterprises to acquire and effectively transform external knowledge into their own knowledge resources. It is mainly manifested in the ability of enterprises to collect, self-process and re-create other key links. The collection of knowledge refers to the process of finding external effective information and judging its value; the self-processing of external knowledge means that the enterprise effectively learns and grasps the external information to be absorbed, and thus becomes a trial-available enterprise. The process of internal knowledge; the ability to create external

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knowledge refers to the process in which an enterprise innovates according to the knowledge that has absorbed the transformation and forms the innovative knowledge of the enterprise.

3.4   Network heterogeneity level

The level of network heterogeneity is based on the degree of knowledge heterogeneity of enterprises using network systems, and is the degree of network realization of various internal and external heterogeneous knowledge resources. It is specifically reflected in the market value and degree of substitution of the material resources owned by the enterprise. In addition, the network relationship formed by the close relationship with other enterprises, government research institutes, intermediaries and service departments is also an important part of the level of network heterogeneity. It is directly related to the application of enterprise network structure. In addition, the organization status of the enterprise in the network structure is that the enterprise is the leader or follower and the enterprise in the process of knowledge transfer with other organizations. The measure of the level of network heterogeneity has far-reaching implications.

4   Conclusion

From the perspective of knowledge heterogeneity, the article specifically studies the connotation of enterprise knowledge innovation ability, and divides enterprise knowledge innovation ability into knowledge stock level, knowledge sharing level, knowledge absorption ability and network heterogeneity level. A set of scientific and complete enterprise knowledge innovation capability evaluation index system was constructed. Of course, it is a very complicated task to study the ability of enterprise knowledge innovation from the perspective of knowledge heterogeneity. Especially when modern enterprises are in a dynamic environment, the evaluation and optimization of enterprise knowledge innovation ability needs further research and deepening. And gradually improve in practice.

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INDUSTRY 4.0 – CHANGES IN BUSINESS ADMINISTRATION STUDIES:
THE CDO AS A FUTURE PROFILE DESCRIPTION FOR THE GRADUATES FROM THIS FIELD?

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Abstract
The second decade of the 21st century will be impacted by the fourth industrial revolution at all levels, particularly in the economy, politics and society. Due to the digital transformation, not only companies but also universities, in particular the study programs, have to adapt. Thus, at the World Economic Forum 2018 in Davos, due to the recent failure to implement the fourth industrial revolution, governments were urged to address the impact of new technologies on labor markets and make the necessary adjustments in education policy. The paper is focused on the issue of digitalization and its impact on business administration curriculum. The aim of the present study was to find out, what changes companies and universities currently see in business administration studies in order to derive a new curricular adapted to Industry 4.0. The research question What does the business graduate of tomorrow look like should therefore be answered. To this end, twelve expert interviews have been conducted with companies and universities. The experts said that the classic business administration modules, such as accounting, controlling, financing, human resources, marketing, tax, should continue to be maintained and extended with digital skills. One possible result could be the profile of the CDO.

1   Introduction

In the literature, many keywords do appear under Industry 4.0 or the fourth industrial revolution, such as for example the Internet of Things, cloud computing or cyber-physical technologies. Also, at the World Economic Forum 2018 (short: WEF), questions about Industry 4.0 and the related future development of employees were discussed. (World Economic Forum, 2018) An important appeal should be picked out from the forum, as it offers an elementary added value for this scientific paper. On the one hand, the companies are responsible for the qualification measures of the employees and on the other hand, governments are advised to deal with the effects of new technologies in the labor market in order to implement the required skills and knowledge in the context of a modern education policy, especially with regard to the STEM areas.

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2   Objective

The aim of this work was to find out which changes companies and universities are currently seeing in business administration studies, in order to derive recommendations for action from this in a new study programme for business administration studies, as the WEF 2018 is striving for.

With the help of semi-structured and problem-centered expert interviews, it was possible, on the one hand, to interview study course directors of business administration studies, of both bachelor's and master's degrees, and on the other hand, managing directors, HR managers and experts on Industry 4.0. The aim of this survey was to obtain a status quo of competence in business administration studies and, based on Industry 4.0, to point out or incorporate the necessary changes to the business education curriculum.

The university-wide selection of experts had to meet two requirements: a) the interviewee should have at least five years' experience in the higher education sector and b) he/ she should have a professorship or at least be a lecturer in a Bachelor's or Master's degree in business administration. In order to obtain as broad a spectrum of opinions as possible, the interviews were conducted at various universities, irrespective of the type of study, responsible body and type of university. For the initial contact, the website of the Foundation for the Promotion of the University Rectors' Conference was consulted and searched for business administration studies throughout Germany.

There were also requirements for the expert selection of companies. The interviewee should have at least five years of professional experience in business administration as a personnel manager, managing director or have expert knowledge in the field of Industry 4.0. The source for the initial contact was the website of the federal state related Chamber of Commerce and Industry, regardless of any restrictions such as industries, location, region, size etc.

A total of 24 experts have been contacted in this way so far. A total of 14 feedback reports have been collected to date, and twelve expert interviews have already been conducted. Six companies and six universities from Germany have so far taken part in these twelve interviews. Two experts only wanted to fill in the interview guide and were not interested in an interview. The respondents expressed great interest in this study, which also reflects in the considerable participation rate. The duration of the interview was announced at 60 minutes, but this time was easily disputed by some experts.
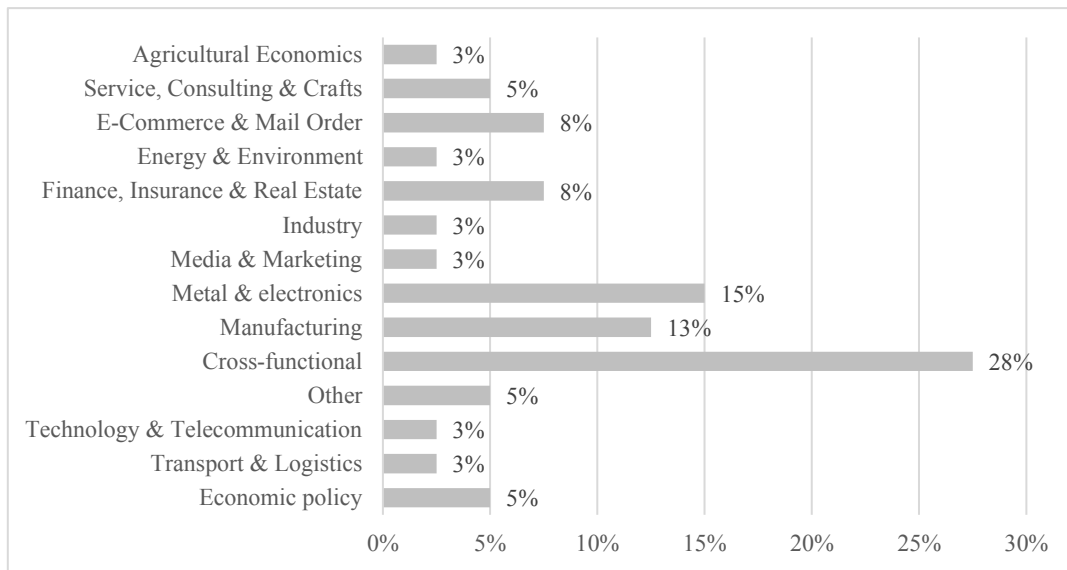
3   Methodology and Data

The surveys were each recorded on a dictation machine, when available, and then transcribed. For the statistical evaluation, the transcribed interviews were evaluated with the help of MAXQDA, which means that in the first step, the codes are stored according to the interview guide and in the second step, the relevant text passages were assigned these codes. On the one hand, the qualitative content analysis according to Philipp Mayring was used, if the necessary categories could be taken from the literature studies and, on the other hand, the Grounded Theory according to Anselm Strauss, in order to be able to record further categories.

In this section the statistical data will be explained and subsequently the main results will be derived.

Mostly HR managers and managing directors where interviewed at the companies. A wide range of industries was chosen; the surveyed companies are largely subdivided into the cross-divisional functions with 28%, followed by the metal & electronics industry with 15% and the manufacturing industry with 13%. All other sectors have a percentage value below 10%; cf. Figure 1.

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Figure 16. Industry distribution of the expert interviews

Source: (own illustration)

The interviews have shown that companies are finding it increasingly difficult to allocate themselves to any industry. The current examples show that in future an industry-specific classification, possibly with regard to the statistical background, will become increasingly difficult, as the example of Amazon shows. In the beginning, the company was associated with the book industry, then it increasingly became a multi-channel mail order company and today the company advertises with a bot Alexa for robots and artificial intelligence.

