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Contents

Research Articles

Systematic Literary Research

Excellent Dissertations

Research Articles

EVALUATION OF EGOVERNMENT AND GOOD GOVERNANCE DEVELOPMENT IN EU MEMBER COUNTRIES

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Abstract

Good Governance is a contemporary trend in public administration worldwide. It emphasizes efficiency, openness and transparency in the management of public affairs. An important factor of Good Governance is the application of ICT in public administration and the expansion of eGovernment, as a progressive element of the modernization of public administration. The presented article is focused on the evaluation of the interdependence between eGovernment and the development of Good Governance in the European Union (EU) countries. The interdependence of variables is examined based on the results of eGovernment evaluation model using multicriterial decision-making (MCDM) methods (TOPSIS method) and the values of WGI index monitored and processed by the World Bank. Based on the use of correlation and regression analysis, the interdependency between eGovernment and Good Governance development in EU member countries was confirmed.

Keywords

E-government; European Union; Evaluation; Good governance; Public administration.

Introduction

As stated by [11], [14] and [42], eGovernment is one of the priority modernization trends of public administration in the EU member states. eTools help to ensure more efficient government service delivery and sharing information, to eliminate obsolete hierarchical and bureaucratic structures, to support customer orientation and to increase transparency and accountability in public sector.

General definition of eGovernment is broad and divergent. United Nations [36] describes eGovernment as the use of information and communication technologies (ICT) in a way of government transformation for the purpose of increasing availability, effectiveness and accountability. eGovernment promotes and improves broad stakeholders' contribution to national and community development, and deepens the governance process as well [3]. As stated by [23], in accordance to the trend of cost savings in the public sector, eGovernment became one of the possible options how to operate more efficiently, effectively and transparently, to provide better, cheaper and faster services and open data to the public and to facilitate the participation of citizens and businesses into the public decision-making.

Currently, the concept of Good Governance is significantly promoted in the field of public affairs administration. As specified by [21] or [45], Good Governance is the designation for high-quality and properly functioning public administration with an integrated element of subsidiarity, allowing for the participation of the citizens and respecting democratic values

and the rule of contemporary modern state. The successful implementation of Good Governance concept in the individual countries indices the quality of governance and overall maturity of public administration in the state. However, as stated by [2], Good Governance is an ideal state of government, which is as a whole difficult to achieve.

The article deals with the evaluation of possibilities of the current state of eGovernment and Good Governance development in the European Union member countries and assessing their interrelations. The goal of the presented article is to investigate the relationship between the eGovernment state and public administration maturity based on the correlation and regression analysis of eGovernment indicators and Good Governance indicators (presented by WGI index). In the presented research there are used results obtained by evaluation of eGovernment in EU countries by TOPSIS method [4] and the data provided by the World Bank, see [43], and processed in own research [5]. The goal of the research is supported by the research question: Countries with higher level of eGovernment development also have an advanced Good Governance. To verify the research question, a hypothesis was determined, which is tested in the application part. H_1: There was a statistically significant correlation between the level of public administration (Good Governance Index) and the level of eGovernment (eGovernment index).

1   Problem Formulation

The evolution of the concept of Good Governance began in the 20th century. The role of the government started to grow in importance as a significant factor of socio-economic development. Good Governance is primarily presented by the World Bank as a requirement of national states to successfully facilitate economic and administrative reforming processes [18].

The interrelation between governance in the country and eGovernment maturity is discussed and supported by many authors, e.g. [22], [26] or [17]; however, there is not much empirical research in this area. According to [30] both concepts are focusing on the improvement of administrative efficiency, quality of public services and democratic participation. eGovernment is considered to be a significant factor of promoting Good Governance [27]. For this reason, eGovernment is the most important part of administrative reforms in the EU countries [11].

The confirmation of the positive impact of eGovernment development on Good Governance is an important issue affecting not only development countries but also the developed countries comprising the EU countries [20]. It has been increasingly recognized that the involvement of eGovernment tools enhance governments' information sharing and interaction with citizens [37]. eGovernment provides the opportunity to transform the public administration towards greater transparency, accountability and anticorruption. eGovernment tools comply with the principles of Good Governance by requiring appropriate organizational structures, new forms of leadership, transformative public and private partnerships, participatory processes and increased accountability.

1.1   Current Evaluation Approaches of eGovernment Development

The development of eGovernment is a continuous process of improvement that requires continuous evaluation and updating framework using modern computing technologies and platforms [24]. According to [26] world eGovernment rankings are increasingly important since they guide countries' focus of their efforts. The eGovernment rankings are in a process of maturation in that direction, moving from purely measuring web sites to assessing use and government qualities.

A large amount of research has been investigated into monitoring, evaluating and benchmarking eGovernment systems [35]. Thus, with the rapid eGovernment development, it becomes critical to investigated, redefine, restructure and also reweight the related eGovernment development frameworks and indices, as stated by [33] or [36]. There is a number of indexes describing eGovernment development. Each model measures how ready a society or economy is to benefit from ICT. However, the range of tools uses widely varying definitions and different methods for measurement [26].

eGovernment has been monitored by many organizations. However the approaches to eGovernment monitoring differ considerably across organizations. E.g. [15] processes and evaluates data in the field of eGovernment by indicators measuring the interaction of citizens and businesses with public administration. [16] uses indicators describing the state of fulfilment of the European Information Policy. OECD also deals with economic analysis of eGovernment, see [29], focusing on the identification of the eGovernment impacts in terms of costs and benefits comparison. In contrary, the European Commission's approach to eGovernment evaluation is connected with the effectiveness of evaluation of the European Information Policy [14]. This activity is based on the obligations of European institutions. For the purpose of the European Information Policy evaluation, there was designed the evaluation framework of basic eServices by the organization Capgemini [7]. These eServices are evaluated annually in the EU. At the international level, the evaluation of selected aspects of eGovernment also deals with benchmarking with UN. There is evaluated the practice and progress of UN member countries in eGovernment. UN [38] deals with the evaluation of eGovernment on the basis of the annual evaluation of "eGovernment Readiness index" and "eParticipation index". In contrast, on the distinction of different levels of "overall maturity scores" of eServices is based on the evaluation of the organization Accenture from 2000, see [1].

