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Faculty of Business Economics with seat in Košice



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Editor's office

University of Economics in Bratislava
Faculty of Business Economics with a seat in Kořice
Tajovského 13, 041 30 Kořice
Tel.: 055/722 3111, fax: 055/623 06 20
IČO 00 399 957
E-mail: acta.phf@euke.sk
<http://www.euke.sk>
<http://acta.euke.sk>

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DETERMINANTS AFFECTING COUNTRIES' INNOVATION PERFORMANCE

DETERMINANTY OVPLYVŇUJÚCE INOVAČNÚ VÝKONNOSŤ KRAJÍN

Juliana BÉREŠOVÁ

Abstract

The paper deals with the evaluation of the innovation performance of the European Union member states, taking Summary Innovation Index methodology as a starting point. In particular, the paper focuses on the selection and application of multivariate statistical analysis to distinguish factors influencing the innovativeness of the European Union member economies to the highest degree. Based on the identified set of diagnostic variables, individual country rankings are revised and compared to the country order stated in the Summary Innovation Index.

Keywords: innovativeness, innovation performance, European Innovation Scoreboard, Summary Innovation Index, European Union

Abstrakt

Predkladaný príspevok sa zaoberá hodnotením inovačnej výkonnosti členských krajín Európskej únie, vychádzajúc z metodiky sumárneho inovačného indexu. Príspevok využitím multivariačnej štatistickej analýzy identifikuje faktory, ktoré v najväčšej miere ovplyvňujú hodnotenie inovačnej výkonnosti ekonomík Európskej únie z hľadiska spomenutého indexu, na základe týchto faktorov zostavuje vlastný rebríček inovačnej výkonnosti krajín a porovnáva ho s výsledkami uvedenými v rámci sumárneho inovačného indexu.

Kľúčové slová: inovatívnosť, inovačná výkonnosť, European Innovation Scoreboard, sumárny inovačný index, Európska únia

Introduction

Scientific literature emphasizes the difficulty and the weakness of the use of individual innovation indicators including patents, R&D expenditure, percentage of sales related to new products, etc. to measure the global concept of innovations (Kleinknecht et al., 2002; Patel – Pavitt, 1995; Grupp – Schubert, 2010). Individual indicators are generally partial and do not measure innovation as a whole, while collections of selected indicators can be used to measure innovation more broadly (Grupp – Schubert, 2010: 68).

Recent years have witnessed the increasing application of synthetic indicators for national and regional science & technology policy (Archibugi – Coco, 2005). Hence, different models and composite indicators for assessing and ranking countries' innovation performance are being elaborated (e.g. Cornell University – INSEAD – WIPO, 2019; European Union, 2019; BDI, 2020). Nevertheless, although composite or multidimensional indices combine and capture different pillars of input and output measures of innovations, they are not entirely without

problems. As addressed in the subsequent chapter, also European Innovation Scoreboard (EIS) – the most widely set of composite innovation indicators in Europe – has its shortcomings (Paas – Poltimäe, 2010: 12).

The main goal of this paper is to identify the factors with the strongest influence on the innovativeness of the European Union member economies (EU-27) measured by the Summary Innovation Index (SII). The identified set of diagnostic variables does not describe the innovation drivers or driving forces of innovation, on the contrary, it classifies the main determinants affecting countries' innovation performance based on SII methodology. Finally, based on identified factors, the paper distinguishes the countries into clusters and compares this outcome with the ranking presented by the European Commission (2019b).

1 Evaluation of countries' innovation performance

The Lisbon European Council of 2000 established the strategic goal for the European Union to become the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion, by 2010 (European Parliament, 2000). With regard to the Lisbon Strategy, the European Commission developed the European Innovation Scoreboard (EIS) in order to provide a comparative evaluation of the innovation performance of the European Union member states (Hollanders – van Cruysen, 2008: 2).

Annual EIS provides a comparative assessment of the research and innovation performance of the EU-27 countries and benchmarks their performance with main global economic competitors including Australia, BRICS countries (Brazil, Russia, India, China, and South Africa), Canada, Japan, South Korea, and the United States (European Union, 2019: 6).

The EIS deals with data from the most recent statistics from Eurostat and other internationally recognized sources as available at the time of analysis. International sources have been used wherever possible in order to ensure comparability between countries (European Commission, 2019c: 12).

1.1 European Innovation Scoreboard

MERIT¹ and SPRU² developed the EIS as part of the European Commission's Trend Chart project. The first version in 2000 covered 17 European countries and 16 indicators, resulting in one of the first scoreboards using results from innovation surveys with 4 indicators from the CIS³. The EIS has been published annually from 2001 and, following a number of revisions, the number of countries

¹ Maastricht Economic and social Research and training centre on Innovation and Technology

² Science Policy Research Unit

³ The community Innovation Surveys (CIS) are a series of harmonized surveys executed by national statistical offices throughout the member states of European Union, designed to provide information on the innovativeness of sectors by type of enterprises, on the different types of innovation and on various aspects of the development of an innovation (Eurostat, 2020).

has increased to 36 in 2019 and the number of indicators to 27 in 2019 (Hollanders, 2009: 29, European Commission, 2019b: 6-7).

Table 1 EIS 2019 measurement framework

1	FRAMEWORK CONDITIONS
1.1	Human resources
1.1.1 [X ₁]	New doctorate graduates per 1000 population aged 25-34
1.1.2 [X ₂]	Percentage population aged 25-34 having completed tertiary education
1.1.3 [X ₃]	Percentage population aged 25-64 participating in lifelong learning
1.2	Attractive research systems
1.2.1 [X ₄]	International scientific co-publications per million population
1.2.2 [X ₅]	Scientific publications among the top-10% most cited publications worldwide as percentage of total scientific publications of the country
1.2.3 [X ₆]	Foreign doctorate students as a percentage of all doctorate students
1.3	Innovation-friendly environment
1.3.1 [X ₇]	Broadband penetration
1.3.2 [X ₈]	Opportunity-driven entrepreneurship (Motivational index)
2	INVESTMENTS
2.1	Finance and support
2.1.1 [X ₉]	R&D expenditure in the public sector (percentage of GDP)
2.1.2 [X ₁₀]	Venture capital expenditures (percentage of GDP)
2.2	Firm investments
2.2.1 [X ₁₁]	R&D expenditure in the business sector (percentage of GDP)
2.2.2 [X ₁₂]	Non-R&D innovation expenditures (percentage of turnover)
2.2.3 [X ₁₃]	Enterprises providing training to develop or upgrade ICT skills of their personnel
3	INNOVATION ACTIVITIES
3.1	Innovators
3.1.1 [X ₁₄]	SMEs introducing product or process innovations (percentage of SMEs)
3.1.2 [X ₁₅]	SMEs introducing marketing or organizational innovations (percentage of SMEs)
3.1.3 [X ₁₆]	SMEs innovating in-house (percentage of SMEs)
3.2	Linkages
3.2.1 [X ₁₇]	Innovative SMEs collaborating with others (percentage of SMEs)
3.2.2 [X ₁₈]	Public-private co-publications per million population
3.2.3 [X ₁₉]	Private co-funding of public R&D expenditures (percentage of GDP)
3.3	Intellectual assets
3.3.1 [X ₂₀]	PCT patent applications per billion GDP (in Purchasing Power Standard)
3.3.2 [X ₂₁]	Trademark applications per billion GDP (in Purchasing Power Standard)
3.3.3 [X ₂₂]	Design applications per billion GDP (in Purchasing Power Standard)
4	IMPACTS
4.1	Employment impacts
4.1.1 [X ₂₃]	Employment in knowledge-intensive activities (percentage of total employment)
4.1.2 [X ₂₄]	Employment in fast-growing enterprises (percentage of total employment)
4.2	Sales impacts
4.2.1 [X ₂₅]	Exports of medium and high technology products as a share of total product exports
4.2.2 [X ₂₆]	Knowledge-intensive services exports as percentage of total services exports
4.2.3 [X ₂₇]	Sales of new-to-market and new-to-firm innovations as percentage of turnover

Source: European Commission, 2019c: 4

Innovation performance in the EIS is measured using data from 27 innovation indicators. These indicators are grouped in 4 main types covering framework conditions, investments, innovation activities, and impacts, covering 10 innovation dimensions. *Framework conditions* capture the main drivers of innovation that are external to the firm covering the availability of high-skilled and educated people as captured in the human resources dimension, the international competitiveness of the science base captured by the dimension of attractive research systems, and the availability of innovation-friendly environment in which enterprises operate. The availability of finance for innovation projects and the support of governments for research and innovation activities as captured in the finance and support dimension, together with firm investments are part of the *Investments* type of indicators. *Innovation activities* capture different aspects of innovation in the business sector and differentiate between 3 dimensions: innovators, linkages, intellectual assets. Lastly, *Impacts* capture both the impact of innovation on employment, as well as the economic impact of innovation by measuring exports and sales. Table 1 provides a detailed description of the latest EIS innovation indicators.

1.2 Summary Innovation Index

The EIS provides a composite indicator, the Summary Innovation Index (SII), which summarizes the innovation performance by aggregating the various indicators of each country's innovation system into one single number. The index uses a range of data sources, including innovation survey indicators. For each country, a composite SII is calculated as the unweighted average of the rescaled scores for all indicators where all indicators receive the same weight, $1/27$ if data are available for all 27 indicators (European Commission, 2019c: 18).

Based on the average performance score calculated by the SII according to the following formula,

$$SII_c^t = \sum_{l=1}^{27} \bar{v}_l \hat{u}_{lc}^t, \quad \bar{v}_l = \frac{1}{27}, \quad \hat{u}_{lc}^t \in [0, 1]$$

where

SII_c^t refers to SII in country c in a period t ,

$u_l, l = 1, \dots, 27$ refers to EIS indicators,

\bar{v}_l represents the weight of the indicator,

\hat{u}_{lc}^t refers to re-scaled scores⁴ of indicator l in country c and a period t (Edquist et al., 2018: 3),

the EIS distinguishes between 4 performance groups: innovation leaders, strong innovators, moderate innovators, and modest innovators.

⁴ To adjust the values of each indicator in country c in period t to a notionally common scale, the EIS performs a max-min normalization by subtracting the minimum value and dividing by the observed range: $\hat{u}_{lc}^t = (u_{lc}^t - \min(u_{lc}^t)) / (\max(u_{lc}^t) - \min(u_{lc}^t))$, $c = 1, \dots, 36$ countries.

In 2018, only 4 countries, i.e. Sweden, Finland, Denmark, and the Netherlands were included in the group of innovation leaders, as their innovation performance reached more than 20% of the EU-27 average. Strong innovators, i.e. Luxembourg, Belgium, Germany, Austria, Ireland, France, and Estonia, perform above or close to EU-27 average and their SII values exceed the average of the EU-27 by less than 20% and at the same time may be lower than the average but not more than 10%. The most numerous group (in total 14 countries) found themselves in the group of moderate innovators, as they achieved an innovation performance below the EU-27 average by more than 10%, but at the same time constitute not less than 50% of the EU-27 average. Among the weakest countries in terms of innovation performance was Bulgaria and Romania, who perform below 50% of the EU-27 average.

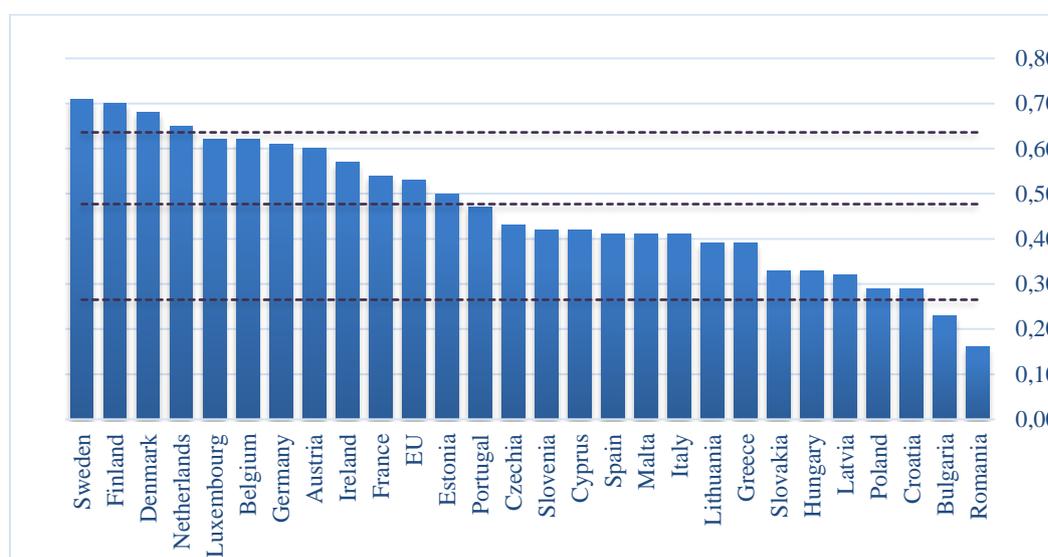


Figure 1 Innovation performance of EU-27 in 2018

Source: Own illustration based on European Commission, 2019a

Although SII is considered to be useful in its ability to integrate large amounts of information into a single index, compare countries with regard to their innovative abilities and is valued as a communication and political tool, a number of articles containing criticisms of the EIS, its underlying concept, selection of indicators and modeling choices (weighting, aggregation methods) have been published (e.g. Schibany – Streicher, 2008; Grupp – Schubert, 2010; Mairesse – Mohnen, 2010). One of the main criticisms over the years consists in the methodology and calculation of SII, which supposedly lacks an underlying model of innovation that would justify the choice of innovation dimensions and indicators (European Commission, 2017). Edquist et al. (2018) claim that innovation performance should be understood as the relationships between innovation inputs and outputs, instead of mixing input and output innovation indicators and averaging them as currently by SII. Criticism also focuses on the multicollinearity of some indicators that may thus capture and measure the same latent innovation determinant (Grupp – Moge, 2004). In the sense of measuring

innovation performance, not only the selection of proper indicators but also data availability for a large number of countries is relevant. Considering the study from Mairesse and Mohnen (2010), for some indicators and countries data are not available, furthermore, for some countries, some indicators are based on more recent data than for other countries. Missing data together with differences in the timeliness of the data between indicators, as well as between countries for the same indicator could jeopardize a robust comparison of countries' performance.

2 Data and research methodology

For the analysis, the database of innovation indicators, The European Innovation Scoreboard Database (European Commission, 2019a), was used. It uses the most recent statistics from Eurostat and other internationally recognized sources available on June 2019.

With regard to the critical arguments on the interrelationships of SII indicators and the goal of this paper, the analysis is devoted to the extraction of correlated variables and to the reduction of the set of variables used for the SII calculation. Initially, we statistically described the observed variables using descriptive statistics. Afterwards, we conducted correlation analysis for the purpose of the primary reduction of diagnostic variables, we excluded strongly correlated variables with relatively small volatility and thus the co-linearity of explanatory variables was eliminated. Subsequent principal component analysis identified how much an observable variables contribute empirically to the latent factor. Finally, we performed k-means cluster analysis in order to find subgroups of observations within the data set. We carried out all calculations during analysis in MS Excel considering European Union member countries.

3 Results

In the initial step, we used a descriptive statistic in order to quantitatively describe the basic features of the studied data. Table 2 provides information for the 27 indicators used for the SII calculation mentioned previously in Table 1. The information includes mean and median values, minimum, maximum, sample variance, standard deviation, variation coefficient, and skewness across countries for one reference time point – year 2018.

Table 2 Descriptive statistics for the considered variables

Variable	Mean	Median	Min	Max	Variance	Std.Dev.	Coef.Var.	Skewness
X ₁	1,660	1,668	0,528	3,167	0,569	0,754	45,443	0,096
X ₂	41,489	41,600	25,100	58,200	71,893	8,479	20,437	0,084
X ₃	11,207	9,000	1,100	30,400	62,577	7,911	70,583	1,044
X ₄	1255,432	981,709	256,879	2929,328	538041,013	733,513	58,427	0,619
X ₅	9,189	9,719	2,683	15,769	15,081	3,883	42,262	0,005
X ₆	19,448	12,865	1,391	80,811	300,694	17,341	89,164	1,861
X ₇	21,370	19,000	4,000	46,000	116,242	10,782	50,451	0,720
X ₈	3,588	2,698	1,040	11,090	6,582	2,565	71,497	1,726
X ₉	0,576	0,570	0,210	1,070	0,066	0,256	44,449	0,302
X ₁₀	0,093	0,073	0,006	0,324	0,006	0,077	82,227	1,349
X ₁₁	0,981	0,680	0,140	2,420	0,450	0,671	68,410	0,794
X ₁₂	0,780	0,737	0,116	2,005	0,214	0,462	59,275	1,179
X ₁₃	21,444	24,000	5,000	36,000	68,103	8,252	38,483	-0,182
X ₁₄	33,148	37,745	4,633	56,034	172,367	13,129	39,607	-0,277
X ₁₅	33,180	33,364	7,354	52,043	163,714	12,795	38,563	-0,306
X ₁₆	28,860	33,166	4,248	51,194	139,717	11,820	40,957	-0,226
X ₁₇	11,551	9,821	1,712	24,584	42,169	6,494	56,218	0,587
X ₁₈	84,244	60,320	16,377	267,592	5039,117	70,987	84,264	1,291
X ₁₉	0,033	0,028	0,001	0,118	0,001	0,027	81,398	1,534
X ₂₀	2,502	1,403	0,230	9,573	6,444	2,538	101,477	1,413
X ₂₁	11,896	8,681	2,585	46,475	121,642	11,029	92,710	2,231
X ₂₂	3,858	3,816	0,863	9,934	5,446	2,334	60,488	0,716
X ₂₃	14,015	13,700	7,700	22,000	12,179	3,490	24,901	0,531
X ₂₄	4,889	4,790	1,839	8,550	3,735	1,933	39,530	0,319
X ₂₅	50,160	49,716	21,382	68,316	134,749	11,608	23,142	-0,354
X ₂₆	54,226	51,000	19,069	94,036	378,958	19,467	35,900	0,343
X ₂₇	10,998	10,408	4,744	20,274	18,622	4,315	39,238	0,492

Source: Own calculations based on European Commission, 2019a

In order to reduce the initial number of variables, we applied correlation analysis using the Pearson correlation coefficient. From all pairs of variables with a very strong correlation according to Evans (1996), the variable with a higher volatility coefficient based on standard deviation was considered for further analysis. The following table shows identified pairs of 13 strongly correlated variables, their correlation coefficient and additionally, rejected variables according to the mentioned criterion considering volatility. Based on this, we reduced the total number of variables from 27 to 18.