The six companies surveyed were equally allocated to micro enterprises and large enterprises with equal shares of 43% each, followed by medium-sized enterprises. Small companies could not be identified in the course of the expert interviews.

If the focus is shifted to the university view, then it can be said that among the business administration degree programs interviewed, predominantly study directors were surveyed, who as a rule have already taken the first steps in the direction of digitization. Thereby, the focus was on the bachelor's and master's programs in business administration.

The question of the size of the degree program was answered in equal proportions with a small study program (10 to 49 students) and a medium study program (50 to 249 students). No degree programs could be identified which would represent a minimal degree programm (<10 students) or a large degree programm (> 250 students).
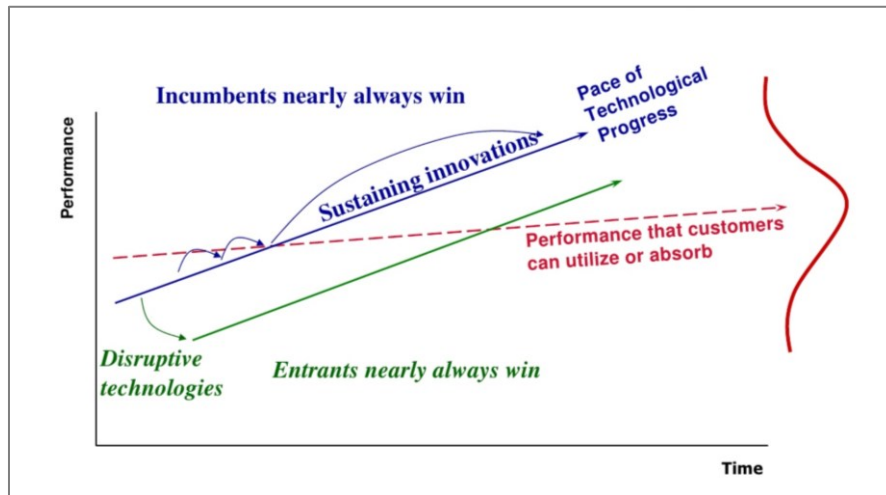
4   Empirical Results

Based on the statistically collected data, the research results for the modified business administration study ought to be recorded in this chapter.

4.1   Technology trends 2019

At this point, the ten disruptive technology trends, which are predicted for the year 2019, are considered in more detail, so that subsequently a possible and modified curriculum for the course of study of business administration can be derived. Disruptive trends combine radical changes in the economy and society, which means that the digital transformation leads to social and cultural upheavals. Mutius 2016 said in an interview that we now have to start with creative thinking. (Hornung, 2016)

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Figure 2. Influence of disruption

Source: Wanamaker (2013)

Figure 2 of Christensen 2013 illustrates that the adjusting and changing market requirements lead to the continuity of the initial innovation resulting in lower product performance and lower costs. With a disruptive innovation change, in turn, higher product performance and a higher price can be achieved. Hence, it can be deduced that disruption is conducive to a company. (Wanamaker, 2013)

After the conceptual explanation, the consideration should be redirected to the ten technology trends: (Herrmann, 2018a and 2018b and 2018c):

- Trend 1: Autonomous things, that is to say, the degree of automation is steadily increased by AI. Evidence of this is the development of drones, robots or vehicles.
- Trend 2: Augmented Analytics is considered to be a more intensified automated data preparation (metadata). This leads to a significant improvement in business intelligence.
- Trend 3: AI-based software development. The previous and classic software development will be replaced by the use of AI.
- Trend 4: A Digital Twins will change the corporate world in the future. In this way, entire business units or companies could be mapped in order to perform process optimization.
- Trend 5: Empowered Edge supports data transfer, that is to say, data collection and processing with cloud solutions, between a variety of devices, in order to minimize the amount of data transmitted, also known as network traffic.
- Trend 6: Immersive Experience. The use of new technologies, such as virtual reality glasses, for example, are changing our awareness of digitization so much that, in the future, computers and sensors can interact with other human senses in terms of, for instance, heat or moisture. The result is then: our environment as a computer.
- Trend 7: Blockchains are databases that manage the data a) without any control, b) without the required trust, and c) in complete transparency. With this technology, complex transactions, for example in the areas of banking, supply chain, music or public institutions, can be executed more securely.
- Trend 8: Smart Spaces are known as spaces that intelligently support you everyday life and are becoming increasingly important. Think of smart home devices or Smart Cities like Helsinki with the Kalasatama district.
- Trend 9: Digital Ethics and Privacy, the digital world is increasingly causing us to wonder if this or that process is safe. Such issues of single individuals and organizations will become more of a focus, now that users have already stored a wealth of data and algorithms from our habits can be derived, which will happen next.
- Trend 10: Quantum computers can process data even faster than conventional computers, and their application is predicted in the automotive or financial sector in particular.

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The technology trends of the future years were considered. In the following, the focus will be directed to the business administration studies.

4.2   Industrie 4.0: opportunity or risk?

The term Industry 4.0 was equated with the digitization or used as synonymous by some of the respondents. A large number of the interviewees mentioned in this context the year 2011, which dates back to the year of origin of the neologism. At the Hannover Fair 2011, Kagermann, Lukas, and Wahlster first used the term Industry 4.0 together with the Internet of Things and Internet of Services in connection with a pending paradigm shift (Lasi et al., 2014) in the industrial sector. (Kagermann et al., 2011) A chronological sequence of the preceding three industrial revolutions ought to be omitted here in order to preserve the scope of this work.

It must be added that in fact some of the interviewees see the term merely as a buzzword, which currently has no influence on their field of activity. This finding can be confirmed with the FHM study, since 49% of the surveyed companies, and thus almost every second company, believes that digitization does not represent a significant factor in the further development of products and services as well as their innovation. (Werning et al., 2017) The following statement in the context of the expert interviews has been memorable: Who says today from an entrepreneurial point of view, that Industry 4.0 does not matter to me, whose company will not exist in the next 10 to 20 years. (Expert No 9, 2018)

For those discussions that differentiated the two words, the following can be summarized: a) Industry 4.0 is considered a processional disruption in the corporate world where the added value of a physical product is at its end. (Expert No 4, 2018) b) In the interconnected production, there can be either a horizontal crosslinking, which stands for transparent production among the existing suppliers within the value chain, or there is a vertical networking. (Kagermann et al., 2011) In the latter case, in-company communication is understood across department boundaries, i. e. within a company. c) Digitization is considered by some interviewees as an informational and technological change that brings about holistic changes for all, that is to say, in all areas, especially business, society and politics. Deriving from this, digitization is a kind of triad of technology, process and human. With the latter statements, also the authors go along.

The question of whether the term Industry 4.0 is more of an opportunity and a challenge, was answered by the respondents both as well. Very interesting was this statement: if we take this opportunity, then we have to overcome some challenges before." (Expert No 3, 2018) In part, Industry 4.0 sees opportunities to change something and, secondly, the joy of finding something yet undiscovered. For the challenges considered as risk, the respondents mainly see a) uncertainties in process automation and b) in the communication and transparency of employees and c) in employee retraining.

A large number of the interviewees report in the interview that a large part of the German Mittelstand has until now, due to filled order books, dealt little or not at all with Industry 4.0. (Expert No 7, 2018) A study by the FHM 2017 shows that within North Rhine-Westphalia, an average digitization index of 4,2 of all industrial companies was reached instead of the possible 10,0. (Werning et al., 2017)

4.3   The Business Administration Studies with Digital Competency Orientation

In the context of the interviews, the question of the future graduate in business administration became the focus of attention. In the competence orientation of the future graduate students of business administration, the experts gave the following weighting, with the methodological competence being defined as the most important competence with 37%, followed by the social competence with 34% and the professional competence with 29%.

In terms of specialist skills, application orientation and basic knowledge stand out as important competences. By implication, it is the task of the universities to enable a close integration between science and practice. In terms of methodological competence, priority was given to self-responsibility, followed by the ability to apply knowledge in practice as well as problem and solution orientation, which

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were given equal weighting. Self-responsibility as well as problem and solution orientation can be promoted by universities with the help of case studies and project tasks. In terms of social competence, motivation leads the way, followed by team and communication skills. The motivation of an individual is difficult to promote in the view of higher education institutions, as they are subject to intrinsic and extrinsic motivators. The extent of team and communication skills can also be intensified through project tasks, teamwork, and subsequent presentation.