1.2   Good Governance Evaluation Approach

Due to the fact that Good Governance concept has a relatively short history, there is a large number of projects dedicated to the modern measuring of governance. The outputs of these projects cover a wide portfolio of governance indicators. The beginnings of the application of the governance indicators are in the 80s of the 20th century, when the qualitative case studies were published emphasizing the importance of governance for socio-economic development, see [28]. The main sponsor of these research projects were organizations such as USAID, IMF, WB, UN or EU.

Approaches to evaluating of individual aspects of the governance are focusing mainly on expert assessment panels that enable comparisons among countries using a variety of indicators. The pioneers of this type of projects became private consulting firms already in the late 70s and 80s of the 20th century. In academic research, the data for assessment of governance began to be used in recent years, e.g. [9]. Parallel to these commercial activities, as documented by [32], non-profit and academic projects of expert measurement of governance gradually began to be promoted. The most famous is the "Corruption Perception Index of Transparency International". Other projects dealing with the evaluation of governance are e.g. Studies of the World Bank "World Business Environment Survey", an investigation of the University of the United Nations' "World Governance Survey" or the "Transformation Index" by Bertelsmann Foundation and "Global Governance Initiative" of the World Economic Forum, see [10]. Article [8] developed the European Quality of Government Index (EQI). It is based on survey data on corruption and governance in the EU regions in 2010 and 2013. "Institute Aggregate Governance Indicators", a project of the World Bank, represents a very important contribution to the development of Good

Governance indicators, see [38]. The benefit of Good Governance indicators lies primarily in the fact that they highlighted the key role of Good Governance for successful socio-economic development.

The World Bank has been collecting data about Good Governance for broad international comparison since 1996 and currently they have been monitored annually. It processes indicators of governance for 215 economies of the world, closer [38]. Good Governance is monitored on the basis of six aggregate indicators, so called WGI (Worldwide governance indicators): Voice and Accountability, Political Stability and Absence of Violence, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption. Each of the aggregate indicators becomes normalized values in the interval from -2.5 (worst result) to 2.5 (best result).

2   Research Methodology

The interdependency between eGovernment and Good Governance development in EU member countries was examined by usage of correlation and regression analysis. Data for investigation of variables interdependence were obtained by former research, see [4]. The data are describing the state of Good Governance and eGovernment in 2013.

The evaluation of the state of Good Governance in EU countries was performed based on the World Bank approach and dates of aggregate indicators of Good Governance for 2013 provided by the World Bank [43]. The state of Good Governance in EU countries was determined on the basis of the above mentioned six aggregate indicators as the arithmetical average, see formula (1)

$$\bar{x} = \frac{1}{n}(x_1 + x_2 + ... + x_n) = \frac{1}{n}\sum_{i=1}^{n} x_i \qquad (1)$$

where $\bar{x}$ is the Composite Index of Good Governance, *n* is the number of aggregate indicators and x_i are the results of individual aggregate indicators.

The evaluation of the state of eGovernment was based on the eGovernment evaluation model. The model included nine eGovernment indicators monitored by international institutions (United Nations – UN, European Union and Eurostat). The evaluation was performed using the multiple criteria decision making (MCDM) method – TOPSIS method (The Technique for Order Preference by Similarity to Ideal Solution). The TOPSIS as a MCDM method is a practical tool for selecting and creating a rank of more alternatives, the application of which can be found in various areas of economy. Within the scope of these methods TOPSIS is used as the main decision-making technique in the "Asia Pacific area". Olson [31] sees its use also in manufacture, financial investment, assessment of sports teams, and application of automatized processes. Shih, Shyur, Lee [34] see its use, for example, in water management, in robot selection or facility location selection. Area risk assessment of construction projects and comparison of the regional aircraft parameters are completed by [19]. Vavrek, Kotulič and Adamišin [39] and [40] use this method in public sector to municipal evaluation. According to [34] or [6] the aim of the method is to determine ranking of individual variants in terms of selected criteria, wherein the variant with the best ranking represents the best compromise variant. TOPSIS method is based on the selection of a variant that is closest to the ideal variant and furthest from the baseline variant. It is assumed to be the maximizing character of criteria. Application of TOPSIS method is described in [44] and it consists of 7 steps:

- creation of the criteria data matrix;
- creation of the normalized data matrix;

- creation of the weight normalized data matrix;
- determination of the ideal and basal variant relative to the matrix values;
- distance calculation of variants from the ideal variant, respectively basal variant;
- calculation of the relative distance indicator of variants from basal variant;
- creation of the ranking of EU countries.

The evaluation is based on data set across multiple data sources. These are "eGovernment Benchmark" study from 2014, see [14], data processed by Eurostat, see [15] and data managed by UN, see [38]. Evaluated data described the state of eGovernment in the year 2013. In the research there was selected the final list of variants (the EU-28 countries) and criteria (9 eGovernment indicators.) The selected eGovernment indicators ($i1 - i9$) included 3 types of indexes:

- Indexes monitored by European Commission: User Centric Government (i1), Transparent Government (i2); Citizen Mobility (i3), Business Mobility (i4) and Key Enablers (i5);
- indexes monitored by UN: Online Service Index (i6), E-Participation Index (i7);
- indexes monitored by Eurostat: Individuals Using Internet (i8) and Enterprises Using Internet (i9).

These above mentioned outputs of our own research were used as input data for regression analysis examining the correlation between the Good Governance maturity and eGovernment state. The relationship between variables was tested by correlation analysis and regression analysis. In both cases, firstly normal distribution of each variable was tested by Shapiro-Wilk test in formula (2).

$$W = \frac{(\sum u_i x_i)^2}{\sum u_i^2 \sum (x_i - \bar{x})^2} \qquad (2)$$

where u_i is constant, x_i is the value of i-th statistical unit and $\bar{x}$ is average of variable.

Linear correlation between TOPSIS evaluation of eGovernment (eGovernment Index) and Good Governance (Composite Index of Good Governance) was tested by Pearson correlation coefficient or Kendall rank coefficient (depends on normal distribution of each variable). Estimation of constant and regression coefficient was realized by Method of Least Squares is described in formula (3)

$$\sum_{i=1}^{n}(y_i - \hat{y_i})^2 = \sum_{i=1}^{n} e_i^2 \rightarrow \min \qquad (3)$$

where y_i is measured value, $\hat{y_i}$ is estimated value and e_i is random error (residue).

Model suitability was assessed by coefficient of determination which is a number that indicates how well the data fit the statistical model, see formula (4)

$$R^2 = \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}(y_i - \bar{y}_i)^2} \qquad (4)$$

where y_i is measured value, $\hat{y}_i$ is estimated value and $\bar{y}_i$ is average value.