Table 3 Pearson correlation coefficient

Variables	Correlation coefficient (ρ)	Rejected variable
X ₄ , X ₃	0,803	X ₄
X ₈ , X ₃	0,828	X ₃
X ₁₈ , X ₃	0,804	X ₃
X ₂₀ , X ₃	0,840	X ₃
X ₅ , X ₄	0,831	X ₅
X ₁₈ , X ₄	0,844	X ₄
X ₁₁ , X ₉	0,845	X ₉
X ₂₀ , X ₉	0,819	X ₉
X ₁₈ , X ₁₁	0,853	X ₁₁
X ₂₀ , X ₁₁	0,975	X ₁₁
X ₁₅ , X ₁₄	0,830	X ₁₅
X ₁₆ , X ₁₄	0,982	X ₁₄
X ₁₆ , X ₁₅	0,820	X ₁₅
X ₂₀ , X ₁₈	0,885	X ₁₈
X ₂₆ , X ₂₃	0,810	X ₂₃

Source: Own calculations based on European Commission, 2019a

In the next step, we analyzed the interrelationships among the group of 18 selected variables and tried to explain them in terms of a smaller number of common underlying dimensions using factor analysis. Instead of exploratory factor analysis (EFA), Principal Component Analysis (PCA) with Kaiser-Varimax rotation was used, as PCA distinguishes most relevant factors and corresponding factor loadings and Kaiser-Varimax maximizes the variance of primeval factor loadings on variables. The variance was standardized to 1 in the correlation matrix, meaning that the total variance for all variables is 18, which is also equal to the sum of the eigenvalues listed in Table 4. Table 4 lists the eigenvalues in decreasing order and shows the percentage of the total variance accounted for by that eigenvalue. According to the eigenvalue-greater-than-one rule or Kaiser criterion (1960), the number of factors to retain should correspond to the number of eigenvalues greater than one. In our case the factors that meet this criterion account together for 74,22% of the total variance.

Table 4 Eigenvalues and variances by variables

Variable	eValue	% of variance	Cummulative %
X ₁	5,569	30,939%	30,939%
X ₂	2,680	14,889%	45,828%
X ₆	2,302	12,787%	58,615%
X ₇	1,582	8,788%	67,403%
X ₈	1,227	6,814%	74,217%
X ₁₀	0,870	4,836%	79,053%
X ₁₂	0,805	4,474%	83,527%
X ₁₃	0,710	3,943%	87,470%
X ₁₆	0,514	2,856%	90,325%
X ₁₇	0,455	2,530%	92,855%
X ₁₉	0,321	1,786%	94,641%
X ₂₀	0,271	1,506%	96,147%
X ₂₁	0,215	1,195%	97,342%
X ₂₂	0,158	0,877%	98,220%
X ₂₄	0,131	0,730%	98,950%
X ₂₅	0,091	0,503%	99,453%
X ₂₆	0,059	0,328%	99,781%
X ₂₇	0,039	0,219%	100,000%

Source: Own calculations based on European Commission, 2019a

Figure 2 represents the resulting scree plot, graphing the eigenvalues against the considered variables in order of the amount of variation they cover. The most important principal components, considered as significant are listed first and include X1, X2, X6, X7, X8.

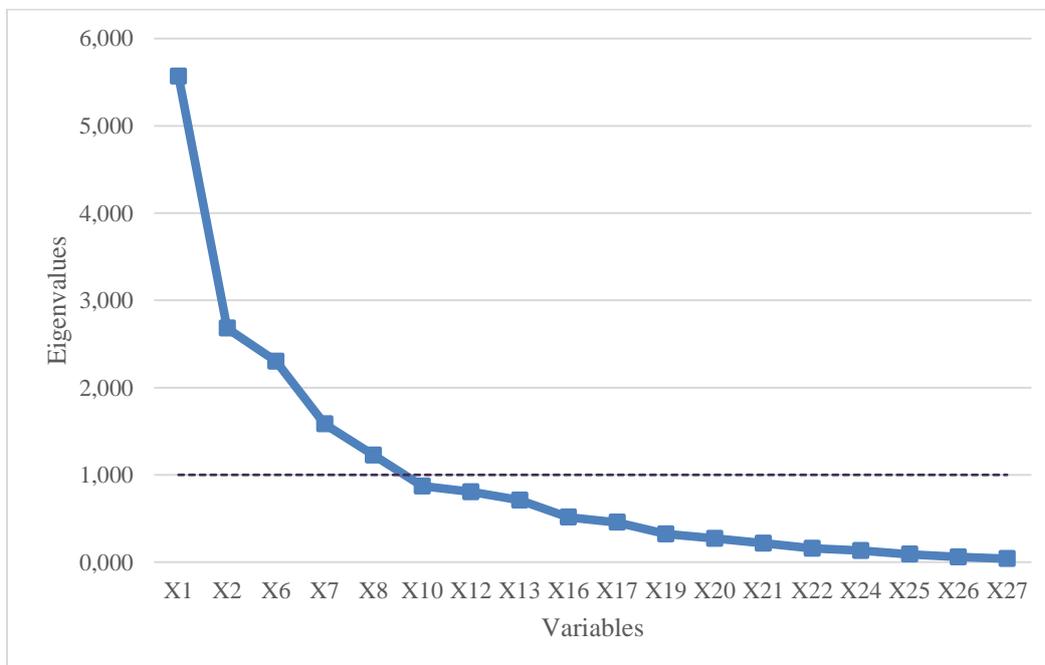


Figure 2 Scree plot of eigenvalues

Source: Own calculations and illustration based on European Commission, 2019a

Last but not least, after the identification of the significant principal components, we calculated the corresponding factor loadings established for particular variables. The results are summed up in Table 5.

Table 5 Factors and corresponding factor loadings

Variable / Factor	1	2	3	4	5
X ₁	0,045	-0,177	0,756	-0,152	0,437
X ₂	0,732	-0,315	0,050	-0,145	-0,193
X ₆	0,777	-0,079	0,268	0,287	0,239
X ₇	0,263	0,073	0,776	0,172	-0,158
X ₈	0,262	-0,057	0,733	0,409	0,033
X ₁₀	0,787	0,094	0,123	0,146	-0,079
X ₁₂	-0,430	-0,476	-0,094	-0,080	-0,440
X ₁₃	0,345	-0,374	0,370	-0,059	0,611
X ₁₆	0,249	-0,750	0,263	-0,035	0,072
X ₁₇	0,153	-0,812	0,258	-0,182	-0,083
X ₁₉	-0,223	-0,433	0,463	-0,154	0,209
X ₂₀	0,150	-0,240	0,804	0,201	0,336
X ₂₁	0,580	-0,346	-0,313	0,498	0,117
X ₂₂	0,094	-0,236	0,283	0,705	0,230
X ₂₄	0,031	0,741	0,150	-0,326	0,098
X ₂₅	-0,136	0,213	-0,020	0,017	0,830
X ₂₆	0,726	-0,045	0,329	0,116	0,373
X ₂₇	-0,030	-0,369	-0,070	-0,787	0,242

Source: Own calculations based on European Commission, 2019a

Based on Hair et al. (2014: 114), we identified meaningful factor loadings and highlighted them in the table. Considering only variables with high factor loadings, the resulting set of variables consists of X1 New doctorate graduates, X2 Population aged 25-34 with tertiary education, X6 Foreign doctorate students, X7 Broadband penetration, X8 Opportunity-driven entrepreneurship, X10 Venture capital expenditures, X20 PCT patent applications, X22 Design applications, X24 Employment in fast-growing enterprises of innovative sectors, X25 Medium and high-tech product exports, X26 Knowledge-intensive service exports.

Table 6 EU-27 in clusters after k-means analysis

Cluster Nr.	SII	k-means whole list	k-means reduced list
1	DK, NL, FI, SE	DK, CY, LU, NL, FI, SE	BE, DK, LU, NL, SE
2	BE, DE, EE, IE, FR, LU, AT	BE, EE, IE, AT, PT, SI	DE, IE, FR, CY, FI
3	CZ, EL, ES, HR, IT, CY, LV, LT, HU, MT, PL, PT, SI, SK	CZ, DE, EL, ES, FR, HR, IT, LT, MT, SK	BG, EE, EL, ES, HR, LV, LT, PL, PT
4	BG, RO	BG, LV, HU, PL, RO	CZ, IT, HU, MT, AT, RO, SI, SK

Source: Own calculations and elaboration based on European Commission, 2019a and European Commission, 2019b

Based on the conducted analysis and identified drivers of the countries' innovation performance, we clustered the EU-27 countries using k-means analysis

and compared the outcome with the ranking presented by Summary Innovation Index (European Commission, 2019b: 7). We conducted the k-means analysis on the full list of 27 variables (k-means whole list) and based on the reduced list consisting of a resulting set of 11 variables (k-means reduced list). As shown in Table 6, in all cases, Denmark, Nederland, and Sweden are part of the strongest group according to their innovation level. Although Finland belongs to the group of innovation leaders according to Summary Innovation Index, while considering the reduced set of variables, it is not the case and on the other hand, Belgium and Luxembourg account for better performance in the reduced set. In Summary Innovation Index classification, the smallest group consisting of only 2 representatives is a group of modest innovators, while k-means analysis considering reduced set of variables expands the group by Czech Republic, Italy, Hungaria, Malta, Austria, Slovenia, and Slovakia.

Conclusion

European Innovation Scoreboard as well as Summary Innovation Index well serve its purpose as an analytical tool to help monitor, measure and benchmark the innovation performance of the European Union and its member states (European Commission, 2017: 4). Nevertheless, they both have not remained without criticism. In this paper we limited ourselves to critical arguments with statistical nature, in particular, we intended to avoid co-linearity of diagnostic variables and we used only normalized (by standardization) variables.

In connection with the research goal, the paper firstly provided an overview about European Innovation Scoreboard, Summary Innovation Index and its methodology. To identify the factors with the strongest influence on the innovativeness of the European Union member economies measured by the Summary Innovation Index, we applied different methods of multivariate statistical analysis. As a first step, we conducted the correlation analysis for the purpose of the primary reduction of diagnostic variables, from the initial set of 27 to 18 variables. We eliminated strongly correlated variables with relatively small volatility and thus we eliminated the co-linearity of explanatory variables. Furthermore, another reduction of diagnostic variables was based on the results of the Principal Component Analysis, resulting in the set of 11 variables with the strongest impact on innovativeness. Based on the conducted analysis and identified drivers of the countries' innovation performance, we clustered the EU-27 countries using k-means analysis and compared the outcome with the ranking presented by Summary Innovation Index (European Commission, 2019b: 7).

The analysis showed that after the removal of strongly correlated variables from the primary set of 27 indicators, there is a change in orientation. Redundancy and repetition of statistical information are eliminated and the focus goes to different variables, which results in non-negligible changes in individual country rankings compared to results stated in Summary Innovation Index.

Last but not least, it is important to mention, that the identified set of diagnostic variables does not describe the innovation drivers or driving forces of innovation, on the contrary, it classifies the main determinants affecting countries' innovation performance based on SII methodology. The present analysis should be further extended by the use of other multidimensional statistical methods and data mining methods for detecting indicators that impact innovation performance the most. Furthermore, the future research should also deal with the forecasting of innovation performance of countries using various econometric models. Such research could be beneficial for developing suitable international economic policies in order to achieve a better innovation performance in the whole European Union.

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About the author

Ing. Juliana Bérešová

Department of Economics

Faculty of Business Economics with seat in Košice

University of Economics in Bratislava

Tajovského 13, 041 30 Košice

Email: juliana.beresova@student.euke.sk

MANAGEMENT OF SELF-EMPLOYED FARMERS IN SLOVAKIA

HOSPODÁRENIE SAMOSTATNE HOSPODÁRIACICH ROĽNÍKOV NA SLOVENSKU

Erika DUDÁŠ PAJERSKÁ – Kristína DEÁKOVÁ

Abstract

The beginnings of agriculture date from the beginning of civilization. Agriculture is one of the sectors of the national economy and one of its primary spheres. Based on the studied literature, we obtained information about insufficient food self-sufficiency in Slovakia. For this reason, we will discuss in more detail the management of self-employed farmers in Slovakia, based on the methodology of the Research Institute of Agriculture and Food Economics (RIAF), which has been a part of the National Agricultural and Food Center (NAFC) since 2014.

Key words: agriculture, self-employed farmers, crop production, livestock production

Introduction

Based on the literature we can conclude that Slovak agriculture had problems long before joining the European Union. The Slovak Republic is characterized by its fertile agricultural land spreading on the Rye Island and the East Slovak Lowland. Geographically, Slovakia is considered a mountainous country with predominant forests, meadows and pastures, which are unsuitable for growing crops but are adapted for livestock production.

One of the main tasks of agriculture is to provide food for humanity without which human life would not exist. Food resources are limited, but we also know that people's ability to consume these resources is limited too. It is therefore essential to ensure the transfer of these foods from countries with a surplus of resources to countries with lower economic levels. Soil is considered a fundamental means of production. It is a variable means of production and has different fertility in individual regions of Slovakia. The development of the land market is currently directly proportional to the development of the agrosector and the increasing profitability of farms.

1 Object of examination

The object of the research are individual agricultural enterprises of the type of self-employed farmer in Slovakia, whose existence is necessary for the maintenance of productive agriculture and development of economic activities important for the life of the population. Based on the FSS carried out by the Slovak University of Agriculture, the Plan for the selection of agricultural holdings is compiled according to the uniform FADN methodology, which is the starting point for all Member States.

2 Methodology

Representative sample of holdings shall mean holdings characterized by land management, production for the market and operation of agricultural production. The sampling plan, which consists of returning holdings, determines the number of holdings in the sample and their structure according to typology criteria. The most up-to-date data which are suitable for the classification and compilation of the Farm Selection Plan are obtained through the structural survey of farms. FSS performed by the Statistical Office of the Slovak Republic (SO SR). The main function of the system is to ensure that the sample is represented by all types of enterprises on the basis of three selection criteria:

1. a territorial unit,
2. type of economic size of the unit,
3. type of production orientation of the unit.

By the term 'territorial unit' we can imagine the territory of a State or any part of it which is delimited. There are businesses on the territory that provide regular data. Slovakia is one territorial unit in the EU FADN Database.

The second most important criterion is the size type of the farm, which is expressed in terms of the value of standard production in euros. First of all, it is necessary to express the value of the Standard Output (SO) per company by means of coefficients calculated on the basis of data contained in the ISPU database. The average SO values of individual commodities are used to calculate the economic size of a company, most frequently for a period of five consecutive calendar years. Both commodities are valued at strike prices, excluding subsidies and value added tax (VAT). Subsequently, the obtained data are sent to the Eurostat database through the Statistical Office of the Slovak Republic. To classify a particular enterprise into individual economic classes, it is necessary to calculate the total standard production, which is the sum of products from crop and livestock production.

Crop production is characterized by the following calculation:

*the area of land where crops grown * the relevant SO coefficient for the crop*

The livestock production is characterized by a calculation:

*number of animals by categories * coefficient for the animal category*

In the next table we can see the classification of enterprises into individual classes according to standard production expressed in euro.

Tab. 1 Classification of enterprises into individual economic classes according to SO

Economic size type	Standard production in € from	Standard production in € to
1	0	2 000
2	2 000	4 000
3	4 000	8 000
4	8 000	15 000
5	15 000	25 000
6	25 000	50 000
7	50 000	100 000
8	100 000	250 000
9	250 000	500 000
10	500 000	750 000
11	750 000	1 000 000
12	1 000 000	1 500 000
13	1 500 000	3 000 000
14	3 000 000	

Source: own processing according to Commission Implementing Regulation (EU) n.220/2015

The third selection criterion that ensures that all holdings are representative of the sample is the type of farming. It is structured into three different levels:

- a) General type (1 – 9);
- b) Main type (15 – 84);
- c) Special type (151 – 844).

Through the results of the structural census of farms and the coefficients of standard production of SO 2010 carried out by the Statistical Office of the Slovak Republic, enterprises were classified into individual classes according to their economic size and type of production orientation. The business selection plan is established according to a uniform FADN methodology, which is the starting point for all Member States.

3 Management of self-employed farmers in Slovakia

In the first step of the financial situation analysis we evaluate the situation in companies through the analysis of selected costs. This is an analysis of selected indicators, which include the total annual labour cost per employee, fuel, fertilizers, protected designation of origin (PDO), plant protection products (PPP), maintenance and repair of machinery, real estate tax and indebtedness. We will examine their development for the years 2011 – 2017.

Based on Table no. 2, we can see how selected costs develop in companies such as self-employed farmers over the reporting period. The most important indicator is the total annual labour cost per employee expressed in euro. This indicator shows fluctuating developments and reaches its highest values at the beginning and at the end of our period, which is a negative situation. Similarly, other cost indicators show fluctuating developments. Until 2015, the indicator called Chemical Protective Equipment (CHPE) was used, which expresses costs

in the company. After 2015, the CHPE was renamed by the Plant Protection Products indicator (PPP).

Table 2 Selected costs – self-employed farmers

Year/ indicator	2011	2012	2013	2014	2015	2016	2017
Total annual labour cost per employee (€)	5589,36	5268,18	5336,68	4356,96	4178,22	4648,33	5855,31
Fuel (€·ha⁻¹·p.p.)	116,30	128,99	122,18	139,49	121,86	122,78	113,52
Fertilizers (€·ha⁻¹·p.p.)	118,85	140,45	124,42	121,99	133,70	134,89	104,38
PDO / PPP (€·ha⁻¹·p.p.)	83,69	96,85	81,49	94,31	98,55	105,54	92,83
Maintenance and repair of machinery (€·ha⁻¹·p.p.)	63,82	56,56	54,56	65,55	59,87	69,73	69,77
Real estate tax (€·ha⁻¹·p.p.)	5,71	7,92	8,17	7,98	9,03	9,34	9,27
Indebtedness (€·ha⁻¹·p.p.)	327,34	265,67	139,99	157,97	266,73	270,59	262,90

Source: own processing according to Adam, 2018, 2019; Buday, 2013, 2014, 2015, 2016; Nouzovska, 2017.

In the following table we will evaluate the financial situation in companies by means of selected indicators, which include revenues from own products and services as well as other revenues. We will examine their development for the years 2011 – 2017.

Table 3 Selected sales – self-employed farmers

Year/ indicator	2011	2012	2013	2014	2015	2016	2017
Revenue from own products and services (€·ha⁻¹·p.p.)	760,54	859,56	807,83	870,59	896,13	933,16	875,50
Other sales (€·ha⁻¹·p.p.)	290,65	182,89	286,09	305,38	320,29	323,07	313,13

Source: own processing according to Adam, 2018, 2019; Buday, 2013, 2014, 2015, 2016; Nouzovska, 2017.

Based on Table no. 3, we can see how selected sales turnover in self-employed farmers enterprises in the reporting period. Revenues have fluctuated over the reporting period. In 2016, indicators such as revenues from own products and services as well as other revenues reach the highest value in our reporting period. If sales increased each year, it would positively affect the economic side of the company.

In the following table, we assess the financial situation in enterprises through selected indicators such as national subsidies, the rural development plan, direct payments of crop production (CP), direct payments of livestock production (LP) and payments for disadvantaged production conditions. Agriculture is financed through the national subsidy indicator. The rural development plan serves primarily to improve the quality of life in rural areas. The direct payments indicator is one of the EU Common Agricultural Policy instruments and their primary task is to ensure the agricultural production function. These payments also serve to manage the land and provide income for farmers. The last subsidies selected include an indicator expressing payments for disadvantaged production conditions. Its primary objective is to maintain and promote sustainable management systems that serve to protect the environment. We will examine their development for the years 2011 – 2017.