Figure 3. Detailed consideration of the competences of future business administration graduates

competence	characteristics	values	total result
professional	Application Location	**1,5**	
	Basic knowledge	2,0	
	Work experience in studies	2,5	
	Specialization	2,5	**2,8**
	Additional qualification	3,2	
	Vocational training	3,5	
	Research orientation	4,1	
methodological	Individual responsibility	**1,4**	
	Ability to apply knowledge practically	1,5	
	Problem and solution orientation	1,5	
	Analytical understanding	1,6	
	Criticism	1,7	**1,7**
	Methodic procedure	1,7	
	Economical thinking	1,8	
	Decision-Making techniques	2,0	
	Cognitive abilities	2,1	
social	Motivation	**1,5**	
	Team and communication skills	1,6	
	Self-perception	1,9	
	Foreign experience / foreign language	2,2	
	Leadership skills	2,2	**2,0**
	Resilience / flexibility	2,2	
	Manners	2,4	
	Voluntary work	2,7	

Notes: The evaluation is based on the following schemes: 1 - very important, 2 - important, 3 - rather important, 4 - rather unimportant, 5 - unimportant, 6 - completely unimportant.

Source: (own illustration)

As part of the interviews, the question of the future business administration graduates was asked. The majority of respondents concluded that business administration studies must change. The classic business administration modules, such as controlling, financing, cost and performance accounting, marketing, accounting, human resources and organization, statistics and taxes, should be maintained and enhanced with digital skills. Based on this statement, the digital competences will now be discussed in more detail.

Digital skills are the capabilities of the digital world, including the procedural and technological knowledge associated with digitization. In addition, it is important to know the potential opportunities and risks of a technology but the limits as well. (Brüggemann, 2018) Key figures are already today and will increasingly be of high relevance for the business administration graduate, which is already an existing field of responsibility. The basic framework, that is to say, the required skills is statistical knowledge in order to read and verify these key figures and to derive or initiate necessary steps. The business administration graduate must also have a basic understanding of information technology (short:

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IT), especially knowledge about technologies currently used in the company and their application areas, such as, cloud solutions. (Expert No 9, 2018) The experts also said that digital knowledge requires methodological skills. What seemed important earlier is simply not enough in today's world; today more emphasis needs to be placed on methodical competence rather than specialist skills. The experts said that studying business administration has to adapt in the age of digitization. Here are some excerpts of some essential IT requirements: Business Analytics, Data Mining, Artificial Intelligence and the handling of Cloud / Mobile Computing and modern trends such as Block Chain.

If we devote ourselves to imparting knowledge, it would be conceivable that seminary teaching and teamwork would rather bring about the desired success, and thus less the classical lectures with frontal lessons. Accordingly, the questions arise, how can the digital skills be integrated into the course of study? On the one hand, this could be done through a cross-sectional integration by expanding the above-mentioned modules with digital skills, thus a horizontal cross-linking. On the other hand, the digital skills could also be taught as individual modules, i. e. vertical cross-linking. The authors are in favor of the latter, as these modules are a promising factor in teaching and have a positive impact on tomorrow's business administration graduates.

Most recently, the experts were asked if the CDO could become the new education profile for the business administration graduate. A Chief Digital Officer (short: CDO) is responsible for the digital transformation of the company. He is the direct contact person for the changing business processes and advances them. Some of the interviewed companies have already implemented a CDO, others have not yet done so, and some of the other experts do not consider this necessary. In conclusion, the experts at large companies confirm this thesis, but in smaller companies, this activity would rather take over the management. This agrees with this finding: "The controller becomes the navigator through the digital transformation and transforms from Controller to Chief Digital Performance Officer and Data Scientist." (Gerberich, 2018)

5 Discussion and Conclusion

The expert interviews with companies and universities have shown that both sides are calling for a change of the course of study. It should be noted that in the future methodological competence will increasingly dominate social and professional competence. This is closely linked to new digital transformation and digital technologies and new evaluation methods. When it comes to the most important individual criteria's of methodological competence, self-responsibility has to be mentioned first. The ability to apply knowledge in practice and problem and solution orientation were cited as the second most important characteristic. On the other hand, the application orientation and the basic knowledge could be derived as important characteristics of the business administration graduate. Motivation and the ability to work in a team and to communicate are upfront in social competence.

In addition to these common methods, the future business administration graduate should acquire a further competence, digital competence. In doing so, the previously classical business administration course of study should be expanded by this competence. The necessary business administration modules were mentioned in extracts: Controlling, Financing, Marketing, Statistics and Taxes. Digital competences are associated with the process-related and technological knowledge associated with digitalisation. An opportunity/risk assessment of a technology is also part of this, but basic IT understanding and statistical knowledge are required for this. Based on these results, the Chief Digital Officer could be regarded as the future education profile for business administration studies.

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RESEARCH ON THE IMPLEMENTATION OF CSR OF LISTED COMPANIES IN CHINESE HOUSEHOLD APPLIANCE INDUSTRY

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Abstract

After nearly 40 years of development, the Chinese economy has made tremendous achievements in terms of quantity, but there is still a huge gap with the developed countries in the term of quality. In the past most companies paid more attention to the development of the economy, ignored the impact on environment even made serious damage to the environment. Now it has reached the point that must be emphasized and changed. That is, enterprises must be responsible for society while achieving economic goals. That means enterprises should be responsible for their stakeholders, put in efforts to improve the environment and make contributions to the public. This article takes the listed companies in China's household electrical appliance industry as the analysis object, and builds an evaluation index system suitable for China's current economic development level based on the method of AHP. According to the index system, the scores of CSR of sample companies are calculated and ranked. It is found that in terms of the implementation of CSR of the listed companies in China's household electrical appliance industry, individual companies have performed well and stably, but the most companies performed worse and need to be further improved.

Keywords

CSR, AHP, Chinese appliance industry.

1   Introduction

After 40 years of development, the Chinese economy has achieved remarkable achievements. According to the GDP ranking, China has become the third largest economy in the world after the United States and the European Union. Apart from rejoicing, we should be soberly aware that after economic development to a certain degree, we should not blindly pursue the repeated expansion of the economic mass but shift to the pursuit of quality, including the impact on the environment and society as a whole. This is also the original intention of GRI which started to explore how to measure corporate social responsibility (CSR) in 1987.In the household electrical appliance industry closely related to the lives of the people, many Chinese companies have reached the advanced level of technology in the world and made considerable profits. However, how is the performance of their corporate social responsibilities? This issue is worth studying. The goal of this article is to evaluate the performance of CSR in the household electrical appliance companies.

2   Literature Review

In recent years, there are some literature which researches the implementation of CSR of Chinese companies. Weiyan Jiang et al. (2015) identified the key factors or activity areas of CSR for contractors to implement in Chinese construction industry, including environmental protection, quality and safety, local community, employees, clients and CSR administration. Qinghua Zhu and Qiangzhong Zhang (2015) research the internal values and external drivers on CSR practices in Chinese state-owned companies based on the framework of ISO26000 and characteristics of state-owned companies. Antonio K.W. Lau et al. (2018) empirically develop an exploratory taxonomy of CSR practices in China's

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manufacturing industries. From the existing literature, there is few research about CSR of Chinese companies in home appliance industry yet. Therefore, the goal of this article is to evaluate the performance of social responsibility of listed companies in the Chinese home appliance industry by constructing an index system that adapts to the current development status of Chinese enterprises.

3   Methodology and Data

3.1   The method of the analytic hierarchy process

The analytic hierarchy process (AHP) was officially proposed by the University of Pittsburgh Professor Thomas L. Saaty in the mid-1970s. It is a systematic and hierarchical analysis method combining qualitative and quantitative. Due to its practicality and effectiveness in dealing with complex decision-making problems, it has quickly gained worldwide attention. This method is usually adopted to measure CSR by many authors, e.g., Olaolu J. Oluwafemi and Emmanuel Olateju Oyatoye (2012), Lei Xu et al. (2013) and Abdullah S. Karaman and Engin Akman (2017), and so on. This article is adopted this method to measure the performance of CSR, too.

In summary, the procedure of decision-making by the method of AHP mainly contains the following four steps. First, it needs to construct the structure of the decision hierarchy, including the goal, criteria and alternatives; second, a set of comparison matrices are constructed by comparing the criteria or sub-criteria in pairs; third, the weights of criteria are calculated if consistency tests pass; fourth, the final score of every alternative are calculated and the optimal choice is made.