All these procedures were realized two times with the original data and also the normalized data. Monitored indicators were normalized according to equation (5)

$$A_{i-NORM} = \frac{A_i - \bar{A_i}}{s_{x_i}} \qquad (5)$$

where A_{i-NORM} is normalized value of the indicator i, A_i is original value of the indicator i, $\overline{A_i}$ is average value of the indicator i and s_{x_i} is standard deviation of the indicator i.

The data were processed in MS Excel and in the statistical program Statgraphics.

3   Results and Interpretation

Based on the results of TOPSIS method it was possible to determine the ranking of EU countries in terms of the functioning of eGovernment, see Fig.1 (original data). The detailed calculations are processed in [4]. In Fig. 1, there are also presented the normalized data according to formula (5).

Assessment of the state of eGovernment in the EU countries in 2013 showed that Estonia, Finland and Sweden ranked on the best place, while the worst eGovernment state was detected in Croatia, Bulgaria and Romania.
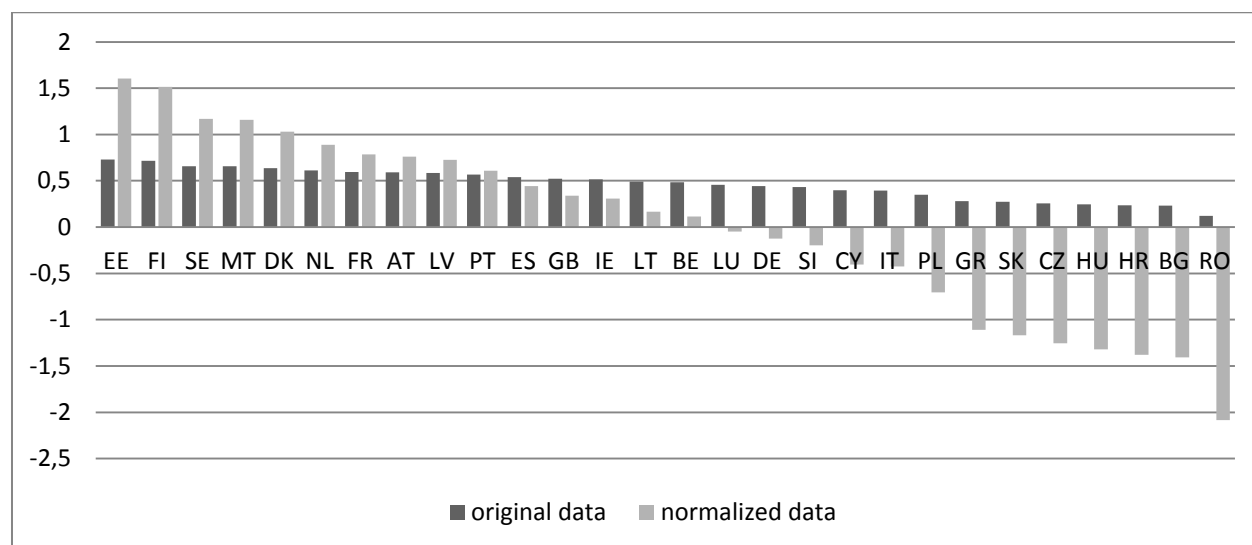
Source: Own calculations based upon data from European Commission (2014), Eurostat (2013) and UNPACS (2014).

Fig. 1:   *eGovernment evaluation in the EU countries by TOPSIS method in 2013 (eGovernment Index)*

Summarized positions of EU countries according to the state of Good Governance (original data) are in Fig. 2. The normalized data are also included in this figure. The obtained results showed that the top ranked countries in EU are the Nordic countries: Finland, Sweden and Denmark. On the contrary, the worst score was reached by Greece, Romania and Bulgaria.

The obtained results of the eGovernment and Good Governance state in EU countries in the year 2013 indicated possible interrelations of both variables (eGovernment Index and Composite Index of Good Governance). The assessment of the relation between the eGovernment and Good Governance development in EU countries was analyzed in the regression model.

Fig. 2: *Good Governance evaluation in the EU countries in 2013 (Composite Index of Good Governance)*

Input data for the verification of research hypothesis were eGovernment Index processed by TOPSIS and Composite Index of Good Governance from 2013. In order to check the relationship (the correlation of these two variables), it was necessary to verify their normal distribution. Results are summarized in Tab.1.

Tab. 1: *Normal distribution of variables*

Name of index	Original data	Normalized data
eGovernment Index	0.958 (0.347)	0.958 (0.347)
Good Governance Index	0.957 (0.331)	0.957 (0.331)

Source: Own calculations

Confirmation of the normal distribution of both variables allowed to test the relationship between these variables using Pearson coefficient, which confirmed their linear correlation (Woriginal = Wnormalized = 0.7503; $p \leq 0.001$). According to Tab. 1 we can confirm that variable normalization does not affect its distribution.

By usage of correlation analysis (Tab. 2 and Tab. 3) we can confirm the null hypothesis, i.e. countries with higher level of Good Governance have also higher level of eGovernment in both case (original and normalized data).

Tab. 2: *Linear regression – original data*

Source	Sum of Squares	D.f.	Mean Square	F-Ratio	P-Value
Model	0.415261	1	0.4152610	33.49	0.0000
Residual	0.322407	26	0.0124003		
Total (Corr.)	0.737668	27			

Source: Own calculations

The results of regression model for original data are summarized in Tab. 2 and the results in case of normalized data are in Tab. 3.