Table 4 Selected subsidies – self-employed farmers

Year / Indicator	2011	2012	2013	2014	2015	2016	2017
National subsidies (€·ha⁻¹·p.p.)	47,38	1,53	1,27	11,91	46,09	15,55	49,37
Rural development plan (€·ha⁻¹·p.p.)	103,32	116,87	15,18	118,86	192,12	79,17	63,82
Direct payments CP (€·ha⁻¹·p.p.)	166,99	185,32	181,34	207,76	133,63	104,00	104,62
Direct payments LP (€·VDJ⁻¹)	108,22	47,03	45,77	89,18	42,84	45,61	54,76
Payments for disadvantaged production conditions (€·ha⁻¹·p.p.)	54,64	51,30	26,46	59,97	57,44	56,26	57,91

Source: own processing according to Adam, 2018, 2019; Buday, 2013, 2014, 2015, 2016; Nouzovska, 2017.

Based on Table no. 4, we can see how selected subsidies in companies called self-employed farmers develop over the reporting period. The values of subsidies have an increasing and decreasing tendency in the monitored period. In 2017, agriculture is most funded through national subsidies. Based on the rural development plan indicator, we can conclude that the self-employed farmers are the least funded through subsidies in 2013. Two years later, this indicator shows the highest value in our reporting period. Direct CP payments are granted per hectare of the applicant's current agricultural area. Within our 2014 review period, the highest direct payments to LP are provided and, on the other hand, 2016 shows the lowest support through these payments. At the beginning of our period under review, self-employed farmers show the highest subsidies received in the form of direct payments to CP and on the other hand 2015 shows the lowest support through these payments. In our research period in 2013, self-employed farmers achieve the lowest financial support through payments for disadvantaged

production conditions. One year later, the value of these payments increases by € 33.51 ha⁻¹p.p. compared to the previous year.

In the following table we evaluate the average fertility of selected crops according to the legal form in t.ha⁻¹. Specifically, we will focus on selected agricultural crops such as: wheat, oilseed rape, sunflower, potatoes, sugar beet, apple and pear, vineyards. Based on the available information, we found out that the Slovak Sugar Association (SSA) is based in Slovakia. It is an interest association of legal entities engaged in sugar beet processing and subsequent sugar production. We will examine their development for the years 2011 – 2017.

Table 5 Average fertility of selected CP crops – self-employed farmers

Year / Indicator	2011	2012	2013	2014	2015	2016	2017
Wheat	4,39	3,41	4,13	5,22	5,35	5,57	4,47
Oilseed rape	2,32	2,11	2,51	3,63	2,71	3,44	3,27
Sunflower	2,30	2,14	2,30	2,63	2,34	3,00	2,56
Potatoes	25,55	24,63	18,71	14,62	16,47	17,31	17,69
Sugar beet	70,60	45,84	55,43	63,38	53,35	73,86	57,14
Apple and pear	4,24	4,63	12,55	18,93	17,96	17,37	22,76
Vineyards	5,78	5,17	5,45	4,59	3,74	3,06	3,57

Source: own processing according to Adam, 2018, 2019; Buday, 2013, 2014, 2015, 2016; Nouzovska, 2017.

Based on Table no. 5 we can see how the fertility of selected agricultural crops, which are reported by self-employed farmers during the period under review, develops. Values of selected crops have an increasing and decreasing tendency. Fertility is measured per tonne per hectare (t.ha⁻¹). In 2016, the highest fertility among selected crops is achieved by sugar beet. Its fertility is 73.86 t.ha⁻¹. Its high values are the result of tolerance to the variability of weather conditions. Potatoes and orchards are less fertile than sugar beet. Among the selected crops, crops such as oilseed rape and sunflower show the lowest fertility. Both crops show the lowest fertility for self-employed farmers in 2012. On the basis of the table we can conclude that the values showing the fertility of vineyards are relatively low. The grapes are difficult to grow and require brown soil, heavier clay soil and diverse climatic conditions.

In the following table we will evaluate the realization price of selected CP crops and focus on selected agricultural crops such as: wheat, rape, sunflower, potatoes, sugar beet, apple and pear, vineyards. We will examine the development of their exercise price for 2011 – 2017.

Based on Table no. 6 we can see how the exercise price of selected agricultural crops, which are reported by self-employed farmers within the reference period, develops. The realization prices of selected crops are increasing and decreasing. On this basis we can conclude that the realization price is not stable but fluctuates in time and space. Among the selected crops, sugar beet has the lowest realizable price. The main reason for the low price is the abundance of this commodity and

its high fertility. We are talking about indirect intention, the higher the realization price, the lower the fertility and vice versa.

Table 6 Sale price of selected CP crops – self-employed farmers

Year / Indicator	2011	2012	2013	2014	2015	2016	2017
Wheat	176,54	198,39	153,77	144,85	153,54	132,58	152,87
Oilseed rape	440,73	449,34	356,68	337,91	358,34	357,26	379,85
Sunflower	356,71	431,57	320,35	293,03	343,33	307,72	312,88
Potatoes	168,93	169,92	279,70	166,72	172,67	172,86	189,34
Sugar beet	28,36	39,48	27,99	27,62	28,43	24,68	23,37
Apple and pear	233,89	318,11	230,12	265,38	250,35	304,94	-
Vineyards	444,60	425,05	390,88	468,70	479,22	358,13	462,86

Source: own processing according to Adam, 2018, 2019; Buday, 2013, 2014, 2015, 2016; Nouzovska, 2017.

Oilseed rape, vineyards and sunflower show the highest realization price. These commodities achieve lower fertility due to difficult growing conditions. Crops such as wheat, potatoes and orchards are valued at average realizable prices due to their fertility. In our period, wheat in 2012 reaches the highest realizable price of 198,39 € .t⁻¹ due to the lowest fertility reported this year. The other two crops show similar values.

Table 7 Average output of the selected LP products – self-employed farmers

Year / Indicator	2011	2012	2013	2014	2015	2016	2017
Cow's milk (l/cow)	5659,95	5904,64	5551,12	5197,26	3528,62	4480,37	6297,91
Sheep's milk (l/sheep)	71,64	84,84	86,24	85,8	86,04	95,89	91,25
Goat's milk (l/goat)	261,25	427,43	219,28	-	-	-	201,74
Hen's eggs (ps/hen)	0,00	157,60	281,07	143	-	-	-
Wool (kg/sheep)	2,25	2,28	2,61	1,81	2,34	2,11	2,29

Source: own processing according to Adam, 2018, 2019; Buday, 2013, 2014, 2015, 2016; Nouzovska, 2017.

In the previous table we evaluate the average output of the selected products by the self-employed farmers. In particular, we focus on selected LP products such as: cow's milk, sheep's milk, goat's milk, hen's eggs and wool. We investigate the production of these products for 2011 – 2017.

Based on Table no. 7 we can see how the production of selected products of animal husbandry, which are reported by self-employed farmers within the monitored period, develops. Values of selected products have an increasing and decreasing tendency. The highest production among the selected products reaches cow's milk in 2017. In that year, 6,297.91 l cow's milk was produced. The main reason for increased cow's milk production is the fact that cows are being bred and the feed is treated. Based on the data provided by the self-employed farmers, we know that in 2012 427.43 l / goat goat's milk was produced, which represents

the highest production in the period under review. Furthermore, we can see that RIAF does not disclose the number of eggs produced in 2011, 2015, 2016 and 2017. Self-employed farmers report that in 2013, 281.07 eggs / hen are produced. This means the number of eggs laid by the hen in a given time. One year later this value drops to 143 eggs / hen. When producing wool, you can see how the values of the wool produced change over the reporting period. Self-employed farmers show the highest value in 2013, which is 2.61 kg of sheep wool. What is the weight of wool, expressed in kg, obtained by processing from one sheep over the selected period. One year later this value drops to 1.81 kg of sheep wool.

In the next table we will evaluate the realization price of selected products. In particular, we will focus on selected LP products such as: cow's milk, sheep's milk, goat's milk, hen's eggs and wool. We will examine the development of their exercise price for 2011 – 2017.

Table 8 Sale price of selected CP crops – self-employed farmers

Year / Indicator	2011	2012	2013	2014	2015	2016	2017
Cow's milk (l/cow)	0,33	0,30	0,31	0,35	0,28	0,24	0,32
Sheep's milk (l/sheep)	0,84	0,80	0,89	0,97	1,01	1,02	1,00
Goat's milk (l/goat)	0,00	0,00	-	-	-	-	-
Hen's eggs (ps/hen)	0,00	0,10	0,10	0,10	-	-	-
Wool (kg/sheep)	0,55	0,93	0,65	0,43	0,65	0,58	0,58

Source: own processing according to Adam, 2018, 2019; Buday, 2013, 2014, 2015, 2016; Nouzovska, 2017.

Based on Table no. 8, we can see how the realization price develops for selected LP products, which are reported by self-employed farmers within the reference period. The realization prices of selected LP products have an increasing and decreasing tendency. On this basis we can conclude that the realization price is not stable but fluctuates in time and space. The lowest realizable price of selected products is reported by cow's milk in 2016. The main reason is its increased production. Sheep's milk is the second commodity showing higher realization prices in 2011 – 2017 compared to goat's and cow's milk. We are talking about indirect intention, the higher the realization price, the lower the production and vice versa. In 2016, self-employed farmers show 1.02 € / l of sheep's milk, which is the highest price in the period. The values of goat's milk are not given to RIAF. Based on Table no. 8 you can see that the evaluation of chicken eggs in 2012, 2013 and 2014 at the level of 0.10 € / pc. The following years are unpublished.

During the analysis period, the realization prices of the wool change. In 2012, we record the highest realizable price for 1 kg of wool, which is € 0.93 / kg. In that year self-employed farmers show 2.28 kg of sheep wool. Since that year we

have been seeing a decline in the realization price, but there has been no rising production yet.

3.1 Crop production

The following chart shows the development of sales and subsidies in relation to the realization prices and costs, which are reported by self-employed farmers for CP for the period under review. We focus more on the development of sales and direct payments for CP, which represent a specific form of subsidy for the period under review.

Based on a comparison of these indicators, we can conclude that self-employed farmers achieve much higher funds through CP revenue than through subsidies. The graph shows the fluctuating development of earnings and direct payments for CP over the reporting period. In 2017 self-employed farmers reach the highest CP revenue. They receive the lowest financial support in the form of a subsidy for the CP area in 2016 and the value of direct payments in the aforementioned year is € 104.00. ha⁻¹p.p. One year later, this value increases by almost € 200. ha⁻¹p.p. On the basis of the graph we can see how the realization prices of selected agricultural crops are developing in dependence on the mentioned revenues and subsidies for the area of CP.

For selected crops, fluctuations in their realization prices can be seen. Among the selected crops, vineyards get the highest realization price due to lower fertility and demanding cultivation. In 2015, the strike price is the highest and is € 479.22 per t⁻¹. One year later, their strike price drops to € 358.13 per t⁻¹. Crops such as oilseed rape and sunflower reach higher feasibility prices during our reporting period compared to wheat, potatoes and orchards, which are valued at average feasibility prices due to their fertility. The oilseed rape crop in 2012 is awarded the highest realization price, which reaches the level of €449,34 € per t⁻¹. In the following years, the realization price of this crop decreased due to its increasing fertility. In the same year, the sunflower also reaches the highest realizable price within the monitored period, which is € 431.57 per t⁻¹. The crop under the name sugar beet achieves the lowest valuation in the selected agricultural crops due to the high fertility, which is the result of tolerance to the variability of weather conditions.

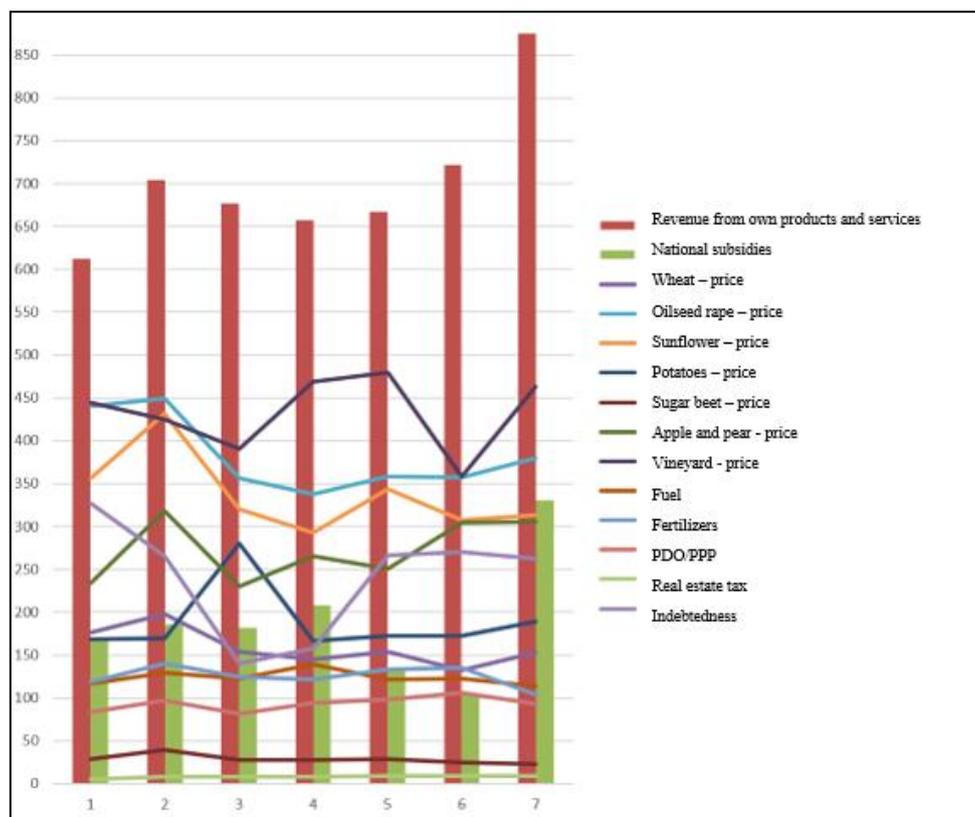


Figure 1 Graph of development of sales and subsidies in relation to the realization prices and costs of CP of self-employed farmers

Source: own processing

The year 2017 shows the lowest realization price, which reaches €23.37 per t¹. On the basis of the graph it is possible to see how the indicators, which represent costs for self-employed farmers in dependence on revenues and subsidies for CP, develop. Within the selected costs, self-employed farmers report that the indebtedness reaches the highest value in the period under review. The lowest indebtedness is in 2013 and its value is €139.99 € per ha^{-1p.p.} Compared to the indebtedness, the real estate tax is the lowest, which increases every year. Fuel, fertilizers, PPP / PDO, which also represent costs for self-employed farmers, show average values compared to the above mentioned indicators. The values of these indicators have an increasing and decreasing tendency.

3.2 Livestock production

The following chart shows the development of sales and subsidies in relation to the realization prices and costs, which are reported by the self-employed farmers for the LP in the reference period .

We focus more closely on the development of sales and direct payments for life support, which represent a specific form of subsidy for the period under review. If we compare these two indicators, we can conclude that self-employed farmers achieve higher financial means by means of revenues from living expenses than in the form of subsidies. The graph shows the fluctuating

development of funds generated from sales and subsidies. In 2014, self-employed farmers amounted to €660,81 per large livestock unit⁻¹ (LLU⁻¹) and this value represents the highest revenues from life support in the monitored period. Two years later, self-employed farmers show the lowest turnover in life insurance. They receive the lowest financial support in the form of subsidies for environmental protection in 2015 and their value is €42.84 per LLU⁻¹. For two consecutive years, self-employed farmers have shown similar achievements of financial support through direct payments.

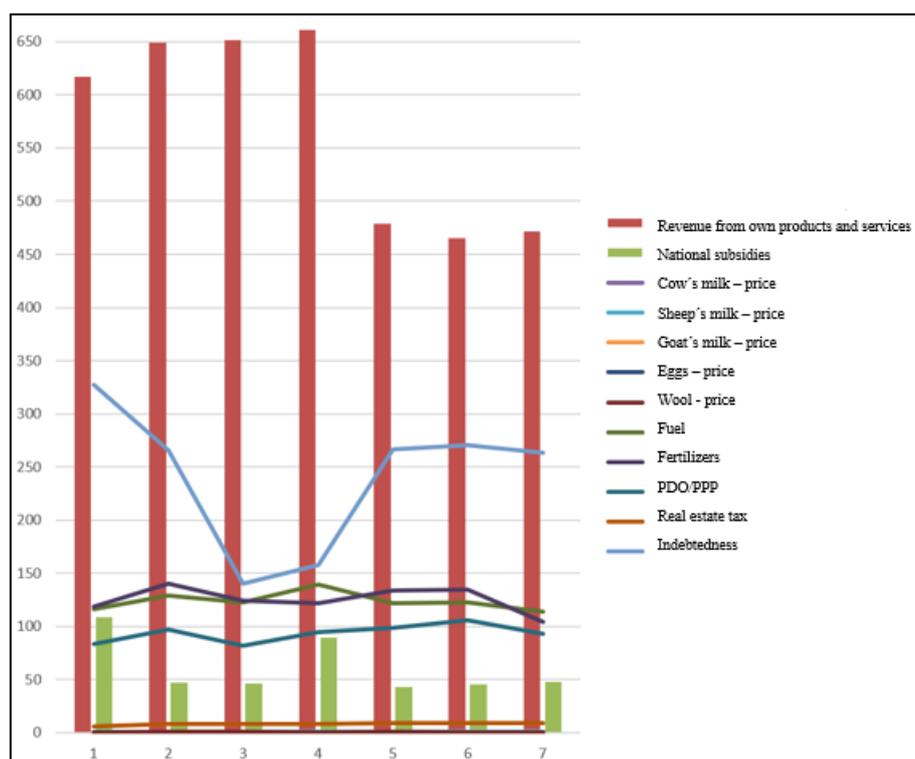


Figure 2 Graph of the development of sales and subsidies in relation to the realization prices and costs of LP of self-employed farmers

Source: own processing

On the basis of the graph we can see how the realization prices of selected products evolve in relation to the above mentioned revenues and subsidies for life support. The realization prices of selected products have an increasing and decreasing tendency within our monitored period. Compared to cow's and goat's milk, sheep's milk is the commodity that has the highest realizable prices within the reference period. The main reason for the higher realization price is its lower production. In 2016, self-employed farmers show €1.02 / 1 sheep's milk, which is the highest price in the reporting period. In comparison with goat's and sheep's milk, the lowest realization price is shown in 2016 for a commodity called cow's milk. Its value in the mentioned year reaches the level of €0.24 / 1. The main reason for the low price is the increased production of cow's milk. On the basis of the graph we can point to the changing realization prices of wool. In 2012 we record the highest realization price for 1kg / wool, which reaches the level of €0.93

/ kg. Subsequently, the strike price gradually decreases. Within the selected costs, the self-employed farmers show that the indebtedness reaches the highest value within the reference period. The same values are achieved for CP. The year 2013 shows the lowest indebtedness and self-employed farmers report the value of €139.99 per ha^{-1p.p.}. Compared to the indebtedness, the real estate tax, which shows an increasing value every year, is the lowest. For 2017, the value is €9.27 per ha^{-1p.p.}. Fuel and fertilizers have a rising and declining tendency over the period under review and are among the costs that have reached average values compared to the previous indicators.

Conclusion

The main desire of farmers is to work peacefully on their land and offer consumers healthy, quality and safe Slovak food. It is in their interest to improve the countryside, which is one of the pillars of the beauty and livelihood of our homeland.