3.2   Construction of evaluation system of CSR of Chinese home appliance companies

By means of the method of AHP, the evaluation system about the CSR of companies in Chinese home appliance industry is constructed. The concept of CSR advocated by Elkington[20] – the so-called triple bottom line principle – assumes that if an enterprise forms an economic and social system, then its development objectives should constitute a triple beam, which relates to the profit, the people associated with the company, and care for the planet .This notion of social responsibility points to its direct relationship with the three pillars of sustainability (economic, social and environmental).so this article constructs the evaluation system about the CSR of companies in Chinese home appliance industry from these three aspects, too. But the meaning of economic and social aspects are different from the statement in the concept by Elkington. The author believes that the economy involved in CSR should be a broad scope. The economic aspect should include main stakeholders which involve shareholder, consumer, employee, supplier, dealer, government. And for social aspect, the author thinks it mainly refers to the public which has no direct relationship with the company. So this article sets the criteria of CSR from three perspectives of economy, environment and society, and economy further contains five respects of shareholder, consumer, employee, supply chain, government. And the sub-criteria of each criterion of CSR is built by author's understanding of CSR, which are the key indicators reflecting most directly the implementation of CSR in Chinese appliance companies currently. Criteria, sub-criteria and specific index are shown in table 1.

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Table 1. Criteria, sub-criteria and specific index constructed in this article

Criteria	*Sub-criteria*	*Specific index*
shareholder	Preserving and increasing value of equity Cash dividend returns Dividend return ability	Growth rate in owner equity Cash dividend yield Dividend rate
consumer	Product quality Product R & D spending Product R & D capabilities	The proportion of export revenue R & D expenditure as a percentage of revenue R & D staff ratio
employee	Salary level The growth of salary Employee training	Salary competitiveness Salary growth rate Qualitative indicator[1]
Supply chain	Capital occupation of supplier relationship with supplier relationship with dealer	Accounts payable turnover ratio Qualitative indicator[2] Qualitative indicator[3]
government	Tax ability Dependence on state subsidies Employment issues	Taxes as a share of revenue The proportion of government subsidies in net profit Number of employees
environment	quantitative description of energy saving and emission reduction qualitative description of energy saving and emission reduction recycling of discarded or old household appliances	Qualitative indicator[4] Qualitative indicator[4] Qualitative indicator[4]
society	Donation expenses Charity activity public welfare	Donation expenses as a percentage of net profit Qualitative indicator[5] Qualitative indicator[5]

Notes: 1 if the company's annual report or CSR report has clear expression about employee training, this index is assigned 1, and otherwise it is 0.

2 If the company could help the supplier to develop, this index is assigned 5. If the company evaluates suppliers before purchasing, it is assigned 4. If they are cooperative, it is assigned 3.If the company just accepts the product passively, it is assigned 2. If there is no disclosure about the relation between the company and their supplier, it is assigned 1.

3 If the company actively trains its dealers to make them better understand the products, this index is assigned 5. If enterprises and dealers establish the stable cooperative relations and jointly make specific plans to market products, it is assigned 4. If they are cooperative, but don't disclose specific plan, it is assigned 3. If the company try to meets the various needs of the distributor, it is assigned 2. If the company only provides products to the dealer, it is assigned 1.

4 If there is related information about energy saving and emission reduction which the corresponding sub-criteria involved in annual or CSR reports, the corresponding index is assigned to 1. If not it is 0.

5 If the company participated in charity activities or public welfare, the corresponding index is 1. If not, it is 0.

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The weights of criteria and sub-criteria are assigned according to the author's understanding about CSR, and the specific data of weights which demonstrates the different importance between criteria and sub-criteria are shown in table 2, and all weights have passed the consistency test.

Table 2. Summary of weights of criteria and sub-criteria

Criteria	Local weight	Sub-criteria	Local weight	Global weight
shareholder	0.1	Preserving and increasing value of equity	0.54	0.054
		Cash dividend returns	0.16	0.016
		dividend return ability	0.30	0.03
consumer	0.24	Product quality	0.50	0.12
		Product R & D spending	0.25	0.06
		Product R & D capabilities	0.25	0.06
employee	0.16	Salary level	0.54	0.0864
		The growth of salary	0.30	0.048
		Employee training	0.16	0.0256
Supply chain	0.07	Capital occupation of supplier	0.20	0.014
		relationship with supplier	0.40	0.028
		relationship with dealer	0.40	0.028
government	0.04	Tax ability	0.54	0.0216
		Dependence on state subsidies	0.16	0.0064
		Employment issues	0.30	0.012
environment	0.35	quantitative description of energy saving and emission reduction	0.65	0.2275
		qualitative description of energy saving and emission reduction	0.12	0.042
		recycling of discarded or old household appliances	0.23	0.0805
society	0.03	Donation expenses	0.61	0.0183
		Charity activity	0.12	0.0036
		public welfare	0.27	0.0081

Source: according to the author's understanding about CSR in Chinese appliance industry

3.3   Source of data and normalization

As of December 2018, there are a total of 27 companies listed on the main board of China's home appliance industry. This article selected data of 2016 and 2017 as the research object. Due to the lPO of Three Stars New Materials and Ecovacs Robotics in 2017 and 2018 respectively, the data of these two companies in 2016 and 2017 are missing. Because of the lPO of Qijing Machinery, Rongtai health, Langdi Group, FLYCO in 2016, the data of these three companies in 2016 are missing. Because some indicators designed in this article involve the comparison between two years, the index value of listed companies with only one year's public data cannot be finished. After removing these five listed companies with incomplete information, the sample size in 2017 is 25 and in 2016 is 21. The basic data involved in the indicator values designed in this article are mainly derived from the listed company's financial reports, CSR reports, www.iwencai.com and relevant government-published statistical data.

In order to enhance the comparability of the same index between different companies, each quantitative index value needs to be normalized, so that the index value is between the interval of 0-1 or -1 to 1. According to the revised AHP proposed by Emma Mulliner et al. (2016), the normalized formulas are shown as

$$x_{i,j} = {x'_{i,j}}\big/{x_{max}} \tag{1}$$

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$$x_{i,j} = x_{min} \Big/ x'_{i,j} \tag{2}$$

where the $x_{i,j}$ is the normalized indicator value, the $x'_{i,j}$ is the original indicator value and x_{max} and x_{min} are the maximum and minimum value of one criterion, i.e., the positive quantitative indicators is to divide each indicator value by the maximum sample value of the indicator, and for the negative indicator, it is normalized by dividing the minimum sample value by each sample value. After such treatment, negative indicators are converted to positive indicators, and this is convenient to calculate the final score of CSR.

4   Empirical Results

The final score of the CSR of listed companies in China's household appliance industry is the sum of all products of each normalized indicator value and its global weight. The scores and rankings of each company are shown in table 3. The CSR scores of the companies in 2017 and 2016 are illustrated with figure 1 intuitively.

Table 3. The scores and rankings of CSR of Chinese appliance companies

Company name	Score	Rank(2017)	Company name	Score	Rank(2016)
HAIER	0.6721	1	HAIER	0.6878	1
TCL group	0.6696	2	TCL group	0.6467	2
GREE	0.5836	3	Whirlpool (China)	0.6102	3
HIGHLY	0.5221	4	HIGHLY	0.5558	4
Qijing Machinery	0.5080	5	GREE	0.5256	5
HisenseKelon	0.4734	6	Little swwan	0.4064	6
Midea Group	0.4233	7	Midea Group	0.3649	7
Little swwan	0.3762	8	Skyworth Digital	0.3631	8
CHUNGHSIN TECHNOLOGY	0.3534	9	Hisense Electric	0.3485	9
KINGCLEAN	0.3445	10	SOLAREAST CORPORATION	0.3468	10
Skyworth Digital	0.3439	11	Sichuan Changhong	0.3172	11
SOLAREAST CORPORATION	0.3421	12	KINGCLEAN	0.3123	12
Hisense Electric	0.3391	13	CHUNGHSIN TECHNOLOGY	0.2954	13
Rongtai health	0.3374	14	HEFEI MEILING	0.2853	14
Shenzhen Konka A	0.3293	15	HUAYI	0.2846	15
Sichuan jiuzhou	0.2900	16	AUCMA	0.2804	16
Sichuan Changhong	0.2852	17	Sichuan jiuzhou	0.2776	17
HUAYI	0.2773	18	LIBA	0.2578	18
HEFEI MEILING	0.2670	19	Shenzhen Konka A	0.2521	19
Whirlpool (China)	0.2431	20	HisenseKelon	0.2459	20
LIBA	0.2321	21	Chunlan	0.1616	21

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Company name	Score	Rank(2017)	Company name	Score	Rank(2016)
Langdi Group	0.2125	22			
AUCMA	0.2095	23			
FLYCO	0.1596	24			
Chunlan	0.0572	25			

Source: The final score of the CSR of listed companies in China's household appliance industry is the sum of all products of each normalized indicator value and its global weight