Tab. 3:   Linear regression - normalized data

Source	Sum of Squares	D.f.	Mean Square	F-Ratio	P-Value
Model	15.1992	1	15.199200	33.49	0.0000
Residual	11.8007	26	0.453872		
Total (Corr.)	26.9998	27			

Source: Own calculations

Tables 2 and 3 capture the significance of regression model that describes the relationship between the monitored variables by means of the following equations (6) and (7):

$$\text{Good Governance Index} = 0.209957 + 0.245182 * \text{eGovernment Index} \qquad (6)$$

$$\text{Good Governance Index} = -0.000008738 + 0.750288 * \text{eGovernment Index} \qquad (7)$$
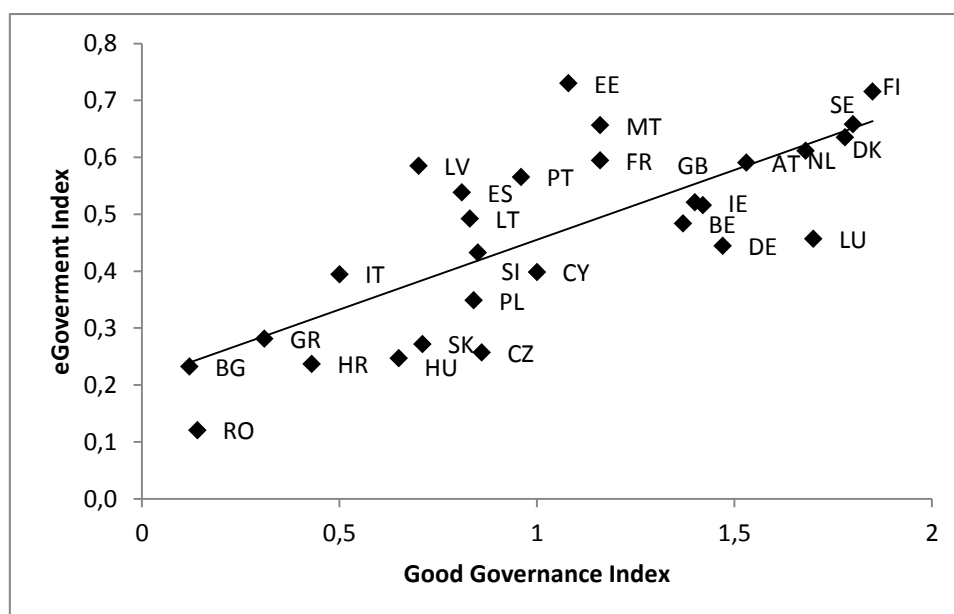
Source: Own elaboration based upon data European Commission (2014), Eurostat (2015), UNPACS (2014) and the World Bank (2014).

Fig. 3:   *Dependence of Good Governance and eGovernment in EU countries – original data*

Coefficient of determination of both regression models (R^2=0.5629) showed the predictive value of regression model. 56.29% of the eGovernment Index total variability was outlined by above mentioned model. The dependence between Good Governance and eGovernment in EU countries is illustrated in Fig. 3. The result is the same for both original and normalized data, see Fig. 4.
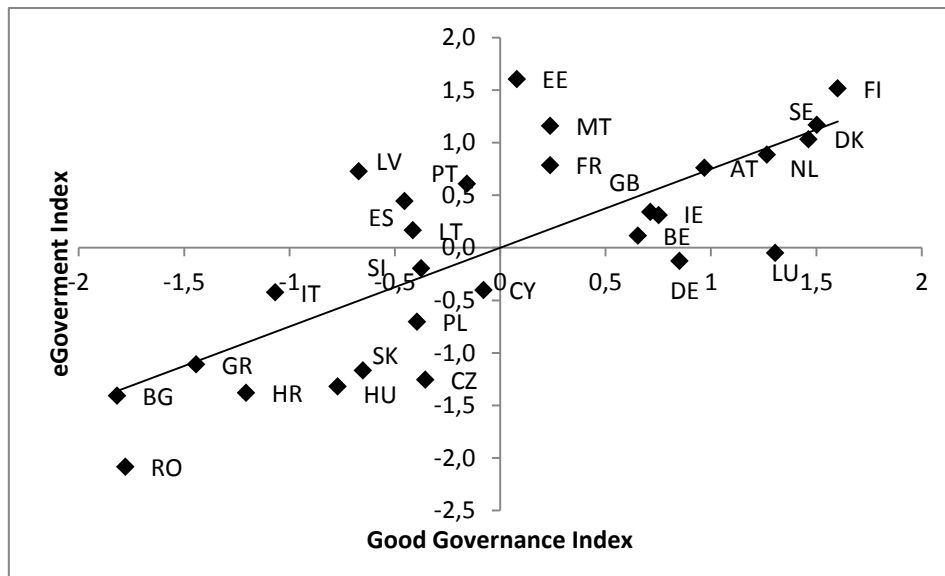
Source: Own elaboration based upon data European Commission (2014), Eurostat (2015), UNPACS (2014) and World Bank (2014).

Fig. 4: *Dependence of Good Governance and eGovernment in EU countries - normalized data*

4   Discussion

The research has confirmed that the state of public administration depends to a large extent on the level of eGovernment in particular countries. The more advanced the level of eGovernment, the higher the level of governance in the country. The dependence between Good Governance and eGovernment was tested in a regression model by usage of eGovernment Index and Good Governance Index. Although both indexes are using different scales (which was the reason for data normalization), this fact didn't affect the resulting arrangement of countries. Similar to our own research, the correlation between eGovernment and Good Governance in relevant countries was approved by [25]. This analysis made across the countries showed correlation with eGovernment development and Good Governance in the case of West Balkans countries.

The results of our own research in the field of eGovernment development also largely reflect the current results of other institutions in this field, such as the European Commission, see [13], [12] or [41]. According to DESI index in the year 2016, see [13], the best position in the dimension of digital public services reach Estonia (1st position – score 0.866), Denmark (2nd position – score 0.808), Finland (3rd position – score 0.789) and Netherlands (4th position – score 0.776). The worst ranking in EU countries was reached by Hungary (25th position – score 0.396), Slovakia (26th position – score 0.352), Romania (27th position – score 0.335) and Bulgaria (28th position – score 0.331). The Czech Republic is on the 24th position from EU countries (score 0.403). In the year 2014 the position of the Czech Republic was the same (24th position) but the score was the worst – 0.366. In case of Slovakia the situation in the year 2014 was better in contrast to the year 2016. In the year 2014 Slovakia reached the 23rd position, the score was 0.368 – better than in 2016. This results of DESI index from 2014 are very similar to results reached in own research. The position of top EU countries corresponds to the conclusions of the research of [41] from the year 2015. According to this research on the 1st position in online services is Estonia and Denmark and on the first position in e-Participation is Estonia and United Kingdom. However in total scores the first three positions are placed by Denmark (1st position), United Kingdom (2nd position) and Estonia (3rd position).

The quality of government in the sense of Good Governance principles was assessed also in all EU member countries. The best state of Good Governance was found out in Finland, Sweden and Denmark. On the worst positions were placed Greece, Romania and Bulgaria. This result is similar to the results of other studies on the quality of government. For example according to [8] on the tree best positions are placed also Denmark, Finland and Sweden. The worst position was found out in the case of Croatia, Bulgaria and Romania.