Based on the acquired knowledge, Slovak farmers do not have suitable conditions for growing crops and animal husbandry to support Slovakia's self-sufficiency. The most common reasons are the limited access of small and young farmers to fertile land. Another reason is the financially and legally burdensome burden on the construction of establishments that would be created for the purpose of processing and producing animal products. The state administration in Slovakia is considered only as a sanction and control body for farmers. The disadvantage is that it also does not serve as an advisory body to farmers. The introduction of bureaucratic methods and insufficient utilization of funds from the European Union for beginning farmers are also having a negative impact on the food self-sufficiency of Slovakia.

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About the authors

Ing. Erika Dudáš Pajerská, PhD.
Department of Commercial Entrepreneurship
Faculty of Business Economics with seat in Kosice
University of Economics in Bratislava
Tajovského 13, 041 30 Kosice
email: erika.dudas.pajerska@euke.sk

Bc. Kristína Deáková
Faculty of Business Economics with seat in Kosice
University of Economics in Bratislava
Tajovského 13, 041 30 Kosice
email: kristina.deakova@student.euke.sk

SOCIO-ENVIRONMENTAL CHANGES SUPPORTING SUSTAINABLE FOOD PRODUCTION AND CONSUMPTION

ZMENY ŽIVOTNÉHO PROSTREDIA PODPORUJÚCE UDRŽATEĽNÚ VÝROBU A SPOTREBU POTRAVÍN

Elzbieta GORYŃSKA-GOLDMANN

Abstract

The aim of this paper is to analyze some chosen socio-environmental changes which support the sustainable production and consumption of food. Sustainable production and consumption of food is an idea driving responsibility and making us care more about the environment and our society, by the implementation of that model. An alternative approach to the way in which food consumption can be turned into a more sustainable use of it, is focusing on local food products. The development of innovative technologies can lead to sustaining the economic growth while decreasing the negative impact on the environment. We have to increase the awareness of the environmental issues and make people realize what are the benefits of sustainability. Building positive consumer's experiences and the willingness to get involved into right actions help to create relations and network connections on the food market. Companies have to redefine the consumers' role in the process and turn to open innovations.

Key words: sustainable production, consumption, society, technology, consumer

Abstrakt

Cieľom tejto práce je analyzovať niektoré vybrané sociálno-environmentálne zmeny, ktoré podporujú trvalo udržateľnú výrobu a spotrebu potravín. Udržateľná výroba a konzumácia potravín je myšlienka, ktorá vedie k zodpovednosti a vďaka implementácii tohto modelu sa viac zaujímate o životné prostredie a našu spoločnosť. Alternatívny prístup k spôsobu, akým sa dá spotreba potravín zmeniť na jej trvalo udržateľnejšie využívanie, je zameranie sa na miestne potravinové výrobky. Vývoj inovatívnych technológií môže viesť k udržaniu hospodárskeho rastu a zároveň k zníženiu negatívnych vplyvov na životné prostredie. Musíme zvýšiť informovanosť o environmentálnych otázkach a prinútiť ľudí, aby si uvedomili, aké sú výhody udržateľnosti. Budovanie pozitívnych skúseností spotrebiteľov a ochota zapojiť sa do správnych krokov pomáha vytvárať vzťahy a sieťové pripojenia na trhu s potravinami. Spoločnosti musia znovu definovať úlohu spotrebiteľov v tomto procese a obrátiť sa na otvorené inovácie

Kľúčové slová: trvalo udržateľná výroba, spotreba, spoločnosť, technológie, spotrebiteľ

Introduction

Changes in our socio-economic reality drive the need to adjust our business models. Their form is more and more often dependent on the global and local processes which are connected to the switch from a traditional model of economy to a socially sustainable model.

Sustainable development became a driving force for modern economy, and makes us focus on entrepreneurship and innovativeness that are the sources of motivation which is needed to improve the results of economic operations at the

level of a company, region, country and international structures. The whole scale of the process is a confirmation of the engagement into the development of the conception. From the manufacturing companies' perspective, it is a milestone towards opening to global issues that our world has to face up with, including the care for the environment (Sadowski 2017), awareness of the depletion of natural resources (*inter alia* in developing countries) and malnutrition (Pawlak 2016). It is a holistic and universal conception which includes a lot of chances and barriers (*inter alia* connected with economy, finances, innovativeness, non-sustainable consumption, poor system of rating and monitoring, as well as institutional barriers) (Czyżewski & Klepacki 2015, Goryńska-Goldmann 2019).

The practical implementation of sustainable development in Poland is a part of a wider, comprehensive socio-economic policy, and includes multi-level cooperation and switch from the industrial farming paradigm to a socially-sustainable conception (Czyżewski & Klepacki 2015). The implementation of sustainable development aims (2018) demands taking actions focused, *inter alia*, on changes in production and consumption.

1 The objective and methodology

The aim of the article is to analyze chosen socio-environmental changes that support sustainable production and consumption of food. While researching into socio-economic changes in relation to the sustainable production and consumption idea, I analyzed source literature, both domestic and international, concerning the problems of agricultural economics, , management economics, consumption economics and decision making under risk. The descriptive conclusions were verified with the use of current results from my own research, as well as research of other authors concerning the problems of the food market and the sustainable development conception. While describing the food market I used data from the Central Statistical Office (GUS).

2 Food products as a category influencing the environment

The food market is significantly influenced by industrialization and globalization of economic processes (including the food chain), mass production and changes in demographics, economy and technology. Food products and beverages are an important part of manufacturing and trade, being at the same time categories strongly influencing the environment. The Polish food market is characterized by imbalance, overproduction and non-balanced level of consumption. It is estimated that 1/5 of Poles spend less on food products than the living wage (in 2018) required. The level of average spending on food and non-alcoholic beverages per person was 24.8% of the total amount of money spent by households, while the percentage of money spent on household maintenance and energy was 18.3% (GUS 2019).

In the perspective of the last few decades, the price of changes that took place on the food market is the degradation of the environment. The symptoms of

degradation of natural resources are climate change, pollution (earth, soil and water), shrinking number of farms and the development of diseases of affluence. Because of that, we have to face up many challenges concerning the environment, climate change, protection of water resources and social changes. They belong to the main problems included in the discussion about sustainable production and consumption of food.

Production and distribution of food require including a lot of elements, and the number of them usually increases with the increase in production. The data from the United Nations Food and Agriculture Organization (FAO) reports show that one-third of food produced is not consumed by people. That number is even bigger in larger societies and because of the impact of climate change.

The problem of waste produced by individuals within the food chain, despite many efforts visible both on the international, and on the domestic level, suggests that the problem of food waste is a part of the food production industry which is interested in solving it. The biggest amount of food waste in developed countries can be noticed at the stage of retail sales and consumption, then in households, and the lowest it is in the accommodation and restaurant industry and in retail shops (McDonald 2019).

Manufacturing of food products is also connected to the excessive use of energy and emissions harmful to the environment. Satisfying even the most basic needs, apart from food, includes also clothing, accommodation, heating (especially in the temperate and cold climates where live a significant number of people) (Sadowski 2017). Currently such issues are regulated by special laws and norms.

Despite the fact that consumers are becoming more and more aware of the relations between food, nutrition and health, they are not likely to change their eating habits and make informed choices. As a result, the environment becomes under bigger pressure connected with the need to provide food for 7 billion people in the world and the number of diseases of affluence is increasing (Rejman et al. 2015).

Food producers are more and more aware of those problems and their connection with the environment, and take actions aimed at protecting the environment and alleviating the effects of climate change, as well as try to change eating habits. Because of that, they introduce some education content into their marketing actions (on the level of their own companies, contractors and final customers). Aware, educated partners are a strong group of buyers and with the help of some more sustainable products and services, they will be more willing to cooperate and build trust, while having stronger feeling of social effectiveness. As a result of such approach, they will also be more open to the new model of sustainable food consumption.

From the perspective of companies, sustainable development is an idea calling for social responsibility and their own contribution, social and environmental, on

the way to its implementation. It is worth to remind Beck (1992), who while writing about environmental issues (their sources and consequences) attributed them as social problems and highlighted that they are problems of all people, their history and include living conditions, attitude and the surrounding reality, as well as some social, cultural and political situation. When Beck was writing about the environment at the end of the 20th century, he highlighted that the nature is the society, and the society is the nature. Every individual that would discuss the nature separately from the society would not act in line with the current times but with companies from the previous century, when the knowledge did not express precisely the real situation. Since that time, researchers have put a lot of attention to the environment and the consequences of imbalanced consumption and production (Fort & Solaroli 2018, Jackson & Michaelis 2003, Assadourian 2010, Sadowski 2017, McDonagh et al. 2011). They try to prove that the new paradigms are extremely important on the way to achieve sustainable development, while encouraging changes and introducing them in our society.

Achieving sustainable production and consumption of food demands analyzing some given issues (on the basis on new conditions, assumptions, rules and methods).

3 The change of the consumer's role on the market

Consumers are key partners in planning and implementing company's strategies and marketing actions. Companies create value for consumers and try to achieve important aims, *inter alia* provide a high standard of living, balance between the possibilities, available resources and market activities. Those elements are reflected in their behavior in the area of economics (they try to maximize the usefulness of goods and satisfaction while engaging specified amount of money), as well as on non-economic level (they want to achieve consumption models, as in the social group within which they exist or aspire to exist) (Goryńska-Goldmann et al. 2016, Wielicka et al 2016).

On the food market we may see a growing number of people interested in high-quality food products, which they can buy from well-known and reliable producers. They are interested in the methods of production and ensuring food safety, manufacturing and storage of products and analyze precisely nutritional value of food products and their impact on health.

The image and the role of a consumer has changed over time. From a passive recipients, they turned into active market subjects who are considered to be important participants, influencing the creation of values, *inter alia* through network approach. They actively participate in building those values. A consumer who has access to the Internet is not only interested in parameters and attributes of food products that he or she wants to buy. Such consumer wants to be sure that the products were manufactured in a right way and that they contain given ingredients (carbohydrates, water etc.). The sources of knowledge about food are labels, family, doctors, and dieticians. On a consumer's way to make a purchase,

he or she filters information concerning the origin of a products, rates its credibility, compares to other products and tests it, while devoting his or her own free time. Such behavior is a proof of the information needs of consumers (Gazdecki & Goryńska-Goldmann 2018). The product quality verification (at the producer level, and then at the retailer and distributor levels and even at the level of the final recipient) requires information, right qualifications, special machinery and innovative packaging.

When a consumer rates a product, more and more often looks at it not only in terms of personal advantages, but also in the context of the whole society. Because of that, the rating is a part of a behavioral strategy for the food manufacturing industry which can provide objective information about the advantages of a given product or service. Food producers should not only satisfy the information needs, but also the cultural, psychological (motivating consumers) needs and try to reflect some social norms and context in which the practices of sustainable consumption exist.

The meaning of a consumer in the strategies of enterprises was redefined and the main focus was placed on the building of relations, maintaining contacts (good and strong), integration and communication. The evolution of the consumer's role on the food market in connection with the implementation of the sustainable food consumption model will strongly impact the shape of the market and other markets of food products. Companies must face those challenges.

4 Local food products – an alternative way to achieve sustainable consumption

Constant development of agriculture and modern solutions influence searching for some alternative models of production and distribution of food products, keeping production more „environmentally friendly”. They also influence the use of natural connections and processes. It is caused by the demographic pressure and connections between the needs of manufacturing and the possibilities of the environment (Sadowski 2017). The manufacturing sector looks for such ways of market growth, so as to be able to offer products in compliance with the expectations and needs of consumers. Focusing on local food is an alternative approach to the way in which consumption of food can be turned into a more sustainable one.

In Europe we may see a dynamic growth of the food market value (including ecological, traditional and regional food), although customers motivation to choose such products varies from country to country (Bryła 2017). We may see an increase in the number of total sales of food products within local markets.

Natural food products in Europe have the potential to reach at least 10-15% of the total share in the food market, and even exceed that numbers in some countries (Krajewski & Świątkowska 2008). In Poland, local products' share in the market is low, about 1-3%, while in Austria it is about 10% and in Sicily even 60%. When we consider only ecological food we may notice that it varies from

0.3% of the market share in Poland to 7.6% in Denmark, 7.1% in Switzerland, 4.4% in Germany and 4% on average in the EU (BÖWL 2018, Nestorowicz & Pilarczyk 2018). On those markets we may notice an increase in the number of participants, both on the side of demand, as well as on the side of supply. That tendency which is strengthened by new business models and applied approaches makes companies engage in social issues Delpal & Hatchuel (2007), Gonzalez et al (2009), and shows that in many cases at least one out of two consumers is ready to pay more, in order to help protect the environment or the society. The results from the report „Cone Communications Employee Engagement Study” (2016) show that every second respondent does not want to work for companies that are not committed to socio-environmental issues.

From the market’s perspective (consumer), the need for high quality food will be increasing, especially in highly developed countries. Taking into account demographic processes, it is worth to mention that Europe has the biggest number of inhabitants over 65 years (in Poland it is over 6 million people) and that group should be taken into account when producing high quality food, along with some specific nutrition needs of those people and health issues. Such actions may help to bridge the existing gap.

5 Building experiences

As a result of technological and electronic development, we may see the creation of some personalized experiences for a single buyer. Modern business models use modern tools while looking for the way of internal creation of relations with the environment – and within it, mainly with customers (Gazdecki & Goryńska-Goldmann 2018, Klang et al 2010).

In the process of building experiences, entrepreneurs use new technologies. The use of advanced technologies in the food industry, apart from increasing the innovativeness, give the possibility to build a network of market relations and relations between participants, including small and big companies. It creates the new perspective for the market analysis (Gazdecki & Goryńska-Goldmann 2019, Wiśniewska-Paluszek 2018), while being a proof of actions taken by manufacturers that help to bridge the technology and social gap in relation to the most highly developed countries.

The possibility of cooperation between market participants from different levels of the food chain, apart from helping to organize processes, help to improve the flow of information about offered benefits (values) of products and services, for both the customer and the producer. Moreover, it helps to improve the competitiveness of companies. For example, during the conference “High resolution satellites – modern support for the agriculture in Poland” (2018) the participants highlighted the need to use in practice the images taken by satellites.

The intellectual potential of companies, strengthened by individuals and scientific institutions, helps to implement such solutions in the food market

(geographic information system) which bring advantages for the final recipient of food and other partners. More and more often food producers, in order to meet the information needs of their recipients, use multispectral imaging. That technology is used for the analysis of food and provides important information which help to determine the quality and safety of a given food product (on different levels of manufacturing, while processing them with the use of a fast and non-invasive method. Solutions used by companies from the food industry are created with the use of that technology and can help to decrease the amount of food waste, maximize the productivity and better meet the information needs of consumers, while offering products of good quality and the stability of declared values. Trade is revolutionized by *inter alia* RFID technology (radio-frequency identification), for example in warehousing management and logistics. The use of radio waves for the remote identification of objects helps to control products.

The development of innovativeness and modern technologies may help to further achieve economic development while limiting the bad influence on the environment. The manufacturing industry has to face some problems and tries to overcome barriers in promoting sustainable lifestyle and consumption, focusing its attention on the innovativeness of products, technological innovations, knowledge and awareness.

In further actions towards achieving sustainability we have to deepen the awareness of the need to protect the environment (on all levels of the marketing chain), and promote the knowledge about advantages coming from the sustainable environment. So far, the results from the research show that not many behaviors belong to the idea of sustainable consumption and consumers are still not willing to implement such model of consumption. For example they talk about their worries connected to the ecology but do not take any actions. (Young et al. 2010). We need to turn our plans into real actions.

6 Engagement

The exchange of information and sharing knowledge has a key meaning for the implementation of the sustainable food consumption idea. Engagement of consumers into creating values should be one of the key directions of operational actions taken by companies which are open to the sustainable food production and consumption. Because of the changing role of the consumer on the market in creating new food products, the entrepreneurs should be more willing to engage them in the production process. Food consumers are the most important participants in the process of the switch to more sustainable production and consumption. Their participation in the process, based on some open innovations, should not be limited to only testing a product at its end stage of manufacturing, but should start much earlier, at the stage when an idea emerges and people are looking for inspirations.

Companies that in their strategies redefine the place of consumers and turn to open innovations, will have more chances to create products or services that will

really come to the market. An interesting direction of development may be including consumers in the process of co-creation of food. Cooperation based on network approach will help to exchange experiences, information and knowledge.

Conclusion

On the way to achieve sustainable development (including sustainable production and consumption) significant is not only the economic development and the environment but also innovativeness which allows to implement the most effective use of resources, manufacturing of products and provide alternative services, regardless of the increasing level of consumption. It is the development of innovativeness and modern technologies that help to sustain economic development and limits the bad influence on the environment. When it comes to Poland and other economies of the EU, the priority was placed on innovations and the sustainable development. We expect that it will help to achieve the expected results.

The will to build positive experiences and engagement is a type of actions giving us the possibility to create relations and network connections within the food markets on which we may find very big companies, international corporations and smaller enterprises, focused on local markets. The possibility of cooperation between companies from different levels of the food chain (production, trade, processing), and start-ups, scientific units, centers of innovations and technology parks plays the key role in creating open innovations, providing value for consumers and producers and helping to provide sustainable products for the food market.

We have to be aware that the analysis of sustainable food production and consumption is still not well described and hard to measure, what makes it difficult to provide some precise conclusions. For the idea of building and strengthening sustainable food consumption, important is the knowledge and skills necessary to create some sustainable attitudes. It is necessary to further deepen the awareness about the socio-economic advantages, in order to further develop sustainable food production and consumption practices.

Cooperation and relations in longer perspective will allow market participants to acquire some natural skills, helping to develop practices and engaging those participants in sustainable food production and consumption, as well as supporting the creation of a sustainable society.

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About the author

Dr. Elzbieta Gorynska-Goldmann
Poznan University of Life Sciences
Faculty of Economic and Social Sciences
Department of Economics and Economics Policy in Agribusiness
Wojska Polskiego 28, 60-637 Poznan, Poland

QUANTIFICATION OF THE IMPACT OF DETERMINANTS

KVANTIFIKÁCIA VPLYVU DETERMINANTOV

Zuzana KUDLOVÁ

Abstract

A very common task of the analyst (analyst) is to explain why the analyzed indicator has changed - to explain its deviation. Substantive analysis - financial or economic - deserves only a procedure that results in an objective knowledge of the relevant factors that caused the deviation and quantification of their impact, which means knowledge of the direction and intensity of their action. In this paper, we prefer models with multiplicative constraints, because they have many advantages e.g. they make it possible to know the impact of extensive (quantitative) and intensive (qualitative) factors, which is very important in the analysis. Then we will use a suitable method to determine the direction and intensity of action of any factor. The allowable scope of the paper allows characterizing (even very briefly) only the methods applicable to multiplicative links.