Fig.1 the CSR scores of listed companies in China's household appliance industry
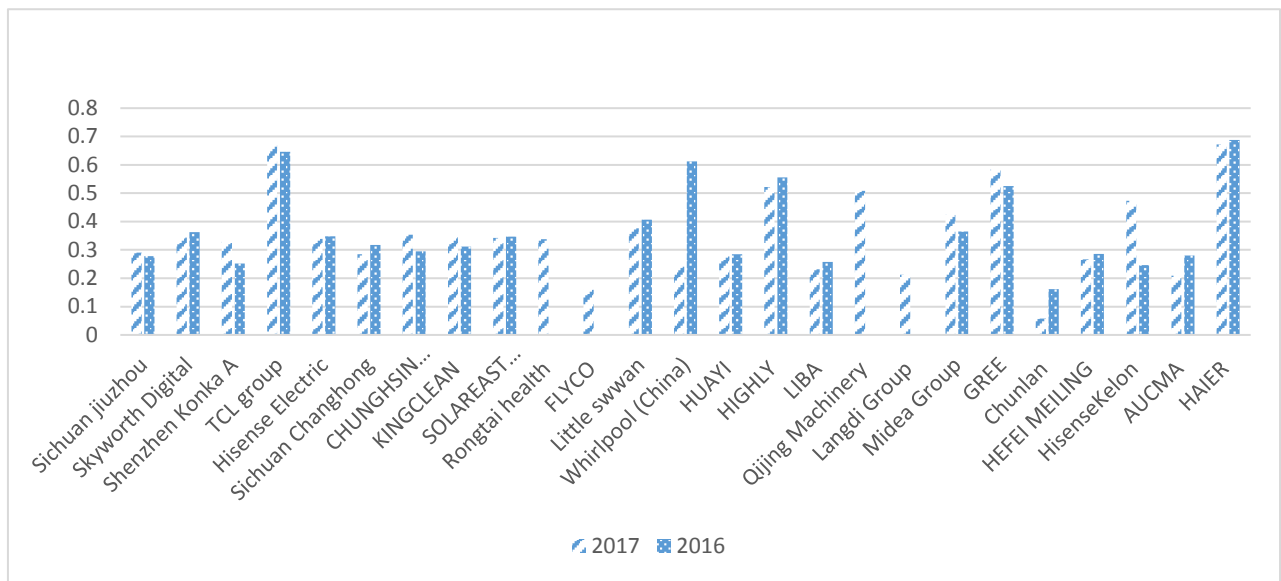
Source: the result of table 3

As shown in table 3, in the ranking list of CSR of listed companies in China's household electrical appliance industry in 2017 and 2016, there are four companies ranking unchanged, five companies ranking rising and eleven companies in the decline. The companies with more declines in the rankings are Whirlpool (China), Sichuan Changhong and AUCMA.

Based on the concentration of the total score, the performance of CSR of listed companies in China's household appliance industry can be divided into four grades: excellent, good, general, and poor. The specific division criteria are shown in Table 4. According to the division criteria, there are only 2 companies with the best performance in 2016 and 2017. They are HAIER and TCL group which hold the first and second place during two years, but their CSR scores slightly decreased. The number of companies that perform better has increased from 3 to 4, which means it has increased by 33.33%, but the absolute number is still small. Among them, only GREE and HIGHLY maintain good performance. Whirlpool (China) has ranked 20th in 2017 from third in 2016, and it is also the company that has changed the most among all companies. Qijing Machinery made its IPO in 2016, it is worth to praise its good performance of CSR. The number of companies that perform generally is 9 in 2017 and 7 in 2016, the corresponding proportion increased from 33.33% to 36%. In 2016, they are Little swwan, Midea Group, Skyworth Digital, Hisense Electric, SOLAREAST CORPORATION, Sichuan Changhong, KINGCLEAN. In 2017 except Sichuan Changhong which drop to the poor performance, other five companies still stay the kind of general performance. The worst performers were 10 in 2017, which contains the 6 worst performing companies in 2016 and 2 companies that were just listed in 2017. Chunlan is still the last company and even the CSR score is less a lot than the last year, which

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demonstrates that its CSR performance is worse and worse. The best performing company score is 11.75 times that of the worst performing company, which showed a huge gap.

Table 4. The classification and distribution of CSR in Chinese appliance enterprises

Score interval	Performance level	Number and proportion of companies			
		2016		*2017*	
0.65~1	**Excellent**	**2**	**9.52%**	**2**	**8.00%**
0.45~0.65	**Good**	**3**	**14.29%**	**4**	**16.00%**
0.3~0.45	**General**	**7**	**33.33%**	**9**	**36.00%**
0~0.3	**Poor**	**9**	**42.86%**	**10**	**40.00%**
Total company number		**21**	**100.00%**	**25**	**100.00%**

Source: the number and proportion is calculated according to the result of table 3.

5   Conclusion

Judging from the overall scores and rankings, listed companies in the Chinese home appliance industry have differed greatly in the performances of CSR. Both HAIER and TCL group scored above 0.65, which performed best, indicating that the two companies are very mature and stable in fulfilling their social responsibilities. The number of better-performing companies has increased from 3 to 4.The scores of most companies still belonged to the general and poor level of performance. Their joint proportion is as high as 75% or more in both years, especially the proportion of companies with poor performance has increased from 40% in 2016 to 42.86% in 2017. It indicates most listed companies in China's household electrical appliance industry are not ideal in fulfilling corporate social responsibility, and there is still room for improvement.

Acknowledgement

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THE ASSESSMENT OF SELECTED ENVIRONMENTS BASED ON CONDITIONS SUPPORTING DEVELOPMENT OF DIGITALIZATION – A REGIONAL BASED APPROACH

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Abstract
Every environment can be described by its unique characteristics and also by specific conditions which are related to the area of digitalization and its development in an analysed environment can be identified. The aim of the paper is to analyse and compare specific conditions from the view of their possible impact on digitalization in the regional scale. The comparison is based on a set of variables which can be considered as supportive for development of digitalization. The multivariate approach is used to include variables from more fields related to circumstances suitable for increase of a dispersal of the information and communication technologies and digitalization. The analytic hierarchy process is used in the paper to compare the regions in terms of indicators related to digitalization. The analysis is a composite of partial analyses in the selected areas (variables). Specific strengths and weaknesses are identified in the assessed environments and also an approach to digitalization and ICT can be presumed. A comparison is made correspondingly.

Keywords
Digitalisation, business environment, regions, comparison, multivariate approach

JEL Classification
D80, O30, O33, R11

1   Introduction

This paper is focused on the comparison of the conditions or supportive factors for digitalisation in the business environments in the selected areas, regions in the Czech Republic. Each region can be described by its specific conditions, strengths and weaknesses. For the comparison of the conditions and also getting the overview of the potential limitations and potencies in the analysed environments the multivariate approach is used to include more perspectives related to digitalisation and information technologies.

The aim of this paper is to compare the regions in the Czech Republic using the selected indicators related to digitalisation or the indicators which can be considered as indicators of supportive conditions for the development of new technologies in the business environment. For these purposes eight indicators have been chosen. These indicators can be divided into two groups according to areas of impacts. These groups are user attentiveness including the approach of the users of technologies and accessibility of resources including financial and also human resources.

The analytic hierarchy process (AHP) is used as a method for an analysis and comparison of conditions in the regions to include more criteria or perspectives. For the comparison of the regions according to the specific indicators quantitative data themself has been used. To include longer term the average values have been used as described in the methodology and data subchapter. Also the weights of the indicators have been taken into account to reflect different importance of the indicators. The scaling in four perspectives has been used and the average evaluation has been applied in the pair comparison to achieve the overall weights of the indicators. Main findings related to the specific characteristics of the regions are also highlighted.

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2   Brief introduction to the topic

As the assessment of the regions from the view of the suitability for the development of the information and communication technologies and digitalization is the aim of the paper, a brief overview of the approaches to the the assessment of digitalisation and of the areas which are presumed as important for digitalisation.

The indexes for evaluation of a level of digitalisation including several areas with relations to digitalisation and also indicates the criteria important for digitalisation according to authors.

One of the indexes is for example index created by the World economic forum (WEF) in this index, high number of variables divided into the multiple areas (Baller Silja, Dutta Soumitra and Bruno Lanvin, 2017) or the index created by the company Roland Berger Consultants described for example by Soldatos et al. (2016, p. 166), or the Networked readiness index which is also used for evaluation of the level of the digitalisation, this index is described for example by Volgesang (2010, p. 12) or Xu (2014, p. 11-12).

In the conditions of the Czech Republic, the digitalisation is studied for example by Mařík et al. (2016), where the problematic is examined from the various perspectives.

As various perspectives should be included to the assessment of the regions, the Analytic hierarchy process described by Saaty (2006) is selected as method for comparison of the regions in the paper.