Conclusion

The goal of the presented article was to demonstrate the relationship between the eGovernment and Good Governance development. In the research it was confirmed that the level of Good Governance depends on the state of eGovernment in specific countries. The more advanced the level of eGovernment in a country, the higher the level of Good Governance development. The research question was verified. Between the level of eGovernment development and Good Governance development is a positive linear correlation in the case of EU member countries, i.e. countries with higher levels of eGovernment also have higher levels of Good Governance.

According to the realized analysis we can conclude that the heterogeneity of variables does not affect the results of correlation and regression analysis. Pearson coefficient confirmed high correlation between eGovernment Index and Good Governance Index. By usage of regression analysis we can add that this relationship is affected by other variables which are not included in the model.

Acknowledgements

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ZHODNOCENÍ ROZVOJE EGOVERNMENTU A DOBRÉ SPRÁVY V ČLENSKÝCH ZEMÍCH EU

Dobrá správa věcí veřejných (Good Governance) je současný trend ve veřejné správě na celém světě. Zdůrazňuje efektivitu, otevřenost a transparentnost v řízení veřejných záležitostí. Důležitým faktorem dobré správy je aplikace ICT ve veřejné správě a rozšiřování eGovernmentu jako progresivního prvku modernizace veřejné správy. Příspěvek je zaměřen na zhodnocení vzájemné závislosti mezi eGovernmentem a rozvojem Good Governance v zemích Evropské unie (EU). Vzájemná závislost proměnných je zkoumána na základě hodnocení eGovernmentu pomocí metod multikriteriálního rozhodování (metoda TOPSIS) na základě hodnot indexu WGI sledovaného a zpracovávaného Světovou bankou. Na základě využití korelační a regresní analýzy byla potvrzena vzájemná závislost mezi eGovernmentem a rozvojem Good Governance v členských zemích EU.

BEWERTUNG DER EGOVERNMENT UND GOOD GOVERNANCE ENTWICKLUNG IN DEN MITGLIEDSTAATEN DER EU

Good Governance ist ein aktueller Trend in der öffentlichen Verwaltung weltweit. Dieser Trend betont Effizienz, Offenheit und Transparenz im Public-Affairs-Management. Ein wichtiger Faktor für Good Governance ist die Anwendung von ICT in der öffentlichen Verwaltung und die Ausweitung von e-Government als fortschrittlichem Element der Modernisierung der öffentlichen Verwaltung. Der Artikel befasst sich mit der Bewertung der Interdependenz zwischen e-Government und Good Governance in den Ländern der Europäischen Union (EU). Die Abhängigkeit der Variablen wird auf der Grundlage der E-Government-Bewertung unter Verwendung von Entscheidungsverfahren mit mehreren Kriterien (TOPSIS-Methode) untersucht, die auf WGI-Indexwerten basieren, die von der Weltbank überwacht und verarbeitet werden. Basierend auf der Korrelations- und Regressionsanalyse wurde die Interdependenz zwischen e-Government und der Entwicklung von Good Governance in den EU-Mitgliedstaaten bestätigt.

OCENA ROZWOJU EGOVERNMENT I DOBREGO RZĄDZENIA W KRAJACH CZŁONKOWSKICH UE

Dobre rządzenie (Good Governance) to aktualny trend w administracji publicznej na całym świecie. Trend ten podkreśla skuteczność, otwartość i przejrzystość w zarządzaniu sprawami publicznymi. Ważnym czynnikiem dobrego rządzenia jest stosowanie ICT w administracji publicznej oraz rozwój e-administracji jako postępowego elementu modernizacji administracji publicznej. Artykuł skupia się na ocenie współzależności pomiędzy administracją elektroniczną a rozwojem dobrego rządzenia w krajach Unii Europejskiej (UE). Współzależność zmiennych jest badana na podstawie oceny eGovernment przy użyciu metod wielokryterialnego podejmowania decyzji (metoda TOPSIS) w oparciu o wartości wskaźnika WGI badanego i opracowywanego przez Bank Światowy. Na podstawie analizy korelacji i regresji potwierdzono współzależność między administracją elektroniczną a rozwojem dobrego rządzenia w państwach członkowskich UE.

ASSESSMENT OF LIVING STANDARD INDICATORS IN THE OECD MEMBER COUNTRIES

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Abstract

The research database for the present article consists of the OECD countries (except Turkey and Lithuania). The primary objective of the study is to group the countries according to twelve variables – average wage, minimum wage, GDP per capita, rates of unemployment, exchange and inflation rates, income tax, GDP per hour worked, indices of industrial, construction and manufacturing production and retail trade index, determining which of them significantly affect the average wage and defining the type and strength of such a relationship. The average wage, minimum wage and GDP per capita are used after their conversion into purchasing power parity, allowing for the comparison of price levels and PPP in different countries. Another important aim is to develop forecasts of the wage level for OECD countries by 2020. With regard to the countries' clustering according to the above criteria, Czechia always ranks alongside other post-communist countries (except Slovenia). The only explanatory variables affecting the average wage significantly are GDP per capita, income tax and manufacturing and retail trade indices, GDP exerting a major influence. Simple regression analysis of the dependence between the average wage and GDP per capita indicates that its course is best captured by the concave parabola with the peak at 77,252 PPP USD. The selected second-order polynomial regression explains approx. 89 percent of the variability of the observed values of the average annual wage. Wage growth by 2020 is expected in virtually all the OECD countries.

Keywords

Average annual wage; GDP per capita; Cluster analysis; Ward method; Euclidean distance metric; Linear regression hyperplane; Quadratic regression function.

Introduction

There is no doubt that the development of the average wage is related to that of the gross domestic product and other relevant indicators, such as income tax, total manufacturing production index and total retail trade index. In a period of GDP growth, the real wage growth is usually also expected. This, however, is not always the case, because GDP represents the total monetary value of goods and services provided over a given period in a particular country. Other factors, such as profit, interest rates and housing rents, come into play. Therefore, it is possible that GDP increases, but the average wage stagnates or even decreases – if, for instance, the profit has a larger share of GDP. Economic growth may also lead to an increase in the profits of companies which, however, do not share them with their employees. Many authors examine the link between wage behaviour and GDP and other labour market indicators. An obvious mismatch between per capita GDP development and real wages in pre-industrialized Europe is addressed, e.g. in [3]. It becomes apparent that the two indicators start

to change if there are any changes to the three following factors – income distribution, labour supply per capita and relative prices. Regarding the changes in GDP, the labour market adjustment mechanism was examined by [1], the results indicating that the adjustments lag behind the growth of GDP.