Keywords: method of chain substitution, logarithmic method, functional method

Abstrakt

Najdôležitejšou úlohou analytika je vysvetliť, prečo sa analyzovaný ukazovateľ zmenil, o.i. vysvetliť jeho odchýlku. Vecná analýza v podobe finančnej alebo ekonomickej určuje postup, ktorý vedie k objektívnej znalosti relevantných faktorov, ktoré spôsobili odchýlku a kvantifikáciu ich vplyvu, čo znamená, znalosť smeru a intenzity ich konania. V tomto článku uprednostňujeme modely s multiplikatívnymi väzbami, pretože majú viacero výhod, napr. umožňujú poznať vplyv rozsiahlych (kvantitatívnych) a intenzívnych (kvalitatívnych) faktorov, čo je podstatou analýzy. Následne využitím vhodnej metódy na určenie smeru a intenzity pôsobenia ktoréhokoľvek faktora. Prípustný rozsah príspevku umožňuje charakterizovať iba metódy použiteľné na multiplikatívne väzby.

Kľúčové slová: metóda reťazového dosadzovania, logaritmická metóda, funkčná metóda

Introduction

The financial situation is a multifaceted, complex phenomenon, so it is possible to approach financial analysis in various ways. Effective and high-quality management of a company is possible only by its thorough knowledge, for which we use analysis as a tool of knowledge. Financial-economic analysis is currently an important tool of business management. Performing a financial-economic analysis on a regular basis, as well as predicting financial health for the future, allows identifying the strengths and weaknesses of the business. Based on the identified threats, the company can take recovery measures to reduce or eliminate its financial problems in the future.

1 Theoretical basis of multiplicative links

Several methods can be used to quantify the effect of multiplicative binding. The choice of which method depends on the indicators and their values.

Method of chain substitution

This method, which is most frequently used, is based on the principle of 'ceteris paribus', that is to say that only one factor changes, the others being unchanged. Graphically, the gradual change of factors can be represented as follows (Zalai, 2013):

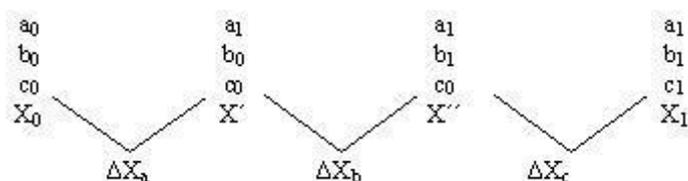


Figure 1 Gradual change of factors

Source: Zalai, 2013

The biggest advantage of the method is its simplicity. However, its use is complicated by the fact that:

- The accuracy of the results depends on the order of the agents. For three factors, six different results can be obtained. Only a general guideline can be given for ranking the factors - first, the factors should be extensive (quantitative) and then the factors intensive (qualitative).
- From the way of dividing the common part of the amendment implies that the influence of the first factor is underestimated and the second (others) overestimated.

Logarithmic method

The method is based on indexes of changes of individual factors. The logarithmic method eliminates the problem of "chain-substitution" related to the correct ranking of the agents and the underestimation of the first factor and the overestimation of the last factor.

The logarithmic method is very "grateful". The necessary logarithms are readily available with every better calculator. Dyadic and natural logarithms can also be used. However, the method also has some limitations. It cannot be used if we have negative numbers because they do not have logarithms. Such a figure (unfortunately quite frequent) is the loss. In this case we have to use another method. The big disadvantage is that it cannot be used if the index of change of one of the sub-indicators comes out negative, because the logarithm is not defined for negative numbers (Sedláček, 2007).

Functional method

This method works with discrete returns. It is consistent with the logarithmic method and the problem of negative indexes of indicators is eliminated. A disadvantage of the functional method is the allocation of weights in the allocation

of common factors, as it is difficult to find an economic justification for the approach chosen. As Dluhošová (2010, p. 35) claims: "This method takes into account the current (combined) the influence of all indicators in explaining the individual influences."

2 Analysis of total cost indicator

We analyze the change in annual labor costs in 2020 compared to 2019 and quantify the impact of factors: the number of workers, the number of hours worked per year (in hours) and the average hourly wage (in euros) of the worker. To quantify the impact we use:

- Method of chain substitution,
- Logarithmic method,
- Functional method.

We will apply the achieved results to the functional method.

Table 1 Input data

indicator	2019	2020
number of workers	139	143
hours worked	1 958	1 965
average hourly wage	2,9890	3,3330

Source: own sourcing

Then we use the methods of quantification of the impact of the determined indicators to proceed to the calculation.

Table 2 Calculation of indicators

Mark	Indicator	2019	2020	Change (Δ)	Index (I)	logarithm of the index (log I)
a	number of workers	139	143	4	1,028777	0,012321
b	hours worked	1 958	1 965	8	1,003831	0,001661
c	average hourly wage	2,9890	3,3330	0,344	1,115089	0,047310
X	annual labor costs	813 284	936 556	123 272	1,151573	0,061291

Source: own sourcing

To quantify the impact, we will use one of the methods used in the multiplicative link between sub-indicators, as the total cost is expressed as a cost-benefit ratio.

a) Solution by means of the chain substitution method

Quantification of the absolute impact of the factors:

$$x_a = \Delta a \cdot b_0 \cdot c_0 = 4 \cdot 1958 \cdot 2,989 = 23\,404$$

$$x_b = a_1 \cdot \Delta b \cdot c_0 = 143 \cdot 8 \cdot 2,989 = 3\,206$$

$$x_c = a_1 \cdot b_1 \cdot \Delta c = 143 \cdot 1965 \cdot 0,344 = 96\,662$$

$$\Delta x = \Delta x_a + \Delta x_b + \Delta x_c = 23\,404 + 3\,206 + 96\,662 = 123\,272$$

Quantification of relative influence of factors:

$$\Delta x_a \% = \frac{\Delta x_a}{\Delta x} \cdot [(I_x - 1) \cdot 100] = \frac{23\,404}{123\,272} \cdot [(1,151573 - 1) \cdot 100] = 2,878 \%$$

$$\Delta x_b \% = \frac{\Delta x_b}{\Delta x} \cdot [(I_x - 1) \cdot 100] = \frac{3\,206}{123\,272} \cdot [(1,151573 - 1) \cdot 100] = 0,394 \%$$

$$\Delta x_c \% = \frac{\Delta x_c}{\Delta x} \cdot [(I_x - 1) \cdot 100] = \frac{96\,662}{123\,272} \cdot [(1,151573 - 1) \cdot 100] = 11,885 \%$$

$$\Delta x^0 \% = \Delta x_a \% + \Delta x_b \% + \Delta x_c \% = 2,878 \% + 0,394 \% + 11,885 \% = 15,157 \%$$

b) Logarithmic solution

Quantification of the absolute impact of the factors:

$$\Delta x_a = \Delta x \cdot \frac{\log I_a}{\log I_x} = 123\,272 \cdot \frac{0,012321}{0,061291} = 24\,781$$

$$\Delta x_b = \Delta x \cdot \frac{\log I_b}{\log I_x} = 123\,272 \cdot \frac{0,001661}{0,061291} = 3\,341$$

$$\Delta x_c = \Delta x \cdot \frac{\log I_c}{\log I_x} = 123\,272 \cdot \frac{0,047310}{0,061291} = 95\,152$$

$$\Delta x = \Delta x_a + \Delta x_b + \Delta x_c = 24\,781 + 3\,341 + 95\,152 = 123\,274$$

Quantification of relative influence of factors:

$$\Delta x_a \% = \frac{\Delta x_a}{\Delta x} \cdot [(I_x - 1) \cdot 100] = \frac{24\,781}{123\,274} \cdot [(1,151573 - 1) \cdot 100] = 3,047 \%$$

$$\Delta x_b \% = \frac{\Delta x_b}{\Delta x} \cdot [(I_x - 1) \cdot 100] = \frac{3\,341}{123\,274} \cdot [(1,151573 - 1) \cdot 100] = 0,411 \%$$

$$\Delta x_c \% = \frac{\Delta x_c}{\Delta x} \cdot [(I_x - 1) \cdot 100] = \frac{95\,152}{123\,274} \cdot [(1,151573 - 1) \cdot 100] = 11,700 \%$$

$$\Delta x^0 \% = \Delta x_a \% + \Delta x_b \% + \Delta x_c \% = 3,047 \% + 0,411 \% + 11,700 \% = 15,157 \%$$

c) Functional solution

In the first step we quantify the so-called. Change coefficients (substitutes).

$$A = \frac{\Delta a}{a_0} = \frac{4}{139} = 0,0288$$

$$B = \frac{\Delta b}{b_0} = \frac{8}{1\,958} = 0,00383$$

$$C = \frac{\Delta c}{c_0} = \frac{0,344}{2,9890} = 0,11509$$

Subsequently, we calculate the substitutes into relations for calculating the effects of individual factors.

$$\Delta x_a = x_0 \cdot A \cdot \left(1 + \frac{B+C}{2} \cdot \frac{B \cdot C}{3}\right) = 813\,284 \cdot 0,0288 \cdot \left(1 + \frac{0,00383 + 0,11509}{2} \cdot \frac{0,00383 \cdot 0,11509}{3}\right) = 24\,801,5$$

$$\Delta x_b = x_0 \cdot B \cdot \left(1 + \frac{A+C}{2} \cdot \frac{A \cdot C}{3}\right) = 813\,284 \cdot 0,00383 \cdot \left(1 + \frac{0,0288 + 0,11509}{2} \cdot \frac{0,0288 \cdot 0,11509}{3}\right) = 3\,342,4$$

$$\Delta x_c = x_0 \cdot C \cdot \left(1 + \frac{A+B}{2} \cdot \frac{A \cdot B}{3}\right) = 813\,284 \cdot 0,11509 \cdot \left(1 + \frac{0,0288 + 0,00383}{2} \cdot \frac{0,0288 \cdot 0,00383}{3}\right) = 95\,130,5$$

$$\Delta x = \Delta x_a + \Delta x_b + \Delta x_c = 24\,801,5 + 3\,342,4 + 95\,130,5 = 123\,274$$

Quantification of relative influence of factors:

$$\Delta x_a \% = \frac{\Delta x_a}{\Delta x} \cdot [(I_x - 1) \cdot 100] = \frac{24\,801,5}{123\,274} \cdot [(1,151573 - 1) \cdot 100] = 3,049 \%$$

$$\Delta x_b \% = \frac{\Delta x_b}{\Delta x} \cdot [(I_x - 1) \cdot 100] = \frac{3\,342,4}{123\,274} \cdot [(1,151573 - 1) \cdot 100] = 0,411 \%$$

$$\Delta x_c \% = \frac{\Delta x_c}{\Delta x} \cdot [(I_x - 1) \cdot 100] = \frac{95\,130,5}{123\,274} \cdot [(1,151573 - 1) \cdot 100] = 11,697 \%$$

$$\Delta x \% = \Delta x_a \% + \Delta x_b \% + \Delta x_c \% = 3,049 \% + 0,411 \% + 11,697 \% = 15,157 \%$$

The number of workers affected the annual labor costs negatively. The indicator increased year-on-year from 139 (a_0) to 143 (a_1) workers, resulting in an increase in annual labor costs of EUR 24 801,5 (Δx_a), an increase of 3,049% (Δx_a %).

Likewise, the number of hours worked per worker negatively influenced the annual labor costs. The worker worked an average of 8 hours (Δb) more in 2020 than in 2019, which caused an increase in annual labor costs by EUR 3 342,4 (Δx_b), an increase in labor costs by 0,411% (Δx_b %).

Unlike the previous factors, the average hourly wage increased from EUR 2.9890 per hour (c_0) to EUR 3.3330 per hour (c_1), ie the average hourly wage increased by EUR 0,344 (Δc). This has had a negative impact on annual labor costs. As a result of the increase in hourly wages, annual wage costs increased by EUR 95 130,5 (Δx_c), an increase of 11,697% (Δx_c %).

Conclusion

When analyzing deviations (changes) of the influence of analytical indicators on the synthetic indicator, the intention is to monitor and determine the indicators so that they have the best explanatory power, so that we can determine the factors and factors in the best and detailed way, causes of change. Our business should not only be interested in traditional ex post and ex ante financial analysis, but should be interested in investment controlling to improve its financial stability, health, intelligence and prosperity.

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About the author

Ing. Zuzana Kudlová, PhD.

University of Economics in Bratislava

Faculty of Business Economy with seat in Košice

Department of Corporate Financial Management

Tajovského 13

041 30 Košice

tel. 055/722 3251

e-mail: zuzana.kudlova@euke.sk

ECONOMIC INCENTIVES IN PUBLIC HEALTH POLICY

EKONOMICKÉ STIMULY VO VEREJNEJ ZDRAVOTNEJ POLITIKE

Jana BELLOVÁ – Cecília OLEXOVÁ

Abstract

This article is aimed at the role of selected pricing interventions as a public policy. It analyses various economic incentives that all have in common one goal. Reduction of overweight and obesity in the population. First of all the connection between non-communicable diseases and eating and drinking habits is established, then various roles of the actors such as individuals, companies and the state or the government are looked at in connection with economic incentives as well as the legal environment in which they take place. Then the article analyses the efficiency of various selected incentives designed to change the eating and drinking habits of the population with the aim of lower health care costs as well as healthier hence happier population. Incentives in a form of a tax on selected items in any form has lots of supporters as well as lots of opponents. What is important to realize is not necessarily the primary impact on consumers but the impact on producers. They are the bearers of most of the costs connected with such an incentive but if we look closer, it is very important to realize that the way most of them handle the situation is by lowering the amount of the targeted item in the product in order to avoid the burden of the tax. Hence leading to healthier choice options for individuals.

Key words: incentives, fiscal policy, health care, tax

Introduction

The goal of this article is to establish whether the analysed incentives in the form of sugar taxes actually work. A sugar tax is looked at as one of the incentives to increase the quality of life of the country's population and evidence of the positive outcomes of the incentive is looked at where such an incentive has been implied. The implementation of such a tax into the legal system is looked at as well.

Incentives are very important in economics. The idea is that once well-defined and set into practice they help to reach the desired goal. The desired goal is usually connected with a change in behaviour of the individuals or population as a whole. There may be various reasons for such a wish, need or desire. These incentives could be in any imaginable form such as for example promotion of healthy life style and healthy body weight, handing out free products connected with healthy life style, promotion of regular exercise, providing free exercise facilities, financial compensations for various desired activities or taxation of products considered as unhealthy or in this case considered in connection with overweight, obesity and also related illnesses. Incentives of any form are very important but so is the legal environment in which they are put to work. If not designed and analysed properly, including the legal system in which they are to be put into actions, unfortunately they tend to backfire and even lead to worsening of the original situation.

As stated earlier, incentives are very important as they can change a human's behaviour. An incentive towards several changes such as a change in people's diet (lower intake of sugar), in people's physical activity (promotion of physical activity) as well as a change in the products (containing less sugar than before the introduction of the incentive) but all leading to the desired outcome that is in this case a lower level in overweight and obesity among the population, lower rate of obesity and overweight related illnesses hence healthier general population with a better quality of life and lower health care costs in the form of money saved that can be used alternatively.

One of such incentives is for example a so-called sugar tax. It is a sort of recent phenomenon and can be looked at and discussed from many various points of view. Should such a tax exist in a country's legal system, what is the most efficient way to implement it, what should the efficient tax rate be, what should be included into the taxed products (e.g. only beverages or all high sugar containing products etc.).

The countries selected for analysis are the United Kingdom, Mexico, Hungary and Australia. The United Kingdom was chosen because the sugar tax is rather a recent phenomenon there, Mexico was chosen because it is a country where obesity levels were very high due to consumption of sugary drinks and the government successfully dealt with the situation by establishing a sugar tax. Hungary was chosen due to its successful junk food tax and Australia was chosen as an example of a country thinking about a sugar tax. The Czech and Slovak republic were chosen as countries without the intention of such an incentive though having problems with increase in obesity levels.

1 Background interconnections

The WHO (The World Health Organization) has recently stated that worldwide obesity has nearly tripled since 1975 followed by the fact that in 2016, more than 1.9 billion adults, 18 years and older, were overweight. Of these over 650 million were obese. In 2016 39% of adults were overweight out of which 13% were obese. Most of the world's population live in countries where overweight and obesity kills more people than those who are underweight. In 2016 over 41 million children under the age of 5 were overweight or obese and over 340 million children and adolescents aged 5-19 were overweight or obese in 2016 (Thow *et al.*, 2017).

In 2016 the WHO recommended the implication of an effective tax on sugar-sweetened beverages as one of several key measures to address childhood obesity. This reflects the conclusions of a WHO Technical Meeting in 2015 that focused on fiscal policies for improving diets and preventing non-communicable diseases. The economic and social costs of non-communicable diseases include not just the direct costs of the relevant health care but also many indirect costs e.g. those associated with higher job absenteeism (Thow *et al.*, 2017).

The popularity of soda taxes⁵ in the last few years has grown rapidly. The popularity of this upstream public health policy designed to reduce the consumption of sugar is exceptional. The first ex-post evaluations suggest soda taxes work in reducing purchases of taxed products. The implementation of a soda tax is generally preceded and accompanied by significant debates in the media between specialists and advocates from both the public and food industry. The former generally focuses on the negative health effects of over consuming sugar or sodas and its associations with obesity and disease, calling for measures such as the tax and suggesting that the revenues, if earmarked for health, nutrition or education can yield even greater benefits. The pro-industry coverage emphasizes the importance of consumer choice, individual responsibility and exercise, disassociates the products from negative health outcomes and generally refers to the tax as a regressive measure with negative consequences on the poor, jobs and the economy. The question therefor arises of whether the price increase that the tax eventually causes is the main driver for behaviour change or the framing of the tax as a health or economy related measure including in the media has a significant role (Thow *et al.*, 2017).

A recent study analysing changes in the sales from a voluntary levy on sugary drinks implemented in a chain of 37 restaurants in the UK, found a large reduction in sales (9,3%) relative to a modest increase in price (about 3,5%). However the levy was supported with different activities, including redesigned beverage menu with the text explaining why the levy was introduced, new products on the drinks menu as well as numerous articles in the press and a documentary screened on a national TV channel, so it is likely that these other activities also influence consumer behaviour (Cornelsen *et al.*, 2017).

A further, related issue that may determine the effectiveness of the tax is whether, once introduced, the tax is signalled to the consumer on the price tag, shelf price or on the receipt as a reminder of the tax. This issue has not been extensively studied in the context of soda taxes, but it relates back to the design of the taxes and at which stage of the supply chain the tax is applied. If taxes included are more salient and consumer response stronger when tax is posted in the price there are important implications to revenue collection from the tax. Simply put, if the aim is to raise revenue, the tax should not be posted and if the aim is to reduce consumption, the tax should be posted as well as signalled to the consumer. Contrary to cigarette taxes, the ability of a soda tax to raise revenue is already more limited because of the own-price elasticity is greater for sodas (Andreyeva *et al.*, 2010).

Whether or not one is in favour of a sugar tax one fact needs to be stated regardless. As will be shown in the cases of selected countries the implementation

⁵ Incentives in the form of a tax can be rather various. In this article I mention soda tax, junk food tax, sugar tax or sugary drink tax. Junk food tax is a tax that is rather specific and has been applied in Hungary. The rest of the taxes depend on the county of origin. In connection with the UK the term sugar tax is used, while in connection with the USA and the rest of English speaking countries such as Australia or New Zealand the terms soda tax or sugary drink tax is usually used.

of tax on SBBs (sugar-sweetened beverages) not only works at an individual level where people actually tend to consume less due to the higher price, it also makes the producers lower the amount of sugar in the drink in order to avoid the tax. From this point of view the sugar tax is a very good solution, especially in the short term.