3   Methodology and Data

The Analytic hierarchy process used in the paper is based on the comparison of variants (in the paper represented by the regions) from the perspective of multiple criteria. For each criterion the variants (regions) are compared to each others in pairs. From this paired comparison the importance (successfulness of a region in an analysed criterion) is derived in a form of a weight for the region. The weights can be also calculated for the indicators by comparison of pairs of the values for the indicators. This method is applied and described by Saaty (2006) and mentioned by several authors, for example by Fotr, Ševcová et al. (2016). Hierarchy is included in the method in the decomposition of the main goal to the subcategories and finally to the specific indicators Saaty (2006, p. 107).

Saaty (2006, p. 101 -104) describes the several types of hierarchies as structural and functional where the structural hierarchies are based on the main classification criterion where the objects on the lower level of the hierarchy are represented by the fragments of the object on a higher hierarchical level. In case of functional hierarchies, structures are based on the relations between the elements of the hierarchy. The complete and incomplete hierarchy is also defined by Saaty (2006, p. 96). In case of the complete hierarchy a criteria on a higher level is influenced by all criteria on the lower level whereas in case of the incomplete hierarchy each higher level criterion has its own sub-criteria. In this paper the functional incomplete hierarchy is created.

3.1   Analytic hierarchy process

The matrices for a comparison are used in the analytic hierarchy process, where the variants (in case of calculation of weights for criteria/indicators the indicators are used) are in the columns and also in the rows of the matrices and the values according to their importance (how many times the assessed value of the variant for the indicator/indicator itself exceeds the value of the compared variant for the indicator/indicator itself) are assigned to their combinations. The matrix marked as A which is symmetrical with n x n components, where the number of analysed objects (values of the variants for the indicators or values of the indicators themself) are represented by n as follows in the equation 3.1

$$A = \left(a_{ij}\right), (i, j = 1, 2, 3, \ldots \ldots n) \tag{3.1}$$

and A consists of pair comparisons of the values of the objects (Saaty, 2006, p. 47). The scale is used for the assessment in a form proposed by Saaty (2006, p. 73). In the paper another approach is used

instead of the values from the scale. The quantitative values for selected indicators for every variant/region are applied in the analysis as mentioned for example Fotr, Ševcová et al. (2016, p.196).

At first the assessment in a form of a weight is calculated for each object (region or indicator) as eigenvalue for the appropriate row. In the paper the eigenvalues are replaced by the geometric means as mentioned by Saaty (2006, 80) as the possible procedure for an approximation. The weight can be calculated applying the ideal or distributive approach as describe by Saaty (2006, p. 20, 21 and p. 115, 116). In the paper the distributive approach is used, where the norming to the sum of geometric means is applied. Geometric mean is calculated by the common equation (3.2), when the process of the calculation is described for example by Taylor (2007, p. 52), for the rows of the matrix as follows

$$GM_i = \sqrt[n]{a_{i,1} * a_{i,2} * \ldots * a_{i,n}} \tag{3.2}$$

where GM_i represents geometric mean for the i-th object (variant, indicator) and $a_{i,1}$ to $a_{i,n}$ represent pair comparisons of i-th variant/indicator with the objects from first to n-th object. The weight of the object is achieved as a ratio of the geometric mean of the i-th object to the sum of the geometric means for all assessed objects as follows in the equation 3.3

$$wi = \frac{GM_i}{\sum_{i=1}^{n} GM_i} \tag{3.3}$$

Equation 3.3 is created based on the procedure described by Saaty (2006, p. 85 - 86). If the objects are the indicators the local weights are multiplied by the weight of the sub-criterion on the higher level of a hierarchy as mentioned by Saaty (2006, p. 17), Saaty also describes the calculation of overall value for a variant where the values (weights) for the variant assessed from the perspective of each indicator multiplied by the global weights of these indicators are summed.

The specific approach is needed to be applied when more than seven variants or criteria/indicators are compared to each other. The procedure is described by Saaty (2006, p. 122 - 124). In the paper 14 regions are compared, therefore the procedure has to be applied on the variants' comparison for each indicator. As proposed by Saaty (2006, p. 122 - 124) the compared objects are divided into smaller groups, whereas the object with a high value of importance from one group is included to the other one to be used as a reference value for the rescaling. If more than two groups are created, analogically an important variant from the second group is included to the third one etc. In every group the pair comparison of the variants is performed and the weights for the variants within groups are calculated. These local weights are represented by $w_{former\ x,y}$, whereas the x represents x-th indicator within y-th group. The weights for the values of the variant for the assessed indicator which are used as reference values and are included into two groups at the same time are for the purposes of generalisation of the procedure placed as follows, weight of the reference value of the variant, which is taken from the group, where it has been formerly included is placed as last in the group and the weight of the same variant (for the assessed indicator) is placed as first in the group, where it is used as a reference value. If there are three groups of values for the variant for the assessed indicators, the procedure as described by Saaty (2006, p. 122 - 124) can be expressed by the equations 3.4 – 3.7, the used symbols for variables have been adapted for the purposes of this paper. For the calculation of the weights used for rescaling of the w_{former}, marked as $w_{goup\ y}$ the equations 3.4 and 3.5 are used. For the first group (y=1) the calculation is applied as follows in the equation 3.4

$$w_{group\ 1} = \frac{(\sum_{x=1}^{n_1} w_{x,1})}{\left(\sum_{y=1}^{m} \sum_{x=1}^{n_y} w_{x,y}\right) - \sum_{y=2}^{m} w_{1,y}} \tag{3.4}$$

and for the other groups, where y>1 the calculation as described in the equation 3.5 is used

$$w_{group\ y} = \frac{(\sum_{x=1}^{n_1} w_{x,y}) - w_{1,y}}{\left(\sum_{y=1}^{m} \sum_{x=1}^{n_y} w_{x,y}\right) - \sum_{y=2}^{m} w_{1,y}} \tag{3.5}$$

where $w_{x,y}$ represents generally value of the x-th variant (for the assessed indicator) in the y-th group, in the group y, there are n_y variants according to the procedure described by Saaty (2006, p. 122 - 124) . There are m groups created (in this paper m = 3). The value of the reference variant (common for two

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groups) has to be included in the the sums in the equation only once to avoid duplicities. In case of three group the weights $w_{1,2}$ and $w_{1,3}$ are excluded from the summation as based on procedure described by Saaty (2006, p. 122 - 124). The weights for variants $w_{x,y}$ which are needed for previous calculations are obtained as follows, in the first group, there is no need for rescaling and the following relation is applied $w_{x,y} = w_{former\ x,y}$, in the groups with y>1 recalculation is needed. In the second group rescaling is applied on the former weights according to the equation 3.6

$$w_{x,2} = \frac{w_{former\ x,2}}{w_{former\ 1,2}} * w_{former\ n_1,1} \qquad (3.6)$$

where the weight of the variant (in the first group) which is common for two groups is represented by $w_{former\ n1,1}$ and the weight of the same variant in the second group is represented by $w_{former\ 1,2}$ and the recalculation for the third group is displayed in the formula 3.7

$$w_{x,3} = \frac{w_{former\ x,3}}{w_{former\ 1,3}} * w_{n_2,2} \qquad (3.7)$$

where $w_{former\ 1,3}$ represents the weight of the variant which is common for the second and the third group in the third group and $w_{n_2,2}$ represents the weight of the same variable in the second group after the recalculation in the equation 3.6 as based on procedure described by Saaty (2006, p. 122 - 124).

Next step is to calculate $*w_{x,y}$. In the group where y=1 no changes of the weights are needed the $*w_{x,y}$ is achieved as $*w_{x,y} = w_{x,y}$. In case of groups with y>1 it is needed to sum the weights calculated according to the equation 3.6 or 3.7 excluding the weight of the variant which is the reference variant (common for group 1 and group 2) from the second group or the variant common for group 2 and group 3 from the third group and normalize the weights by dividing by these sums. This is based on procedure described by Saaty (2006, p. 122 - 124). Finally the $*w_{x,y}$ is multiplied by respective wgroup y and the overall weight for the variant assessed according to the selected indicator is achieved. The procedure is repeated for all indicators, based on procedure described by Saaty (2006, p. 122 - 124).

3.2   Data selection

As the approach using the quantitative data has been used the values for the selected indicators with relations to information and communication technologies (ICT) and digitalisation had been collected. As the resource of the data, the Český statistický úřad (ČSÚ) has been selected. Not only the connection to digitalisation has been assessed also requirements of completeness of the data and absence of missing values have been criteria for selection of the variables.

To include longer time period and the changes in time the average values for the indicators has been used. The averages have been calculated using values from 2013 – 2016 as the data from 2017 are not at the disposal for all indicators and also the data from years before 2013 were not included because of lower actuality. To sustain comparability of the regions in the selected areas the indicators in a form of a ratio has been selected. In case of several indicators additional calculations has to be made to achieve more comparable form. Indicators which has been calculated are marked with the symbol * in the table 1.