The importance of the subject matter researched and the necessity of research in the given area imply from above, as statistical analysis in this area can be an incentive for decision-making in the area of state budget and social policy. The results obtained can be a basis for decision-making of entrepreneurs when considering their sale opportunities, these knowledges may further help, for example, in various considerations regarding the level of tax burden. For the reasons described above, the economic situation of the developed world economies and the economies of post-communist countries has been widely addressed in professional literature. A significant part of the research works in this context is also concerned with the issue of regional economic inequalities, especially with regard to wages and incomes of the population. The authors [5] study the effects of inward foreign direct investment and trade on relative skilled labour demand in Poland, Hungary, and the Czech Republic. Their estimates show significant heterogeneity in the foreign direct investment effect across the three economies. The authors [8] present the complex picture of EU countries at the outset of the recent crisis (2007) in terms of the components of earnings differentials, with particular emphasis on the dimensions of labour market flexibility identifiable with contractual arrangements and self-employment. [9] studies the forecasting ability of various Phillips curve specifications for one year ahead headline and underlying core inflation measures for three open currently inflation targeting countries: Sweden, Canada and New Zealand. The authors [10] use the panel data approach to investigate the relationship between energy consumption and economic growth for V4 countries and for the 14 EU "old" Member States from 1995 to 2012. The authors [11] compare vulnerability to crises of the Czech Republic and Slovakia, which had operated as Czechoslovakia prior to 1993. The objective of the article [12] is to investigate whether a parallel process of tertiarisation has been taking place in the V4 countries. The researchers [13] examine the impact of maturity of economy on an activities' focus of cluster organisations. Article [15] assesses whether the intensity of product market competition is a factor affecting economic growth (measured by the growth rate of real GDP per capita) and whether this impact depends on the model of capitalism. The study covers the 1997–2015 period and all EU 28 countries. The researchers [17] provide an empirical analysis of factors that might determine a stable economic growth in five countries (V4 countries and Romania). The researchers [18] study the determinants of firm resilience in the regions of Eastern Europe during the period 2007–2011 using a novel, dynamic, spatial and broad conceptual framework aspect.

In general, the reason why the average wage may be related to the unemployment rate is the fact that the reduction in the latter variable can affect wage growth due to the labour shortage in certain occupations, the prospects of collective bargaining thus being boosted.

The difference between the wage as the costs of labour and those of other production factors lies mainly in the exclusive nature of the workforce, resulting from the interplay of some indicators (economic, social, cultural) which determine the position of the labour force in the production process and its behaviour in the labour market. Wage level and development is the result of economic performance (expressed as GDP) and functioning of the labour market. At the same time, it is the basic determinant of the living standard of the population.

This research article aims to identify statistically significant indicators that affect wage levels in the OECD countries. The country grouping addresses the question of the existence of "different worlds" in the era of political convergence and economic globalization, post-

communist countries having integrated into OECD. The study also focuses on the prediction of wage levels in individual OECD countries by 2020.

The data for this research come from the official OECD website, see [19]. There are several research objectives that have been pursued. OECD member states (except Turkey and Lithuania due to unavailability of necessary data)were grouped into clusters of countries that are as close as possible to each other in terms of the following twelve variables for the year 2016 – average wage (gross), minimum wage (real), per capita GDP (all the above in constant prices in USD after PPP conversion), unemployment rate (in percentage terms), exchange rate (per USD, period average), inflation rate (annual CPI), income tax (pct. of labour costs for a childless person), GDP per hour worked, industry (industrial production index), construction (construction production index), manufacture (manufacturing production index) and retail trade (retail trade index); for all the above indices, 2010 = 100. The Dunn validation index being used to determine the optimal number of clusters, the OECD states were divided into seven groups. The Ward method with the Euclidean, squared Euclidean and city-block distances was employed for the construction of clusters. Using the Euclidean and city-block distance metrics, Czechia forms clusters together with five other post-communist countries, namely Estonia, Hungary, Latvia, Poland and Slovakia. Applying the squared Euclidean distance metric, Czechia constitutes a cluster along with the same countries plus Israel.

An important goal of this article is to investigate the dependence of the average wage on the other eleven variables for 2016, thus determining which of them statistically significantly affect the explained variable and indicating the type and strength of such a dependence. Normality of the variables was verified both visually and with the use of the Kolmogorov-Smirnov, Chi-Square and Shapiro-Wilks tests. Having employed simple correlation coefficients between the chosen explanatory variables, no problems with multicollinearity were identified. Inspecting visually and using the Glejser test, no heteroscedasticity was detected either. The suitability of the constructed model was verified by t- or general F- tests, determination coefficient and the Durbin-Watson test statistic. The regression hyperplane with eleven explanatory variables was considered in the first step. The methods of stepwise regression and forward selection were used to choose the appropriate set of explanatory variables (backward selection leading to the same selection of variables). It was found that only four explanatory variables – GDP per capita, income tax, manufacture and retail trade – statistically significantly affected the explained variable at a five percent significance level, GDP having the greatest impact. Therefore, a simple dependence of the average wage on per capita GDP was investigated. The concave regression parabola was chosen as the most appropriate model, allowing for the explanation – along with per capita GDP – of almost 89 percent of the variability of the average wage values observed.

Another important aim of this study was to make forecasts of the average wage for each country by the year 2020. The predictions were created analysing the relevant time series from 2000 to 2016. Exponential smoothing was used, the statistical software automatically evaluating the best combinations of equalizing constants. (The advantage of exponential smoothing lies in the fact that the latest observations are the most significant.) Appropriate exponential smoothing was selected using interpolation criteria. In all cases, sample residual autocorrelation and partial autocorrelation functions show that the non-systematic component does not indicate autocorrelation. Values of the Durbin-Watson statistic are close to the value two in all cases. Random failures can be therefore considered as independent. Model quality assessment was also performed using the Theil coefficient of non-compliance.

The research database for the present article consists of the OECD countries (except Turkey and Lithuania). Table 1 gives an overview of the 34 member countries along with their two-letter codes defined in ISO 3166-1 alpha-2.