In an ideal situation there should be no need for such a tax because the population would be fully informed about the risks connected with being overweight in connection with SBBs and sugar intake generally and either would put pressure on the producers to lower the sugar levels in the drinks simply by choice or would abandon such products all together.

One of the main counterarguments to implementing soda taxes is its regressive nature as low-income households tend to consume more of these beverages. Because of low incomes it is likely, however, that low-income consumers are also more responsive to changes in prices so presumably they would also reduce consumption relatively more but whether that carries through to proportionally higher health benefits is yet to be demonstrated (Cornelsen – Smith, 2018).

To understand the health effects, it is crucial to understand if soda taxes have a broader effect on purchase decisions beyond the taxed products. Are there substitutions, complementarity or budget effects towards untaxed beverages, other sugary products and healthier foods such as fruit or vegetables? Some recent proposed taxes fundamentally differ. For example in the UK the sugar tax levy has tax rates set at different levels depending on the sugar content in the beverages and the objective is not to reduce soda purchases but to reduce the consumption of sugar through giving companies incentives to remove added sugar, promote diet drinks and reduce portion sizes for high sugar drinks as drinks containing less sugar are taxed at a lower rate or not at all. In evaluating the possible economic impact of such multi-tiered taxes and those targeted at producers not consumers, we need to consider several scenarios that account for product reformulation and replacement, price increases of taxed products and untaxed alternatives as well as the wider redistributive effects on the economy (Cornelsen – Smith, 2018).

2 Various approaches in selected countries

The United Kingdom

The UK sugar tax that is a tax on sugar sweetened beverages was proposed by the UK Government in 2016. There is so called high tax for drinks with over 8g of sugar per 100ml, then moderate tax for drinks with 5-8 g of sugar per 100ml and no tax for drinks with less than 5g of sugar per 100ml. Briggs estimates the effect of possible industry responses to the levy on obesity, diabetes and dental caries. Three possible industry responses were formed that is to reduce sugar concentration, an increase in product price and a change of the market share of high-sugar, mid-sugar and low-sugar drinks (Briggs *et al.*, 2017).

A comparative risk assessment model to estimate the UK health impact of each scenario on prevalence of obesity and incidence of dental caries and type 2 diabetes was established. The findings show that the best modelled scenario for health is SSB reformulation, resulting in a reduction of 144,383 out of 15,470,813 adults and children with obesity in the UK, 19,094 fewer incident cases of type 2 diabetes per year, and 269,375 fewer decayed, missing or filled teeth annually. The interpretation of the results being that the health impact of the soft drinks levy is dependent on its implementation by the industry. Uncertainty exists as to how the industry will react and about the estimation of health outcomes. Health gains could be maximized by substantial product reformulation with additional benefits possible if the levy is passed on to purchases through rising of the price of high-sugar and mid-sugar drinks and activities to increase the market share of low-sugar products (Briggs *et al.*, 2017).

Mexico

Several systematic reviews and meta-analysis have shown positive associations between the consumption of SSB and weight gain, diabetes, and other chronic diseases. As a consequence, the WHO recommended limiting the amount of added sugars to $\leq 10\%$ of total energy intake. In Mexico, added sugars represent 12.5 % of total energy intake, which is above the recommendation. SSBs represent 70% of the total added sugars in their diet. Taxes have been proposed as a policy to discourage SSB consumption through increases in prices (Colchero *et al.*, 2017).

In January 2014, Mexico implemented a tax on sugar-sweetened beverage purchases of 1 peso per litre to all SSBs with added sugars. The tax excludes 100% fruit juices and all beverages with added artificial sweeteners. Several evaluations have shown reductions in the purchases of sales of SSBs after the tax was implemented as well as increases in untaxed beverages or bottled water. Two studies revealed that reductions in the purchases of SSBs were larger among lower socioeconomic groups. Analysing how beverage purchases changed over time in households with children and adolescents is also highly important because the consumption of added sugars and caloric beverages in these age groups is high and has been increasing. Results show a 6.3% reduction in observed purchases of SSBs in 2014 compared with expected purchases based on trends from 2008 to 2012. It was also found that a 2% reduction in the probability of purchasing SSBs during the post-tax period (Colchero *et al.*, 2017).

Hungary

Hungary is quite specific as it does not have a sugar tax or soda tax that was implemented but a so-called junk food tax that was introduced in 2011 as a unique approach to improve population health. The policy is unique in terms of the range of food covered by the tax, the rate of the tax and the explicit aim of health improvement.

Focusing on broad categories of food can reveal if the junk food tax leads to substantial changes in dietary patterns. If the taxed items are substituted with untaxed but also unhealthy products, then the tax does not achieve its final aim. There is no clear evidence of the efficiency of the Hungarian junk food tax. On the one hand an analysis by the National Institute for Health Development claims that the tax has achieved its aims as the consumption of unhealthy products affected by the tax has declined (Biro, 2015).

According to that the turnover of the taxable goods decreased by 27%, whereas their average prices increased by 29%. At the same time 40% of the affected manufactures modified their production formula so as to avoid the tax payment. On the other hand, the main argument of the producers against the junk food tax is that it does not necessarily lead to a reduction of the consumption of salt and sugar as for example homemade snacks are exempt from the tax (Biro, 2015).

The results indicate that the junk food tax became more efficient after January 2012. The difference between the changes in consumption of processed and unprocessed food is negative after January 2012. The reason behind the negative difference is either a stronger growth in the expenditures on unprocessed items or a decline in the consumption of the processed items although the latter is statistically insignificant. These results reinforce that there was a shift towards the consumption of unprocessed food after 2011 which became stronger after January 2012. Part of these effects could be due to the junk food tax. To sum up some evidence was found that supports the idea that the junk food tax improved the dietary habits of the population in Hungary and the effects of the tax became stronger after January 2012 when the tax rates were increased and the range of taxable items was extended (Biro, 2015).

Australia

Globally, the prevalence of obesity in adults has increased from 3.2% to 10.8% in men and from 6.4% to 14.9% in women over the period from 1975 to 2014. The combined number of individuals being overweight, or obesity has more than doubled over the last 20 years. Being overweight or obese increases the risk of many chronic diseases such as type 2 diabetes, stroke, ischemic heart disease, hypertensive heart disease, osteoarthritis and cancers of the breasts, colon, endometrium and kidney. Being overweight or obese can also increase mortality from various diseases. Several leading public health authorities suggest implementing health policies that influence the individual consumer's choices to help reduce overweight and obesity at the population-level (Nomaguchi *et al.*, 2017).

Unhealthy diets and high body mass index are the risk factors that contribute most to the burden of disease in Australia. The carried-out analysis suggests that a 20% additional tax on SSBs would result in modest reductions in BMI and the proportion of Australians that are obese (Veerman *et al.*, 2016).

Nevertheless, Australians of low socio-economic status are disproportionately affected by high rates of diet-related illnesses and are therefore likely to experience greater dietary improvements as a result of a tax on SSBs. While a tax on SSBs is not currently on the political agenda in Australia, drawing on the evidence and international experience, a tax on SSBs should be considered as part of Australia's tax reform agenda (Sharma *et al.*, 2014).

A recent study shows that an additional 20% tax on SSBs not only improves health outcomes and reduces healthcare costs, but provides productivity gains in both the paid and unpaid sectors of the economy (Sharma *et al.*, 2014).

3 Current situation in the Czech and Slovak republic

The Czech Republic

Based on a recent study (Martinek, 2019) carried out at Palacky University Olomouc whose results were presented by the Czech Minister of Health Care Adam Vojtěch (ANO). The results show that fifteen percent of children and teenagers are overweight and six percent are obese out of which it is more often boys than girls who suffer. Socioeconomic factors play a significant role with children from poor families suffering with obesity three times more often while for children from well situated families it is only three percent. The important factor here is apparently consumption of water which is key in a healthy life style bearing in mind that in poor families it is rarely consumed. This could bring us back to the problem of tax on sugary drinks. The question would such a tax in the Czech Republic lead to a decrease in their consumption especially in poorer families? Based on the results of the above mentioned study the overweight and obesity in children is linked with socioeconomic status where wealthier regions have lower numbers while the poorer ones have higher numbers of overweight and obese people. Regardless of the results the minister did not suggest any approach other than highlighting the importance of movement activities in education.

Based on an article (<https://www.zdravotnickytydenik.cz/2017/01/zvlastni-zdaneni-sladkych-napoju-v-cesku-zatim-nehrozi-ministerstvo-i-politici-radeji-voi-cestu-edukace/>) from 2017 the government is not going to tax high sugar drinks but prefers education. In 2019 the situation is the same. The head of the parliament health care committee Rostislav Vyzula (ANO) commented on the possible sugar tax approach in the Czech republic but apart from the statement that consumption of sugary drinks is linked to obesity and people being overweight his comments were rather of a wait and see nature saying that it would need a complex approach and a discussion as well as the need to see if the results of this approach in other countries such as the UK or Hungary. Other politicians that were approached were even less pro such a step. Vít Kaňkovský (KDU-ČSL) says that though no doubt the overconsumption of sugar is a hot topic he does not view that the effect of a sugar tax would be effective. He believes it would be like

in the case of tobacco or cigarettes and would only have a temporary effect. Bohuslav Svoboda (ODS) was not for a sugar tax either though he originally wanted to put the energy drinks to the same level as alcohol and cigarettes meaning that people under 18 would not be permitted to purchase them. It was not about sugar but about caffeine then but he took the proposal back a few months later but it does not seem that he would be interested in anything similar concerning the sugar tax. As he states it is necessary to bear in mind that the problem of taxing sugary drinks has several levels. It is important to know beforehand the effect of such a step not only on the consumption of the drinks but on the health state of the population. But it is a complication for the tax system. Regardless he says he is sure that the time for such steps in the Czech Republic have not yet come. Mark Benda (ODS) presents his views based on personal freedom and liberty so as he says there is no way he would ever consider suggesting such a step. Jiří Běhounek (ČSSD) is also against such a step when he says that he is not a fan of the simple copying of examples from abroad and also prefers a united concept based on education. The Ministry of health care is not preparing such a step at the time being. It states that it prefers the path of education aiming at children and teenagers as stated by the spokesperson of the Ministry of Health care Štěpánka Čechová.

As presented above the possibility of the implementation of a sugar tax in the Czech Republic are currently remote. Political parties nor any of their individual representatives seem to be interested in such steps. The question of which party would ever be interested in it are rather hypothetical and in the current political climate rather vague.

The Slovak Republic

Slovakia like many other countries is also facing a growing obesity epidemic. Decision-makers are driven to come up with solutions to the issue of rising obesity rate. In Slovakia, the obesity rate has doubled in the last 35 years. Even so there seems little support for introducing a sugar tax at this time. Though due to the Inštitút finančnej politiky (IFP) introduction of tax on sugar sweetened beverages could be a solution though the Ministry of Finance is currently not working on any such a tool ([https://www.etrend.sk/ekonomika/statni-analytici - navrhuj-novu-dan-z-cukru.html](https://www.etrend.sk/ekonomika/statni-analytici-navrhuj-novu-dan-z-cukru.html)). It is also important to look at the trends in the consumption of sugary drinks and sugar in general in Slovakia (Iness, 2019). According to research carried out by INESS (The Institute of Economic and Social Studies) there have been wild fluctuations in the consumption of sugar with the statistics supplied by the FAO (the Food and Agriculture Organisation) which they suggest leads to such data being compromised. For instance in 2001 sugar consumption in Slovakia went down by over 15% followed by a small increase in 2002 this was followed in 2004 and 2005 by increases of over 10% these swings are common in the statistics supplied by the FAO from 1992-2017. This perhaps also indicates that further research in this area is required to ensure that a better

way of recording and monitoring the sugar intake of the Slovak public is introduced. Without reliable statistics it is impossible for any government or political party to make informed policies to fight the obesity epidemic and the related healthcare costs.

In Slovakia the consumption of sweetened drinks was increasing until 2010 and from this time there has been a gentle decline in their consumption. From a peak of just under 150 litres per capita the consumption of sweetened drinks remained quite stable between the period 2012-2015 at just over 110 litres per capita. In 2016 there was a slight dip which took the consumption down to 100 litres of sweetened drinks per capita and this dip was reversed in 2017. Interestingly the decrease in the consumption of sweetened drinks runs parallel with the increase in the consumption of non-sweetened drinks this is especially true of the period 2010-17. Between this periods the consumption of non-sweetened drinks increased by 25 litres per capita and in 2017 it stood at 75 litres per capita.

But organisations like INESS still argue that the benefits of introducing a sugar tax are far from certain and at best are likely to have little impact on the overall obesity situation. They argue there are many complex factors involved and a package of measures are needed to fight the current crisis. Such a package might include allowing health insurance companies to offer financial motivation to policy holders who are taking part in activities which will maintain or improve their health and the education of children at school.

It could be concluded that neither the Czech nor the Slovak Republic are likely to introduce a tax on sugar sweetened beverages and though there might be little debates in the analytical circles any such. It should also be pointed out that taxation subjected entities would, therefor, not be interested in just what taxes and what amounts they are paying, but at the same time for what purposes the tax revenues are used, that is whether the tasks (including the performance of the tasks of the social, educational, cultural nature) of the State and whether their performance is productive, whether it is directed to the development, expansion, and promotion of production, thus to the development of the national economy – good motives do not guarantee good economy (Červená – Vartašová, 2018).

Conclusion

The use of taxes a form of an incentive or intervention is currently rather common round the world. On the other hand, the research about their outcome or desired outcome is quite scarce. Their use and implementation into fiscal policy or health care policy to be more precise has surely its benefits but also its drawbacks. The fact that the research of their direct impact is minimal is one of them. There is no doubt a vast need of the economics discipline assess the impact of these taxes that have already been implemented as well as predict an outcome of any new ones.

It is also necessary to look closer at the substitution effects, using alternative approaches to demand analysis. It may be the case that the aggregation of products may mask important patterns. Hence in order to understand the mechanism of change in current, implemented taxes and the role of framing the taxes through media debates and its effects in combinations with price and changes should be analysed.

Incentives in a form of a tax on selected items in any form has lots of supporters as well as lots of opponents. Arguments such as limitation of personal freedom and personal choice, the impact on low-income families and the role of government and so on are the most often used ones. What is important to realize though is not necessarily the primary impact on the consumers but also the impact on the producers. They are the bearers of most of the costs connected with such an incentive but if we look closer, it is very important to realize that the way most of them handle the situation, though obviously complaining, is lowering the amount of the targeted item in the product in order to avoid the burden of the tax. Hence leading to healthier choice options for individuals. And that is no doubt an advantage.

We strongly believe that public health is and should be our concern as well as the idea that there are some people unable to make the best decisions concerning themselves as well as their loved ones – either due to the lack of information or other reasons. And the government should step in. Of course, ideally first by providing information and educating people in order to make healthier choices but if needed for the short-term quick results, any form of a sugar tax is in my opinion an unequivocal step in the right direction.

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About the authors

Ing. Jana Bellová, Ph.D.
Department of Politics and Social Science
Faculty of Law
Palacky University in Olomouc
17.listopadu 8, 771 11 Olomouc, Czech republic
Email: jana.bellova@upol.cz

Ing. Cecília Olexová, PhD.
Department of Management
Faculty of Business Economics with seat in Košice
University of Economics in Bratislava
Tajovského 13, 041 30 Košice
Email: cecilia.olexova@euke.sk

THE USE OF STATISTICAL METHODS IN THE RETAIL SECTOR REVENUES ANALYSIS

POUŽITIE ŠTATISTICKÝCH METÓD PRI ANALÝZE TRŽIEB MALOOBCHODU

Katarína PETROVČIKOVÁ – Vanda LIESKOVSKÁ – Juraj DEMKO

Abstract

The following paper aims the attention toward using the statistical methods in the analysis of the retail trade revenues. The context in which we look at the revenues is macroeconomic. Retailing as a sector that plays an important role in the state employment, contribution to GDP as well as for the stability in the whole economy. Development of different retailing forms has led to the increase of the selling area, selling area per inhabitants in EU and in the revenues of the whole sector. The paper shows in more details the regression analysis of the retail sector in Slovak republic taking into account GDP, purchase power and the number of people employed in the sector.

Key words: retail, regression analysis, retail revenues

Abstrakt

Predkladaný článok upriamuje pozornosť na použitie štatistických nástrojov na analýzu tržieb maloobchodu. Uhol pohľadu, ktorý je v článku použitý je makroekonomický. Maloobchod ako sektor hrá dôležitú úlohu v zamestnanosti štátu, podiele na tvorbe HDP a tiež na stabilitu celej ekonomiky. Rozvoj rozdielnych maloobchodných foriem viedol k rastu predajnej plochy, ako aj predajnej plochy na obyvateľa v rámci EÚ a tiež k rastu tržieb v celom sektore. Predkladaný článok približuje detailnejšie použitie regresnej analýzy pri analýze maloobchodu v Slovenskej republike berúc v úvahu HDP, kúpnu silu a počet ľudí zamestnaných v maloobchode.

Kľúčové slová: maloobchod, regresná analýza, tržby maloobchodu

Introduction

The elementary part of the trade and the most important distribution channel is retailing. Retail trade covers all the activities connected with the sale of products and services directly to the final consumers for their personal usage. The increased standard of living and the higher consumption has led during the historical development to the building of the store units that are made by buildings, warehouses, selling area, stuff, communication, and information technologies. (Kita et al., 2016).

The retail and the wholesale sector play an important role in human activities. There is more than 1 billion of retail connections between producers and more than 500 million consumers in the whole Europe. Retail as well as the wholesale sector are both dynamic, labour intensive and the major industry of the European economy. Together it creates 11% of EU GDP. On out of three European companies works in retailing or wholesale. More than 99% of those six million companies in retailing and wholesale are the companies that belong to the small

and medium size enterprises. This sector also one of the major ones that create job positions (33 million of Europeans work in retailing or wholesale). Those are the sectors with continuous job creation in the whole Europe area. In the last 10 years around two million of jobs have been created in retailing and wholesale. Further, retail as well as wholesale sector support the jobs places of dependent subjects in the whole supplier chain from local suppliers to international companies. Retail companies offer 7 – 12% of jobs in the national economies of European countries. The higher number of jobs are in the most developed European countries. Retail takes places in various different locations: from small stores to supermarkets or large shopping malls, through direct or remote sale; through mail order or nowadays more often through the Internet. (Eurocommerce, 2020)

GDP is the standard expression of the added value created by the production of the products and services in the country during the specific period. It also measures the income gained from this production or the final amount used for the final products and services (except for import). It is used as the main indicator of the country' production capacity.

When we look at GDP from the point of view of the production sectors; this can be divided into ten separate activities (defined by NACE Rev. 2) according to their contribution to the added valued in nominal prices. NACE consists of the hierarchal structure (according to EC rule No. 1893/2006). The NACE structure is as follows:

- the first level consists of the items named by the alphabet code (sections),
- the second level consists of the items with two digits numeric code (divisions),
- the third level consists of the items with three digits numeric code (groups),
- the fourth level consists of the items with the four digits numeric code (classes). (Eurostat, 2019).