As the analytic hierarchy process and not analytic network process (ANP) is used (in the ANP includes also dependencies between criteria a described by Saaty (2006, p. 38-39) or Saaty and Vargas (2006, p. 7).) also the dependencies between indicators have been considered to include only the indicators, where the strong dependencies are not present. The multicollinearity has been calculated to identify the dependencies. To calculate multicollinearity the variance inflation factor (VIF) has been used as mentioned for example by Kennedy (c2003, 213). Kennedy (c2003, 213) also mentions a value 10 which is a border value and if exceeded indicates a strong dependencies between variables.

All indicators with expected relation to digitalisation and ICT have been considered from the perspective of missing values and completeness. The multicollinearity has also been analysed. After the analysis a higher number of indicators has to be excluded due to strong relations to the others. The combination of indicators covering more areas related to digitalisation has been included to the analytic hierarchy

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process. After the analysis of multicollinearity, that can found in the table 1 in appendix, 8 indicators have been finally selected. An overview of the indicators with respective measures is listed in the table 1.

Table 1. List of used indicators

Indicators	Measure
Persons using mobile internet	% of population older than 16 years
Persons shopping online	% of population older than 16 years
Persons using internet banking	% of population older than 16 years
Persons searching info about goods online	% of population older than 16 years
ICT students*	% of overall number of students
R&D employees*	per 1000 economically active persons
Overall R&D expenditures*	mil. per 1 R&D employee
Students of technological branches*	% of overall number of students

Source: Author's processing – names and the measures overtaken from ČSÚ (2018) (translated)

4   Empirical Results

The eight indicators selected for analytic hierarchy process has been divided into two groups the first group of indicators is focused on users of technologies, the second group contains indicators related to the resources human and also financial resources. The hierarchy displaying the decomposition of the indicators is presented by figure 1.

Figure 17. Indicators for evaluation of an environment from the view of digitalisation readiness
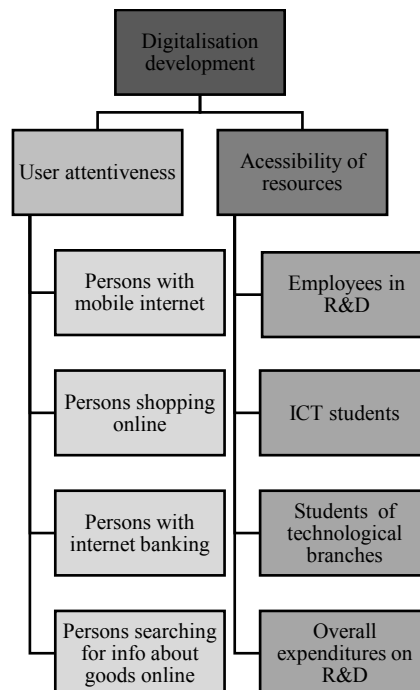
Source: Author's processing – names and the measures overtaken from ČSÚ (2018) adapted and translated

For each of the selected indicators the paired comparisons have been made between regions and the weights have been calculated as described in the methodology. These results can be found in the appendix, table 3.

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Two different approaches have been used. The first one, where the weights of the indicators themself are not considered and the second approach, where also the weights for the indicators have been calculated. In this paper, the approach using the weights of selected indicators has been used as a trial for evaluation of the regions enabling to include the preferences of the person or group or persons evaluating the environments. For example this approach can be used by companies to evaluate the conditions in the region in terms of implementation/development of the digitalization. The weights have been obtained by a subjective approach, where author's evaluation in multiple perspectives has been used. The weights for the indicators have been calculated using also the paired comparison. The values for the calculation are derived from the values obtained as average from the ranking in the four perspectives assessing the importance of the indicator for the indicator on the higher level (for each group of the indicators specific perspectives have been assessed). For indicators in User attentiveness group these perspectives have been assessed: Beneficial influence on business – supportive for ICT usage, Indicator of confidence in ICT , Beneficial influence on spreading ICT/development of user skills, Indicator of current spread of ICT/user skills. In the Accessibility of resources group these perspectives have been considered: Support for future – long term, Short-term support, Beneficial influence on development of business – competitiveness, Beneficial influence on skills and usage of tools connected to digitalisation.

The ranking has been made by the author on the scale 1 – 5, where the 5 represents the highest importance of the indicator for the indicator on the higher level of the hierarchy. The values and the averages for the indicators are included in the table 2 in appendix. The weights for the indicators on the higher level of the hierarchy (user attentiveness and accessibility of resources) have been estimated by author as 0,4 for user attentiveness and 0,6 for accessibility of resources according to an assumption of importance from the perspective of development of digitalisation in the business environment. Based on the local weights presented in the table 2 in appendix and the weights for user attentiveness and accessibility of resources the global weights have been calculated as presented in the table 4.

Table 4. Weights for the selected indicators

Indicator	Persons mobile internet	Persons online shopping	Persons internet banking	Persons info about goods	ICT students	R&D employees	Overall R&D expenditures	Tech. students
Weight	0.1019608	0.0784314	0.094118	0.12549	0.1714286	0.139286	0.15	0.139286

Source: Author's calculations[21]based on author's assumptions and resources as Mařík et al. (2016), Volgesang (2010), Xu (2014), Soldatos et al. (2016) used as introduction to the subject and for getting and outline of approaches to particular factors important for digitalization.

Based on the previously described calculation and evaluation in the four perspectives for each indicator, it can be assumed that under these conditions the indicators with higher impact are: Students in information technologies focused branches and Overall research and development expenditures in the Accessibility to resources group and the Persons using internet to search information about goods and Persons using mobile internet.

4.1 Ranking of the regions based on the indicators with the equivalent weights

At first the approach where all indicators have equivalent weights is used. As the eight indicators are used the weight has the value 0,125. In this approach it is assumed, that the indicators have the same impact on the business environment in the regions.

In this approach only the quantitative values for each indicator compared to the other regions influence the overall values for the region and also the ranking of the region. The values and the ranking for all fourteen regions in the Czech Republic can be found in the table 2.

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[21] More information in appendix, table 2

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Table 2. The ranking of the regions based on the selected indicators without influence of the weights

Region	Value	Ranking
Hl. m. Praha	0.098180307	1
Jihomoravský	0.083316845	2
Středočeský	0.07671691	3
Plzeňský	0.07364368	4
Královéhradecký	0.072530873	5
Pardubický	0.071613065	6
Zlínský	0.070694883	7
Liberecký	0.068780115	8
Moravskoslezský	0.068026724	9
Jihočeský	0.066415475	10
Olomoucký	0.065701972	11
Vysočina	0.064775367	12
Karlovarský	0.062463446	13
Ústecký	0.057140338	14

Source: Author's calculations based on data from ČSÚ (2018)

In the table 2 it can be seen, that the region with the most suitable conditions for development of digitalisation in the business environment is Praha and Jihomoravský region. The regions can be described by the values achieved in the selected indicators presented in the table 3 in appendix.

Praha is specific for the high values (weights) related to the values in the other regions in the indicator Persons using mobile internet in the user perspective and also higher value in case of persons using internet for search information about goods. Praha is also in the first half or the assessed regions in case of persons using internet for online shopping and persons using internet banking. In the perspective of accessibility of resources, there is a significantly higher value for research and development employees. There is also achieved a higher value in case of students of information and communication technologies and also research and development expenditures per 1 employee in research and development. Specific feature in the region is a low ranking for the students in technical branches in comparison to the other regions. Conditions in Praha can be expected as supportive for development of digitalisation in the business environment from the view of the assessed indicators. From the indicator students of the technical branches it can be derived that there is lower focus on the technical areas of digitalisation.

Jihomoravský region can be described by higher values in the perspective of accessibility of resources namely employees in research and development and overall research and development expenditures per 1 employee in research and development, but the achieved values are lower than the results in Praha. Also in case of the students in technological branches relatively higher value in comparison with the other regions has been achieved. In the user perspective, values in case of persons shopping online and persons using internet banking the values are in the first half in the ranking. Results for persons using mobile internet and persons using internet for searching information about goods are lower than in case of Praha. In Jihomoravský region the conditions can be also assessed as supportive for digitalisation in business environment. The results in the analysed indicators are relatively balanced in the assessed areas.

The higher ranking has also been achieved in Středočeský region. Středočeský region has achieved analogous values in the user perspective as in Praha. In case of persons shopping online, the value is higher than in Praha, also in case of persons using internet for searching information about goods is slightly higher. The results are different from Praha in the accessibility of resources perspective. Higher value is achieved in case of research and development expenses per 1 employee in research and development. In Středočeský region the indicator of research and development employees has

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significantly lower value than in Praha. There is also the higher value for students of technological branches identified compared to Praha.