Tab. 1: *OECD country codes (ISO 3166-1 alpha-2)*

Code	Country	Code	Country	Code	Country
AU	Australia	FR	France	LV	Latvia
AT	Austria	GB	Great Britain	MX	Mexico
BE	Belgium	GR	Greece	NL	Netherlands
CA	Canada	HU	Hungary	NO	Norway
CH	Switzerland	IE	Ireland	NZ	New Zealand
CL	Chile	IL	Israel	PL	Poland
CZ	Czechia	IS	Iceland	PT	Portugal
DE	Germany	IT	Italy	SE	Sweden
DK	Denmark	JP	Japan	SI	Slovenia
EE	Estonia	KR	South Korea	SK	Slovakia
ES	Spain	LU	Luxembourg	US	United States
FI	Finland				

Source: http://ec.europa.eu/eurostat

1 Theory and Methods

1.1 The Essence of Cluster Analysis

Cluster analysis was used to divide the OECD member states into relatively homogeneous groups according to the 2016 data on the twelve variables mentioned above. Multidimensional observations can be applied when classifying objects into several relatively homogeneous clusters. We have a data matrix X of n x p type, where n is the number of objects and p the number of variables. Assuming various decompositions $S^{(k)}$ of the set of n objects into k clusters, we look for the most appropriate ones. The aim is to identify the objects as similar as possible to each other within each cluster that are at the same time most different from those in other clusters, only decompositions with disjunctive clusters and tasks with a specified number of clusters being allowed.

1.1.1 Decomposition Quality Assessment Criteria

The general task is to assess the level of achievement of the objective of cluster analysis in a given situation applying a specific algorithm. Several criteria (decomposition functions) were proposed, the most frequently used ones exhibiting the following characteristics. They are the matrices of internal cluster variance

$$E = \sum_{h=1}^{k}\sum_{i=1}^{n_h}(\boldsymbol{x}_{hi} - \overline{\boldsymbol{x}}_h)\cdot(\boldsymbol{x}_{hi} - \overline{\boldsymbol{x}}_h)^{/} \tag{1}$$

and between-cluster variance

$$B = \sum_{h=1}^{k} n_h \cdot (\overline{\boldsymbol{x}}_h - \overline{\boldsymbol{x}})\cdot(\overline{\boldsymbol{x}}_h - \overline{\boldsymbol{x}})^{/}, \tag{2}$$

whose sum is the matrix of total variance

$$T = \sum_{h=1}^{k}\sum_{i=1}^{n_h}(\boldsymbol{x}_{hi} - \overline{\boldsymbol{x}})\cdot(\boldsymbol{x}_{hi} - \overline{\boldsymbol{x}})^{/}. \tag{3}$$

There are vectors of the observations for the ith object and h^{th} cluster $\boldsymbol{x}_{hi}$, the averages for the hth cluster $\overline{\boldsymbol{x}}_h$ and those for the total set $\overline{\boldsymbol{x}}$. There are p^{th}-membered vectors, E, B and T being symmetric square matrices of the pth order. The principal aim, consisting in the creation of the most distant compact clusters, is fulfilled by reaching the minimum of the total sum of the deviation squares of all values of corresponding cluster averages

$$C_1 = \mathrm{st}\, \boldsymbol{E} = \sum_{h=1}^{k} \sum_{i=1}^{n_h} \sum_{j=1}^{p} (x_{hij} - \bar{x}_{hj})^2 \ , \tag{4}$$

i.e. the Ward criterion[1]. Since the st $\boldsymbol{T}$ is the same for all decompositions, the minimization of the st $\boldsymbol{E}$ means the same as the maximization of the st $\boldsymbol{B}$. In order to become independent on the used units of measurement (or, more generally, the invariance to the linear transformations), it is recommended to minimize the determinant of the matrix of the internal cluster variance

$$C_2 = \left| \boldsymbol{E} \right|$$

or to maximize the trace criterion

$$C_3 = \mathrm{st}\ (\boldsymbol{BE}^{-1}) \ \text{ or else } \ C_4 = \mathrm{st}\ (\boldsymbol{BT}^{-1}).$$

The criteria mentioned above are employed not only retrospectively to assess the decomposition quality accomplished, changes in criterion values also guiding the creation of clusters. Since the criteria ultimately reach the limits (C_1 and C_2 the minimum, C_3 and C_4 the maximum) at $k = n$, it is necessary to find the extreme of the purpose function that properly includes the loss following from the growth in the number of clusters. The Ward criterion, for instance, is proposed to move towards the minimization of the quantity

$$Z_1 = C_1 + z \cdot k \ , \tag{5}$$

where constant z represents the loss resulting from an increase in the number of clusters by one.

1.1.2 Distance and Similarity of Objects

Having selected the variables characterizing the properties of the clustered objects and found their values, we decided on the method of the evaluation of distance or similarity of objects, the calculation of appropriate measures for all pairs of objects often being the initial stage of clustering algorithm implementation. The symmetric square matrix of n x n type has zeros or ones on the diagonal, depending on whether it is the matrix of distance $\boldsymbol{D}$ measures or that of similarity $\boldsymbol{A}$ measures, respectively. Let us now focus on measuring the distance of the objects described by quantitative variables. The Hemming distance (also called Manhattan distance or city-block distance) can be used when individual variables are roughly on the same level or at least expressed in the same units of measurement

$$D_{\mathrm{H}}(\boldsymbol{x}_i, \boldsymbol{x}_{i\prime}) = \sum_{j=1}^{p} \left| x_{ij} - x_{i\prime j} \right| . \tag{6}$$

The Euclidean distance can be applied in the same case

$$D_{\mathrm{E}}(\boldsymbol{x}_i, \boldsymbol{x}_{i\prime}) = \sqrt{\sum_{j=1}^{p} (x_{ij} - x_{i\prime j})^2} \tag{7}$$

as well as the Chebyshev distance

$$D_{\mathrm{C}}(\boldsymbol{x}_i, \boldsymbol{x}_{i\prime}) = \max_{j} \left| x_{ij} - x_{i\prime j} \right| . \tag{8}$$

All the above mentioned measurements have some common drawbacks – the dependence on the used measuring units that sometimes hinders the meaningful acquisition of any sum for different variables and the fact that if the variables are considered in sum with the same weights, the strongly correlated variables have a disproportionately large effect on the

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[1] Sign "st $\boldsymbol{E}$ " denotes the trace of matrix $\boldsymbol{E}$.