Since retail represents the large part on the distribution trade (section GI) and because distribution trade represents the high ratio at GDP, retailing is often used as the main indicator of GDP development together with the industrial production and construction. (Benazić, 2013)

If the retail revenues are high every month, it is probable that the GDP development will be positive. It doesn't has to be so if the prices rise due to inflation. (Amadeo, 2020).

Methodology

To analyse the retail sector in terms of the revenues, the area of sale in accordance with GDP the data from Eurostat and the Statistical bureau of Slovakia was used. The initial data gained from these resources need to be sorted and evaluated. The first choice is to analyse the data using the graphic tools (graphs,

tables, maps, etc.). Then we used the comparison method and regression analysis as the statistical method to analyse the data. The trend could be diagnosed using the index indicators. Index indicators show the index for a certain period of time (for instance the year 2015 = 100). That means if the index is higher than 100 the measured parameter has higher values than in the year 2015 and vice versa. The trends could be analysed using the comparison method. The regression analysis is used to identify the influence of macroeconomic parameters on the retail revenues. The simplest ways to calculate the regression is by using Excel.

The outcome of the regression and the correlation analysis is comprised of three different parts: the first one is the output of the correlation analysis, the second is ANOVA outcome where the appropriateness of the selected model is tested and the last the third part represents the results of the regression analysis.

We were trying to identify whether there is the correlation between two selected variables. Dependent variable Y (explainable) and nondependent variable X (explanatory).

The first part of the Regression Statistics outcome are the results related to the correlation analysis. The value Multiple R is the correlation coefficient. This value the closer it gets to 1 the stronger dependence it is. The value of R Square is the value of the determination coefficient. This value after recalculating with 100 informs us about the probability how many % is selected regression axis able to explain the variability of the revenues, the rest is associated with unexplained variability. Adjusted R – square (adjusted correlation coefficient) takes into consideration also the number of estimated parameters and the number of measurements. Standard Error should be as little as possible. Pole observation explains the number of measurements.

In the second part ANOVA we test the null hypotheses that states that the model we have chosen to explain the dependence (in our case the linear regression axe) is not appropriate (the alternative hypotheses claims the opposite). To come to the solution to this the F test can be used. If the value of Significance F < α (the importance level) H_0 is rejected and it means that the model was used appropriately.

The last outcome represents the regression analysis. Linear regression function has the shape of the axe $y_j = \beta_0 + \beta_1 x_j$. The value β_0 says that if the explanatory variable (x) equals 0, the explanatory variable (y) will equal β_0 . The value β_1 says that if the variable x changes in one unit the variable y increases exactly as the coefficient β_1 . The null hypotheses used in this analysis are tested according to the importance of the intercept constant (β_0) and the regression coefficient (β_1) while the null hypothesis claims no importance of the related coefficient and the alternative hypothesis its importance. To be able to evaluate the results, the P – values are being used. If the P – value for the intercept constant is lower than the level of importance (α) it means that the value of this coefficient is statistically important and vice versa.

In the next part we will introduce as the example the regression analysis of Slovak republic related to its GDP, purchase power of the inhabitants and the number of people working in the retailing.

Regression analysis Slovak republic

As an example, for the regression analysis we will use Slovak republic. As mentioned before, the retail sector is very important in terms of employment and the contribution to the GDP. So, we looked at the variable like the revenues in retail sector and compared it with the GDP, purchase power and the employment in the retail sector.

In two calculations we got the correlation coefficient higher than 0,8 which implies the linear dependence. In the third case the correlation coefficient equals 0,557 that implies just the weak dependence.

In case of Slovak republic, we came to these conclusions:

- the value of GDP explains the variability of the retail revenues for almost 76% and 26% of the retail revenues might be explained by different factors,
- the purchase power of Slovak inhabitants explains the variability of the retail revenues for almost 73% and 27% of the retail revenues variability might be explained by different factors,
- the number of people employed explains the variability of the retail revenues for almost 56% and the variability of the retail revenues might be explained 44% by other factors.
- the linear regression model was applied correctly in all the characteristics despite the influence of the employment to revenues.

Table 1 Regression analysis for Slovak republic

Variables	Correlation coeff.	Determination coeff.	Significance F	Coefficient	P-value	Down boundary	Up boundary
Revenues retail	0,861	0,741	0,001	-8821,795	0,150	-21603,631	3960,041
GDP				0,346	0,001	0,179	0,513
Revenues retail	0,854	0,730	0,002	-11116,197	0,111	-25416,631	3184,237
Purchase power				1,900	0,002	0,957	2,844
Revenues retail	0,557	0,310	0,095	-26355,116	0,289	-79856,175	27145,942
Employement				18,283	0,095	-3,962	40,529

Source: own processing

Table 2 Interpretation of the regression analysis for Slovak republic

Parameters	Equations	Interpretation
Revenues in the retail sector and GDP	$y = -8821,795 + 0,346 * \text{HDP}$	Increase of GDP in 1 mil € will lead to the increase retail revenues by 0,346 mill. €
Revenues in the retail sector and the purchase power	$y = -11116,197 + 1,900 * \text{purchase power}$	Increase of the purchase power of the inhabitants by 1€ will lead to the increase of retail revenues by 1.900 mill. €
Revenues in the retail sector and the employment	$y = -26355,116 + 18,283 * \text{number of employed}$	Increase of the employment by 1000 will lead to the increase of the revenues by 18,283mill. €

Source: own processing

As we see the results indicate that the increase in GDP is reflected in the increase of retail revenues based on the period 2009 – 2018. We can also see that the increased purchase power and the number of people employed in retailing is connected with the increase in retail revenues.

Conclusion

The presented paper pointed its attention toward the retail sector as the main indicator of the economic development due to its important role in GDP and thus in the whole economy. We have explained this by showing how much of GDP is made by retail and wholesale sector. Later we showed how to use different statistical methods (regression analysis in this case) to analyse the relations between the increase in GDP and retail revenues, purchase power of inhabitants and retail revenues and at the end the number of employed people in the sector to the revenues.

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Address of authors:

Ing. Katarína Petrovčíková, PhD.
University of Economics in Bratislava
Faculty of Business Economy with seat in Košice
Department of Commercial Entrepreneurship
Tajovského 13, 041 30 Košice
e-mail: katarina.petrovcikova@euke.sk

prof. Ing. Vanda Lieskovská, PhD.
University of Economics in Bratislava
Faculty of Business Economy with seat in Košice
Department of Commercial Entrepreneurship
Tajovského 13, 041 30 Košice

Bc. Juraj Demko
University of Economics in Bratislava
Faculty of Business Economy with seat in Košice
e-mail: juraj.demko@student.euke.sk

ENTREPRENEURIAL ORIENTATION OF YOUNG POLES GENERATION – COMPARATIVE STUDY IN THE STUDENTS ENVIRONMENT

PODNIKATEĽSKÁ ORIENTÁCIA MLADEJ POĽSKEJ GENERÁCIE- POROVNÁVACIA ŠTÚDIA V ŠTUDENTSKOM PROSTREDÍ

Andrzej SZROMNIK – Krzysztof REJMAN – Elzbieta WOLANIN-JAROSZ

Abstract

The Authors` subject of interest is academic entrepreneurship, in particular, the entrepreneurial intentions of students from selected universities, situated in the South-East Poland and their main determinants. The purpose of this research is to identify attitudes of students from Cracow, Rzeszów and Jarosław towards the issue of running their own businesses after graduation. In order to implement the research project aim, an appropriate research instrument - a questionnaire – has been prepared. Except the diagnosis of future students` intentions in terms of university types, a field of study and university location (sizes of cities where they are) on the labour market, the Authors, based on the results of the surveys, have developed a logit model, which verifies the most important determinants of the level of entrepreneurial orientation of Polish students and their significance of the impact of individual factors.

Key words: business, students, Poland, labor market

Abstrakt

Predmetom záujmu autorov je akademické podnikanie, najmä podnikateľské zámery študentov z vybraných univerzít z juhovýchodného Poľska a ich hlavných determinantov. Účelom tohto výskumu je identifikovať postoje študentov z Krakova, Rzeszowa a Jarosława k otázke vedenia ich vlastných podnikov po ukončení štúdia. Na realizáciu cieľa výskumného projektu sa pripravil vhodný výskumný nástroj - dotazník. Okrem diagnostiky zámerov budúcich študentov z hľadiska typov univerzít, študijného odboru a umiestnenia univerzity (veľkosti miest, kde sa nachádzajú) na trhu práce, autori na základe výsledkov prieskumov vyvinuli logitový model, ktorý overuje najdôležitejšie determinanty úrovne podnikateľskej orientácie poľských študentov a ich význam vplyvu jednotlivých faktorov.

Kľúčové slová: podnikanie, študenti, Poľsko, trh práce

Introduction

Entrepreneurship, enterprise and entrepreneur are the economic categories that have received a lot of attention for many years. It expressed in numerous theoretical studies, research programmes or analytical - comparative projects. In already extensive scientific literature in this field, thus one can find numerous proposals for co-financing the listed categories, developing their theoretical foundations on the basis of not only economics, but also management, sociology

and psychology, but also proposals for their classification from various points of view and based on various criteria units. Cf. (Rachwał, 2019).

Including the multitude of published and widespread definitions of “entrepreneurship”, no attempt has been made to introduce another own definition for the purpose of this study. The approach cited in the management literature, authored by P. F. Drucker, was adopted and accepted. According to the above mentioned approach, entrepreneurship is a way focused on achieving success. Drucker directly claims that “anyone who can face decision making, can learn how to be a good entrepreneur and behave in an entrepreneurial way”(Drucker, 2004). By saying this, this leading representative of management science opposes these psychologists' views about the essence of entrepreneurship, according to which it is a personality trait that determines being a good entrepreneur.

K. Wach reduced the essence of entrepreneurship, in terms of its function in economic sciences, to four elements, namely (Wach, 2015)

- entrepreneurship as a personality function,
- entrepreneurship as a function of managerial activities,
- entrepreneurship as a function of an individual entrepreneur,
- entrepreneurship as a function of the market.

In this way, the author outlined and specified in detail the broad and diverse range of issues related to entrepreneurship and its different understanding, depending on the scope and purpose of research. His proposal does not contrast the underlined definitions, but puts them side by side as potentially possible ways of explaining the essence of entrepreneurship. By resigning from a comprehensive presentation of the leading directions of theoretical considerations about entrepreneurship, considerations initiated by the eighteenth-century economics classics R. Cantillon, A. Smith, JB Say and their subsequent followers - T. Veblen, FH Knight, JE Schumpeter, BF Hoselitz and AH Cole (Piecuch, 2010) it is worth paying attention to the proposed classifications and typologies of entrepreneurship, distinguishing its various types, kinds or levels. On account of their multiplicity, the concepts that will be useful in the mainstream explanations in this paper, will be cited here.

In 1998 M. B. Low and I. C. Mac Millan introduced, for analytical purposes, the division of entrepreneurship into: (Wach, 2015).

- entrepreneurship of the unit (individual),
- team (group) entrepreneurship,
- entrepreneurship of organizations (organizational),
- industry and sector (sector) entrepreneurship,
- entrepreneurship of the society (national).

This analytical and subject division, important in comparative studies, can be expanded to include the territorial division of entrepreneurship by distinguishing:

- entrepreneurship of the individual (person),
- entrepreneurship of the basic territorial community (rural or urban commune – villages or cities),
- entrepreneurship of a higher-level territorial community (region, area, e.g. Country, voivodeship),
- nationwide (country) entrepreneurship,
- entrepreneurship of a group of countries (e.g. Eastern Europe).

Among the above-mentioned specific types of entrepreneurship, the group entrepreneurship is particularly important, regardless of the manner and criterion of distinguishing a given group of people (Twardowski, 2016). Group entrepreneurship can be analyzed in relevant occupational groups (farmers, doctors, scientists, etc.), territorial groups (according to the specific place of residence, e.g. village, small and medium cities, large cities and agglomerations, but also in cross-section of city districts, microregions, macroregions or historical lands), gender groups and finally age groups (youth entrepreneurship, entrepreneurship of mature people, entrepreneurship of seniors and pensioners).

The criteria used to distinguish types of entrepreneurship and their respective components can be based on one parameter only (e.g. age, gender), they can also take into account and express more factors - the characteristics of team entrepreneurship. If we take, for example, entrepreneurship of teachers, then except the criterion of the profession, two additional criteria describing this group, i.e. the criterion of age (having reached maturity, working age) and the criterion of education (higher and usually higher pedagogical) will be taken into account indirectly. Therefore, in analyzes and assessments of group entrepreneurship, it should be assumed that there is a relationship between the considered groups and the resulting from this conventionality of the investigated types of entrepreneurship.

1 Academic entrepreneurship – features, structure, environment

Academic entrepreneurship as a concept appeared in the Polish scientific literature relatively late, only at the beginning of the 21st century, although the very issue of business involvement of academic and university environments has a much older lineage dating back to the time of socio-economic reforms at the turn of the 1980s and 1990s of the previous century. From the formal and legal point of view, the problem of economic activity of individuals and science institutions, including the universities themselves, was explicitly authorized for the first time in Poland in the "Law on Higher Education" from 27.07.2005, the legislator in the newly introduced regulations then, indicated new areas and forms of business cooperation with economic practice as an important, additional function of the university, a function enabling commercialization of research

results, and thus generating new streams of funds for universities (Poznańska, 2016).

In the light of the definition of academic entrepreneurship that has appeared in recent years, it should be assumed that in broad terms it means the involvement of the entire university environment, all persons and institutions functioning in the structures of universities in the field of creating new business organizations (Matusiak & Matusiak, 2007). Therefore, this is not about, as it was understood before, only about creating spin-out / off companies by professors, but all founding initiatives using the intellectual resources of the university, combining employees, students, doctoral students and even university graduates in joint operation (Andrzejczak, 2015). The characteristic features of academic entrepreneurship and relevant enterprises are:

- functioning within the structures of the university, involvement of university "people" with a special role of lecturers (cf. Fig.1),
- offering intellectual products for a fee,
- expertise, training in technological, organizational and marketing novelties (Klimczuk, 2011),
- institutional support of contacts with business (creating and strengthening these contacts), including specific cases of market success in the teaching process within the concepts of 'teaching for entrepreneurship', 'studies for entrepreneurs', etc.,
- promoting intellectual entrepreneurs "and the activity of professors in business.

From a structural point of view, the area called "academic entrepreneurship" can be divided on the grounds of the subjective criterion into entrepreneurship of university employees, entrepreneurship of students and doctoral students, and entrepreneurship of graduates (Chrabąszcz, 2011). In addition, mixed entrepreneurship should be distinguished. It encompasses various units and groups of entities, in particular employees and students as well as employees and graduates (Brendzel-Skowera, 2016).

Academic entrepreneurship is a relatively young phenomenon, especially in comparison to the business activity of American and Western European universities. It results, to some extent, from the view, which has been spread over the years in Poland, that a real scientist should not be interested in business. The University should spread "pure" knowledge and the role of a professor is "work in the silence of his/her own study". In this approach to the activity and leading functions of the university, it could be noticed that there was a certain contradiction expressed by the tendencies to separate two "entities" - the university as a science center and the university as an active entity on the technology market (Clark, 1998).

In a new generation university, a creative and entrepreneurial university, business is not only the subject of teaching, but also a place of active business,

associated with the commercial transfer of new technologies. The university creates, tests and sells its intellectual products to interested organizations. It is an important player on the innovation market and a center for the preparation of new entrepreneurs - students and graduates. Academic entrepreneurship, its quantitative and structural condition, creative potential and institutional conditions for functioning in Poland in the beginning of the 21st century was summarized in the form of a report - a synthesis of research effects and analyzes diagnosing the development of spin-out / off companies. This report, commissioned by PARP (Polish Agency for Enterprise Development) and prepared by the team of authors (Banerski, 2009) in 2009, presented the role of universities in shaping the new sector - "spin-off companies" (spin-out and spin-off) as basic institutional solutions in Polish reformed higher education. It indicates the functioning conditions of these companies and the role of universities in their development.

2 Entrepreneurial orientation of students – research review

In research on entrepreneurship, particular attention is paid to entrepreneurship of young people, its features, types and development conditions (Cichocki, 2011). It results from many circumstances, and above all from the fact that the young entrepreneur is:

- a person who promises many years of business activity,
- a seeker who has positive attitude to experiments,
- a person who is full of optimism and hope for success,
- a person without schemes and burdens from the past,
- a person with an appropriate resource of theoretical knowledge (as a general rule).

These are just some of the functional features of young entrepreneurs and they are positive. Abandoning here the analogous enumeration of negative features of "starting" entrepreneurs (cf. Fig. 2), it should be emphasized that so important for the economy, for its development dynamics, innovation, the small enterprise sector is based on entrepreneurial youth. It is this group of enterprises that belongs to the group of pioneering, innovative and leading companies in absorbing technological, organizational and market novelties. Undoubtedly, the group of young entrepreneurs and their companies called 'start-ups' (companies at the initial stage of their operation and development) includes student entrepreneurs and their companies (Matejun, 2016). Students, as young people, combine the characteristics of young entrepreneurs with such important features in modern business as:

- having constant contact with lecturers, consultants and creators of new solutions,
- participation in the process of teaching „entrepreneurship”,

- the possibility of cooperation with AIP – the Academic Business Incubator and the University Center for Knowledge Transfer – (Wolanin, 2014),
- in-depth knowledge of the conditions of running of your own business,
- the opportunity to participate in managerial lectures and trainings.

"Period of study is not wasted time for your own business" - this should be the main slogan of promoting the students' individual founding initiative - an initiative that results in registering your own company (Czyżewska, 2018). How students of different universities, different forms and fields of study will approach this slogan depends on many factors, which determine their entrepreneurial attitude - a tendency to initiate their own business, intentions in this scope, in one word, their entrepreneurial orientation [Shirokova & Osiyevskyy & Bogatyreva, 2015).

Studies of economic writing in the field of student entrepreneurship allow to claim that there is a huge increase in interest in student entrepreneurship, including, above all, their attitudes, intentions and views about starting and running their own small business (Katana, 2016). Numerous thematic publications that have appeared in the country and abroad are the best confirmation of this (Marchand & Hermens 2015). The dominating research trend in the studies about student entrepreneurship and its conditionings is a trend that identifies the entrepreneurial attitudes of students in cross-sections of universities, fields of study as well as cities and regions (Twarowski, 2016). The student's entrepreneurial orientation, identified, in this case, with his entrepreneurial attitude, does not yet mean taking and finalizing the founding initiative - the formal establishment of his own enterprise (Roszkowska – Mądra & Parfeniuk & Studnicki, 2014). There is a relatively long way from attitude to starting actual business. Among many determinants of entrepreneurial activity - launching your own company, it is important to highlight and emphasize the importance of the "idea for a business" factor, idea and concept of the company (see Figure 3). Having an idea allows you to develop an operational plan of action, which indicates, with or without external help, the activities and undertakings preparing for the launch of a new type of product “start-up”.