The regions with the lower ranking according to the selected indicators are Karlovarský and Ústecký region. In Ústecký region values in user perspective are at a relatively low level compared to the results in the other regions. Also the results in the accessibility of resources perspective the values are relatively low for the indicators except of students of technological branches.

In Karlovarský region the results are higher in case of persons shopping online and persons using mobile internet. In the accessibility of resources perspective the values for all four indicators are relatively low.

For Moravskoslezský region the ninth position in the ranking of the regions has been reached. In the user perspective the lower values for persons shopping online and persons using mobile internet are reached whereas for the persons using internet banking and persons using internet for searching for information about goods the values are slightly higher. In the perspective of accessibility of the resources, in the student of information and communication technologies indicator the lower value is achieved. In case of employees in research and development the low value is reached. The relatively high value for students in technical branches is specific for the Moravskoslezský region. In case of overall research and development expenditures per 1 research and development employee the relatively higher value is also reached. The strength of the Moravskoslezský region is the percentage of students of technical branches. In the region, the focus on research and development can be intensified to help to develop the supportive conditions for digitalisation.

4.2 Ranking of the regions based on the indicators with regards to weights

The second variant has been calculated considering different importance of the indicators expressed by the weights. The weights of the eight selected criteria are included in the table 4.

Table 3. The ranking of the regions based on the weighted indicators

Region	Value	Ranking
Hl. m. Praha	0.1015814	1
Jihomoravský	0.0852324	2
Středočeský	0.0762821	3
Plzeňský	0.072793	4
Pardubický	0.07181	5
Královéhradecký	0.0717859	6
Zlínský	0.0700036	7
Liberecký	0.0694769	8
Moravskoslezský	0.0677926	9
Olomoucký	0.0663782	10
Jihočeský	0.0659743	11
Vysočina	0.0647909	12
Karlovarský	0.0596668	13
Ústecký	0.0564318	14

Source: Author's calculations based on data from ČSÚ (2018)

The overall values for the regions containing all weighted values for all indicators in each region and also the ranking are included in the table 4.

If the weights are considered, the final ranking is changed as it can be seen in the table 4. The Královéhradecký region is fifth in the ranking instead of Pardubický region. Also Olomoucký region is now placed before Jihočeský region.

The overall results for Praha and Jihomoravský region has been increased due to the weighting of the values for the indicators and the results for Karlovarský and Ústecký region has been decreased.

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The position of Moravskoslezský region has not been changed by the different weighting of the indicators and the region is ninth from the fourteen assessed regions.

5 Conclusion

The paper has been focused on the assessment of the regions in the Czech Republic from the view of the conditions supportive for the development of digitalisation in the business environment.

The Analytic hierarchy process has been chosen as the method for the assessment. At first the indicators related to the problematic and also fulfilling the requirements described in the methodology has been chosen. Eight indicators have been finally used. Based on the quantitative data for the selected indicators calculations of overall ranking has been performed.

Two approaches have been applied. At first, an equal importance has been assumed for each indicator. From the results it has been found out, that the region with the most suitable conditions according to the assessed indicator is Praha, Jihomoravský and Středočeský region has achieved also high overall values. The regions with the low ranking are Ústecký and Karlovarský region. For these regions the values for specific indicators have been also highlighted.

In the second approach different weights has been considered. New ranking of the regions has been calculated and the differences have been identified.

Also the Moravskoslezský region its position among the assessed regions according to the selected indicators related to the conditions for development of digitalisation in the business environments and also results for specific indicators have been briefly described.

In this field, many areas for further research can be found. As there are various approaches to the selection of indicators for assessment of digitalization, more detailed analyses can be performed to verify the adequacy of the selected variables from statistical and also factual view. Also determining of weights is an area for additional investigation. To decrease subjectivity of the weights, opinions from an expert or group of experts can be used or also methods with more quantitative basis.

Acknowledgement

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Appendix 1

Table 1. Multicollinearity matrix eight selected indicators

	Persons mobile internet	Persons online shopping	Persons internet banking	Persons info about goods	ICT students	R&D employees	Overall R&D expenditures	Tech. students
Persons mobile internet	4.4828	-0.6004	-2.6330	2.3390	1.2212	-1.4528	-0.6030	3.4902
Persons online shopping	-0.6004	3.5141	-1.2746	-2.3367	0.6844	1.2386	0.4373	1.0614
Persons internet banking	-2.6330	-1.2746	4.0733	-1.4909	-1.4497	0.1358	0.4535	-3.5029
Persons info about goods	2.3390	-2.3367	-1.4909	5.0254	-0.5510	-1.6751	-1.5272	1.2916
ICT students	1.2212	0.6844	-1.4497	-0.5510	2.4516	-0.0951	0.5539	2.1839
R&D employees	-1.4528	1.2386	0.1358	-1.6751	-0.0951	2.3135	0.1861	-0.0133
Overall R&D expenditures	-0.6030	0.4373	0.4535	-1.5272	0.5539	0.1861	1.6469	-0.1869
Tech. students	3.4902	1.0614	-3.5029	1.2916	2.1839	-0.0133	-0.1869	5.3530

Source: Author's calculations based on data from ČSÚ (2018)

Table 2. Average values for selected indicators based on the assessment from four perspectives

User attentiveness	Weight	0.4			
	Beneficial influence on business – supportive for ICT usage	Indicator of confidence in ICT	Beneficial influence on spreading ICT/development of user skills	Indicator of current spread of ICT/user skills	Average
Persons mobile internet	2	2	4	4	3
Persons online shopping	4	3	2	4	3,25
Persons internet banking	2	4	1	3	2,5
Persons info about goods	4	4	4	4	4
Accessibility of resources	Weight	0.6			
	Support for future – long term	Short-term support	Beneficial influence on development of business - competitiveness	Beneficial influence on skills and usage of tools connected to digitalisation	Average
ICT students	5	3	3	5	4
R&D employees	3	4	4	3	3,5
Overall R&D expenditures	4	3	4	2	3,25
Tech. students	4	2	3	4	3,25

Source: Author's calculations based on author's assumptions and resources as Mařík et al. (2016), Volgesang (2010), Xu (2014), Soldatos et al. (2016) used as introduction to the subject and for getting and outline of approaches to particular factors important for digitalization.

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Table 3. Weights of the regions for the selected indicators

Indicator	Persons online shopping	Persons internet banking	Persons mobile internet	Persons info about goods	ICT students	Tech. students	R&D employees	Overall R&D expenses	Overall value	Overall value weighted
Region/Weight	0.1020	0.0784	0.0941	0.1255	0.1714	0.1393	0.1500	0.1393		
Hl. m. Praha	0.0757	0.0734	0.1031	0.0769	0.0792	0.0559	0.2466	0.0746	0.0982	0.1016
Středočeský	0.0796	0.0727	0.0839	0.0779	0.0733	0.0620	0.0659	0.0984	0.0767	0.0763
Jihočeský	0.0759	0.0626	0.0650	0.0770	0.0643	0.0662	0.0508	0.0694	0.0664	0.0660
Plzeňský	0.0701	0.0776	0.0805	0.0702	0.0597	0.0748	0.0707	0.0855	0.0736	0.0728
Karlovarský	0.0810	0.0752	0.0805	0.0651	0.0656	0.0706	0.0082	0.0537	0.0625	0.0597
Ústecký	0.0525	0.0607	0.0678	0.0577	0.0644	0.0756	0.0189	0.0595	0.0547	0.0537
Liberecký	0.0595	0.0687	0.0659	0.0704	0.0757	0.0689	0.0702	0.0710	0.0666	0.0670
Královéhradecký	0.0800	0.0785	0.0807	0.0757	0.0896	0.0658	0.0502	0.0598	0.0704	0.0694
Pardubický	0.0759	0.0793	0.0572	0.0776	0.0808	0.0714	0.0677	0.0631	0.0693	0.0692
Vysočina	0.0706	0.0626	0.0585	0.0682	0.0729	0.0722	0.0276	0.0857	0.0638	0.0637
Jihomoravský	0.0759	0.0747	0.0683	0.0749	0.0720	0.0734	0.1476	0.0797	0.0823	0.0841
Olomoucký	0.0628	0.0643	0.0605	0.0638	0.0696	0.0730	0.0747	0.0570	0.0647	0.0652
Zlínský	0.0743	0.0775	0.0652	0.0733	0.0658	0.0866	0.0520	0.0711	0.0695	0.0686
Moravskoslezský	0.0663	0.0723	0.0627	0.0713	0.0672	0.0837	0.0491	0.0716	0.0668	0.0665

Source: Author's calculations based on data from ČSÚ (2018)

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