3 Methodological basis for own research

Realization of the main research goal and specific aims required having a set of data, characterizing various aspects, circumstances and assessing students` orientation towards running their own enterprise. This meant not only interest in this opportunity of becoming independent during studies, but above all, taking specific actions in this direction - clarifying the idea for a business, gathering the necessary financial and material resources, determining the location of the company, choosing the target market and finally formal registration of the company according to applicable regulations in this respect. After meeting these conditions, it is possible to enter the previously identified market with your own

product offer. Finding out the opinions of students about starting their own business and the degree of subjective perception of their own „opportunities and threats” as a potential entrepreneur, is not easy. This is connected to many circumstances, among which, the first place takes the limited awareness of the existence of a real chance to become an independent, small entrepreneur, a chance communicated only to small extent and justified during studies. In the completed research project, according to its general goal - knowing the attitude of students towards the issue of starting an independent business (during studies and immediately after their completion), self-employment, with possible university or external resource support. The project profiled in such a way should answer the following detailed research questions:

- do students consider setting up their own business in their target professional goals?
- was the idea for one`s own business the subject of considerations, plans, discussions?
- what factors and circumstances discourage students from becoming professionally independent?
- how do you see yourself as a young entrepreneur?
- what sector of the economy – branch, would you choose for a possible business?
- what motivates and what discourages people from starting their own business?
- where would you get a business idea, where would you look for a concept?
- what features should a successful entrepreneur have?

These are only selected issues that have been verified in this research project. In addition, attention was paid to the impact of selected demographic, professional, social and geographical features on the students' main views regarding their own entrepreneurship.

Identification of the students` entrepreneurial intentions, including its various conditions, required direct contact with them, which would guarantee finding out about their attitude to running the enterprise independently, a vision of becoming an entrepreneur and mental preparation of a given student to take up and solve managerial problems. Taking into consideration such needs, the research team prepared a survey treated as the main instrument to find out about the entrepreneurial orientation of Polish students. The survey questionnaire used, included 19 substantive questions and 6 “respondent`s particular” ones (identifying the respondent`s person) altogether. The answers to substantive questions were scaled (minimum scales). So-called open questions were thus avoided. Only three out of nineteen questions altogether, have been partially opened – these are half-closed questions. As many as seven questions used the 7-

point Likert scale, enabling the surveyed students to express their own views, feelings and degree of acceptance of a given problem more precisely, feelings.

In the nominal scales used in the survey, the Respondent had the opportunity to choose a wide range of the right answer, because he was offered a choice of up to 14 variants (question 6 - preferred sector of their own business branch). In other substantive questions, the nominal scales had, for example, 12 variants - cafeteria (questions 7 and 12), 11 cafeterias (question 9) or 10 cafeterias (questions 11 and question 14). It results from that, that the survey was prepared as a broad, taking into consideration diagnosing spectrum, research tool.

Surveys were conducted in 2019 in the months of April and May at selected universities and fields of study in South East Poland, i.e. in cities such as Kraków, Rzeszów and Jarosław. The choice of these cities was not accidental, as it was an additional comparison of survey results in terms of a large city (Kraków), medium (Rzeszów) and small (Jarosław). In all these cities there are public universities with different teaching profiles. Thanks to the cooperation with these places, we managed to conduct a survey (we used traditional method - paper version of the questionnaire), with the following number of students (the field, form and year of study were additionally provided):

- Krakow, University of Economics (UEK):
 - Finance and Accounting, full-time second-degree studies - 98 people,
 - Law, uniform Master's studies, year II - 72 people,
- Kraków, Cracow University of Technology (PK), field of study Civil Engineering, , uniform full-time studies III year - 72 people,
- Rzeszów (group 1), University of Rzeszów (URz), major in Economics, first degree, second year, full-time, 100 people,
- Rzeszów (group 2), University of Rzeszów (URz), major in Economics, first degree, first year, full-time studies, 100 people,
- Jarosław, State Higher School of Technology and Economics (PWSTE), field of study Internal Security, 1st degree, 3rd year, full-time studies - 91 people.

In total, the responses were obtained from 533 students (some of the answers were missing or incorrect). The selection of the respondents for the research was not random, although the selection method itself had some features of targeted choice. (diversity in the size of cities, types of universities, fields of study and number of years of study). Despite this, the presented results of the conducted direct survey can be considered as significant and illustrative for the viewed problem.

When characterizing the methodological aspects of this research project, it cannot be ignored that there is the important methodological aspect related to the explanation of factors differentiating the entrepreneurial orientation of the surveyed students and their statistical significance. In statistical analyzes, in

addition to calculations of basic descriptive statistics of the distribution of responses received, a logit model was used, which is an econometric descriptive model of a qualitative variable, a variable with only step values of 1 or 0. The dependent variable in such a model explains the chance of occurrence of the studied phenomenon or not. In this case, it is identified with the fact that you set up your own business also dependent on 0-1 (zero-one) independent variables. The results of the logit model estimation will be presented later in the work.

4 Statistical analysis of the distribution of students replies in the issue of individual entrepreneurship

Among 19 questions included in the survey, Question 1 has a special character. It is a direct question, which concerns the main researched issue – setting up your own business (starting one`s own business). The scaled answers corresponded to the Likert scale, i.e. from “definitely YES” to “definitely NO”. In the cross-section of the surveyed student groups, a certain spread of responses was obtained, namely:

- definitely YES – from 2.86% in case of UEK students (Finance and Accounting, MA) to 12.50% in case of PK students
- definitely YES - from 2.86% for UEK students,
- YES – from 7.69% (PWSTE) to 20.83% (PK),
- probably YES – from 28.57% (PWSTE) to 30.05% UEK – FiR).

The biggest differences in percentage distributions of answers occurred in case of the YES answer, because the class interval (the difference of the largest % share and the smallest share) was as much as 13,14% (for the “definitely YES” answer – 9.64%, and for the “probably YES” answer similarly as it was 10,48%).

In total, the desire to start one`s own business, although it was expressed in different degree, declared the following percentage of students:

- as much as 63.89% of students of the Cracow University of Technology (Construction),
- only 40.66% of students of the State Higher School of Technology and Economics in Jarosław (Internal Security),
- about 53–55% of students from other universities (UEK, URz).

It is worth noting that only 7% of students from the University of Rzeszów (2nd year of study) and as many as 15.15% of students from the same university, only from the first year of study, did not have opinions about starting their own business. On average, undecided students represented around 12% of all respondents for all universities.

The following conclusions can be drawn from the percentages quoted according to the Likert scale distribution:

- the setting up one`s own business is taken into account by students of a technical university in a large city - students of PK - Construction

(63.89%). Some justification for this professional orientation can be found in the dynamically developing construction sector, mainly in the area of housing construction in large Polish cities,

- Chances for one's own business are seen only by 40.66% of PWSTE Jarosław students (department of Internal Security). This is definitely less not only from PK students, but also from the average indicator for all surveyed students. Students and future graduates of "Security" probably take into account that the market of services in the field of personal and property protection is in Poland a market dominated by large and medium-sized companies. The chances of success for a new small company are relatively small, especially for a company without experience, certificates and technical support.

The indicated differences between the degree of acceptance of the fact of starting one's own business among the six groups of students considered were subject to verification of their statistical significance. For this purpose, the chi-square test of independence was used, i.e. the most commonly used test of independence between nominal variables. With the assumed significance level equal to $\alpha = 0.05$ (this is the acceptable risk of making an error), the calculated test values allowed to state that the differences between the following pairs of examined groups of students are statistically significant:

- - between entrepreneurial orientation of PK and PWSTE students,
- - between the entrepreneurial orientation of PK and Urz-1 students,
- - between the entrepreneurial orientation of PK and UEK – FiR students.

At the significance level of $\alpha = 0.10$, differences in entrepreneurial intentions between PK and URz-2 students can be considered statistical (see Table 1).

Table 1 Chi-square independence test values for comparisons of the percentage distribution of entrepreneurial orientation of student studies

Test results	Rzeszów1	Rzeszów2	UEKP	Jarosław	PK
UEKRIC	1.31	8,22	2.92	5.12	12.65**
Rzeszów 1		7.12	4.16	7.52	12.98**
Rzeszów2			3.99	11.41*	6,21
UEKP				4.50	5.28
Jarosław					15.42**

Notes: * significance on the level of $\alpha = 0,10$. ** significance on the level of $\alpha = 0,05$. *** significance on the level of $\alpha = 0,01$.

Source: own calculations.

In the statistical analysis of the results of student survey focused on learning about their entrepreneurial intentions, the size of the dominant (*mode values*) for questions from 2 to 6, in this case, questions very important for identifying the problem.

To question 2 "Do you have an idea on what kind of activity you will open (what will you do)?" students of all analyzed universities mostly answered "no, I don't know yet, I'm looking for an idea" (answer 2 on the scale taken into account) - see Chart 1.

To question 3 "When are you planning to start your own business", as a rule, students stated "I do not know yet" (answer 3), only students from URz-2 and UEK-P stated that they intend to do this after graduation - see Chart 2.

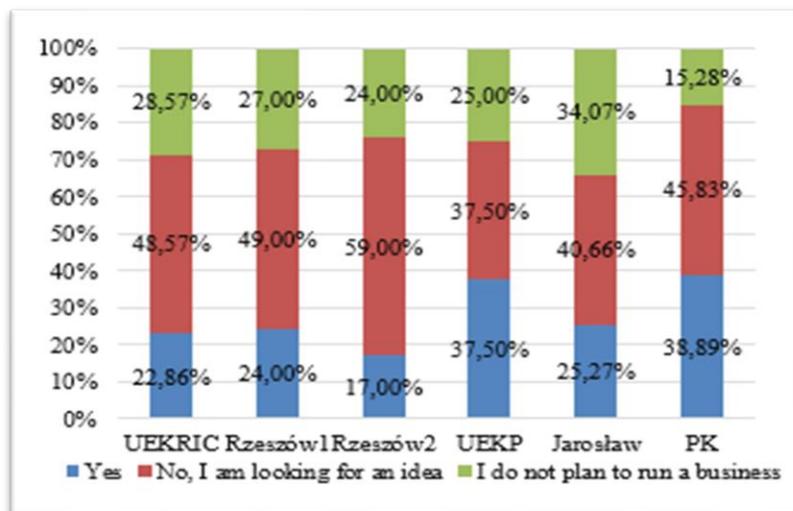


Figure 1 Structure and significance of the differences for the question about having an idea for own business

Source: own elaboration

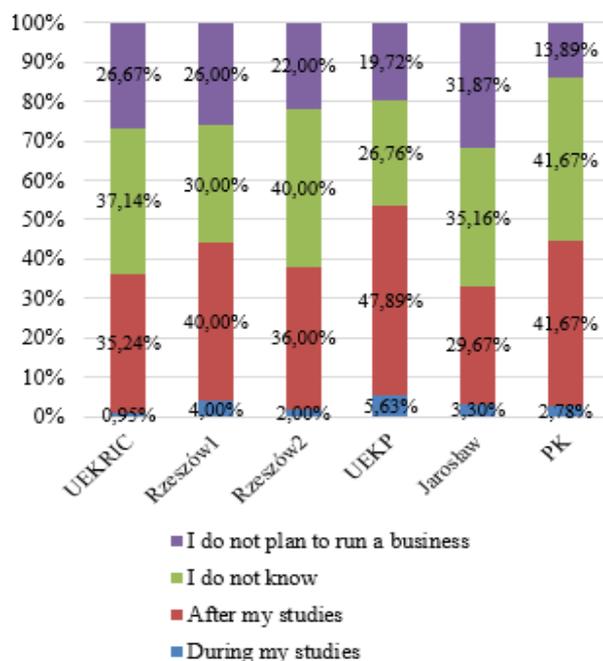


Figure 2 Structure and significance of the differences for the question "When are you planning to start your own business" (question 3)

Source: own elaboration

Question 4 was "What can affect the resignation from starting your own business?". In this case, the dominant answer for UEK-FiC students was "no idea", other students saw the main reason for the lack of entrepreneurial plans mainly in "lack of capital".

In the role of entrepreneurs (question 5 "Do you think you could be a good entrepreneur") generally the students from URz-1, UEK-P and PK would see themselves. Such self-assessment was not confirmed in most cases by the UEK – RiC, URz – 2 and PWSTE students (they accepted the answer “Not yet, I am learning now”) - see Figure 3 and Table 2.

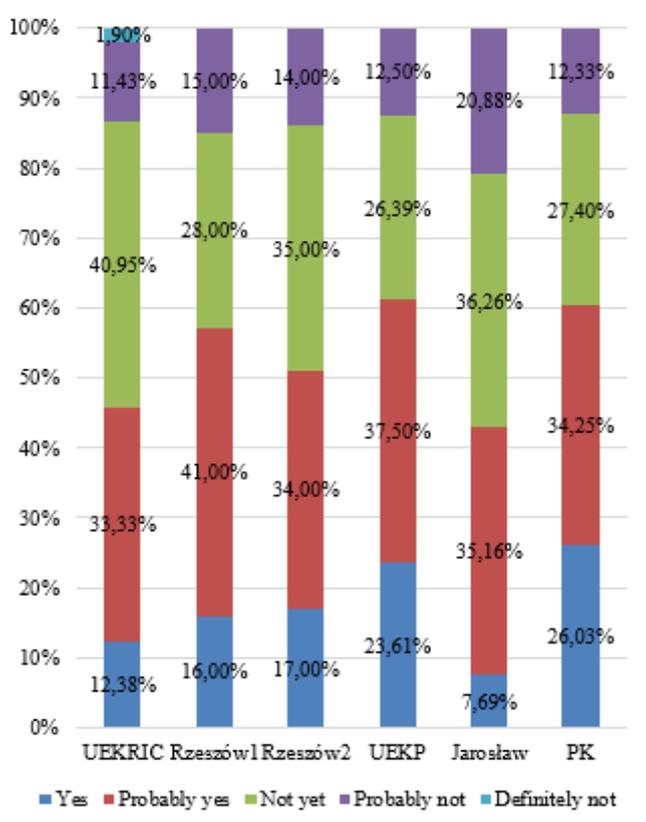


Figure 3 Structure and significance of differences for the question "Could you be an entrepreneur" (question 5)

Source: own elaboration

Table 2 Calculation results of the chi-square test for the question 'could you be an entrepreneur'

Test results	Rzeszów1	Rzeszów2	UEKP	Jarosław	PK
UEKRIC	6.17	3.40	7.39	5.86	8.13*
Rzeszów 1		1.50	1.62	5.10	2.82
Rzeszów2			2.13	4.63	2.51
UEKP				9.85**	0.21
Jarosław					11.32**

Notes: * significance on the level of $\alpha = 0,10$. ** significance on the level of $\alpha = 0,05$. *** significance on the level of $\alpha = 0,01$.

Source: own calculations.

In the very important question 6 about the choice of the economy sector for a possible one's own company, the respondents mainly pointed out - UEK-RiC and URz-1 and URzV2 students for "tax and accounting services", UEK-P students for "other" (from the 14 sectors mentioned), while PK students for "construction services". In the case of PWSTE students, the most frequently indicated sector was the "production" sector (see Table 3). The diverse distribution of responses in the cross-section of student groups, showed the significance of differences in almost every case.

Table 3 Calculation results of the chi-square independence test value for the sector selection for your own company (question 6).

Test results	Rzeszów1	Rzeszów2	UEKP	Jarosław	PK
UEKRIC	25.51***	26.76***	37.69***	76.61***	101.4***
Rzeszów 1		8.20	35.81***	42.95***	89.36**
Rzeszów2			39.39***	39.38***	85.93***
UEKP				69.44**	77.90***
Jarosław					74.85***

Notes: * significance on the level of $\alpha = 0,10$. ** significance on the level of $\alpha = 0,05$. *** significance on the level of $\alpha = 0,01$.

Source: own calculations.

The results of the dominant - the most common choice, are not surprising, at least for students of economic sciences (UEK – RiC and students of both groups from Rzeszów) and students of 'Construction' from PK. Probably the students from the "Law" at UEK most often chose the answer "other sector" because of the lack of possibility of choosing "legal services" on the given list of sectors.

The indicated results of surveys aimed at finding out about the entrepreneurial attitude - the entrepreneurial orientation of the young generation of Poles, in this case based on a detailed survey of the opinions of students from various

universities, did not answer all previously formulated research questions. Due to the considerable scope and volume of research material, this work was necessarily limited to the main analytical and research currents, currents that most clearly explain the adopted goal of the research project.

The second part of the statistical analysis of the level of entrepreneurial orientation of Polish students will concern the identification of the most important determinants of this phenomenon, using the logit model.

Conclusion

Identification of the conditions for the entrepreneurial orientation of studying youth is a complex and multi-faceted issue. The right founding initiatives and the active expression of one's professional plans are influenced by a huge number of factors, both of a student's personality and of an environmental nature. The sphere of macroeconomic conditions, such as the legal system, tax and credit solutions nationwide and individual regions, institutional advisory and assistance solutions, as well as the activity of local self-governments at various levels is not without impact on the intentions of starting your own business.

The conducted research verified the impact of only some of the factors - the determinants of individual entrepreneurship of young people, people just starting their careers. The focus was on demographic and geographical conditions, partly also on the type of education and location of the university where they study. The results of the survey conducted in cross-section of university groups confirmed the significant impact of several factors, but at the same time rejected some assumptions. For example, no differences were noted in the business plans of students from Rzeszów and Kraków (economic studies), although the city of Kraków are several times larger than Rzeszów.

The selection of universities for the research was determined and resulted from the Authors' connections with the scientific environments of these universities, and above all, from the fact of professional work at these higher schools.

Members of the research team usually after the completion of the actual project think about the possibilities of changes, corrections or additions to the operational concept of research, thanks to which the cognitive and application value of an already implemented program could be considered. And in this case the question was asked - what components of the research procedure and the appropriate research concept would be good to modify or supplement.

The first factor which it would be advisable to add in the new project and thus verify its significance of the impact on the main research problem under consideration is the 'student's wealth', i.e. their material situation (even when they would make a self-assessment in this case). This could highlight the concerns connected with the lack of capital to start your own business.

The conducted research did not definitively and unambiguously explain the impact of the factor that could be called "experience in business". It is not only about going through an apprenticeship in a company or an appropriate short-term internship, but about early attempts to earn independent income in various areas, scale and forms. Real business ideas usually arise from personal experience. The conducted research shows their general lack.

The curriculum including or not lecture courses, seminars and other didactic forms profiled intentionally for entrepreneurship education, the provision of useful knowledge and teaching useful basic managerial skills is not without significance for the creation of a team of young entrepreneurs. Undoubtedly, such programme elements should be included in the concepts of study at various faculties, fields and specialties. Preparation for one's own business is necessary not only for students (graduates) of economics and management, but also law, construction, medicine, agriculture, etc. Do universities offer such content to students, meeting their future competence needs? This undoubtedly needs clarification.

Starting business by individual or group of students is a huge effort for them, it is a significant burden on psychological and physical strength, and finally a "revolution" in their free time balance. Meanwhile, running your own company is not a circumstance justifying their absence from obligatory classes at the university, being late or being inactive in various forms of its manifestation. At this point, an important question arises – is there a conflict between the student's business activities and their university duties? The negative consequences of this state of affairs may even prevent a student from further studying, lead to the interruption of studies. These are just hypotheses, but hypotheses that deserve objective verification in continuing research projects.

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About the authors

Andrzej Szromnik
Cracow University of Economics

Krzysztof Rejman
State Higher School of Technology and Economics in Jaroslaw

Elzbieta Wolanin-Jarosz
Bronislav Markiewicz State Higher School of Technology and Economics in Jaroslaw, Institute of Economics and Management

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