outcome. The starting point is the transformation of variables. The adverse effect of the measuring units can be removed by dividing all the values by the balancing factor, which can be presented with the corresponding average $\overline{x}_j$, standard deviation s_j or the range after deletion of extremes

$$\max_i x_{ij} - \min_i x_{ij}.$$

Particular variables can be also assigned more weight – having decided subjectively or on the basis of relevant information – their values then appearing in the formulas for the calculation of distance. Other measurements of distance and similarity of objects for numerical, ordinal, nominal and alternative variables are described in the professional literature. When dealing with variables of a different type, the Lance-Williams distance is recommended

$$D_{LW}(\boldsymbol{x}_i, \boldsymbol{x}_{i'}) = \frac{\sum_{j=1}^{p} |x_{ij} - x_{i'j}|}{\sum_{j=1}^{p} (x_{ij} + x_{i'j})}. \tag{9}$$

Another possible way of expressing the relationship between two objects is the square Euclidean distance

$$D_{ES}(\boldsymbol{x}_i, \boldsymbol{x}_{i'}) = \sum_{j=1}^{p} (x_{ij} - x_{i'j})^2. \tag{10}$$

1.1.3 Algorithm for the Creation of Hierarchical Sequence of Decompositions

The creation of a hierarchical sequence of decompositions belongs to the most widely used techniques applied in the cluster analysis, occurring sequentially in the following steps:

1) $\boldsymbol{D}$ matrix calculation of appropriate measurements of distances;

2) the start of the decomposition process $S^{(n)}$ from n clusters, each of them containing one object;

3) the assessment of the symmetric matrix $\boldsymbol{D}$ (a lower or upper triangle), finding two clusters (the hth and h'^{th} ones) whose distance $\boldsymbol{D}_{hh'}$ is minimal;

4) the connection of the hth and h'^{th} clusters into a new g^{th} cluster, the deletion of the hth and h'^{th} row and column in the matrix $\boldsymbol{D}$ and their replacement with those of the new cluster, the order of the matrix being reduced by one;

5) recording the order of the cycle $l = 1, 2, \ldots, n - 1$, the identification of the connected objects h, h' and the level of the connection $d_l = \boldsymbol{D}_{hh'}$;

6) returning to step (3) if the creation of decompositions has not been completed by connecting all objects into a single cluster $S^{(1)}$.

A divisive hierarchical procedure, contrary to the agglomerative hierarchical one, is less-used, starting from a single cluster $S^{(1)}$, splitting one of the clusters into two in each step and obtaining $S^{(n)}$ at the end of the process. The results of hierarchical cluster procedures can be effectively displayed in the form of a graphical tree dendrogram. Given the choice of variables $x_1, x_2, \ldots, x_p$ and the matrix of distances $\boldsymbol{D}$, the results of applying the described algorithm vary according to the way the distance between clusters is evaluated.

1.1.4 Nearest Neighbour Method

Within the nearest neighbour method, both clusters, whose connection is considered, are represented by objects that are the closest to each other. The $\boldsymbol{D}_{hh'}$ distance between the hth and

$h^{/\text{ th}}$ clusters therefore represents the minimum of all $q = n_h\, n_h^{/}$ distances between their objects, the procedure of the third phase of the above algorithm thus being specified. In the fourth step, the hth and $h^{/\text{ th}}$ row and column in the distance matrix are replaced with the row and column of distances of the new g^{th} cluster from other clusters. In the lth cycle, total $n - l - 1$ distances are determined by

$$D_{g\,g'} = \min\left(D_{g'h}, D_{g'h}\right).$$

(11)

If the way of evaluation of the proximity or similarity of clusters is given, which also determines the conversion of the distance matrix in each cycle, the above algorithm allows for the creation of a hierarchical sequence of decompositions and construction of the dendrogram. When using this method, even considerably distant objects can get together in the same cluster if a large number of other objects create a kind of bridge between them. This typical chaining of objects is considered as a drawback, especially if there is a reason for the clusters to acquire the usual elliptical shape with a compact core. This method, however, possesses many positive features that outweigh the above disadvantage.

1.1.5 Farthest Neighbour Method

The method of the farthest neighbour is based on the opposite principle. The criterion for the connection of clusters is the maximum of q possible between-cluster distances of objects. When editing the matrix of distances, we proceed according to

$$D_{g\,g'} = \max\left(D_{g'h}, D_{g'h}\right).$$

(12)

An adverse chain effect does not occur in this case. On the contrary, there is a tendency towards the formation of compact clusters, not extraordinarily large, though.

1.1.6 Average Linkage Method (Sokal-Sneath Method)

As a criterion for the connection of clusters, this method applies an average of the q possible between-cluster distances of objects. When recalculating the distance matrix, we use

$$D_{g\,g'} = \frac{n_h \cdot D_{g'h} + n_{h'} \cdot D_{g'h'}}{n_h + n_{h'}}.$$

(13)

The method often leads to similar results as the farthest neighbour one.

1.1.7 Centroid Method (Gower Method)

Unlike the above methods, this one is not based on summarizing the information on between-cluster distances of objects, the criterion being the Euclidean distance of centroid

$$D_{\text{E}}(\bar{\boldsymbol{x}}_h, \bar{\boldsymbol{x}}_h) = \sum_{j=1}^{p}\left(\bar{x}_{hj} - \bar{x}_{h'j}\right)^2.$$

(14)

The recalculation of the distance matrix is done as follows

$$D_{g\,g'} = \frac{1}{n_h + n_{h'}} \cdot \left[n_h \cdot D_{g'h} + n_{h'} \cdot D_{g'h'} - \frac{n_h \cdot n_{h'}}{n_h + n_{h'}} \cdot D_{h\,h'}\right].$$

(15)

1.1.8 Ward Method

The method uses a functional of the decomposition quality C_1 in formula (4). The criterion for the cluster connection is an increment to the total intra-group sum of the squares of observation deviations from the cluster average, thus

$$\Delta C_1 = \sum_{i=1}^{g}\sum_{j=1}^{p}(x_{gij}-\bar{x}_{gj})^2 - \sum_{i=1}^{h}\sum_{j=1}^{p}(x_{hij}-\bar{x}_{hj})^2 - \sum_{i=1}^{h'}\sum_{j=1}^{p}(x_{h'ij}-\bar{x}_{h'j})^2 \ . \tag{16}$$

The increment is expressed as a sum of squares in an emerging cluster which is reduced by the sums of squares in both vanishing clusters. Using arithmetic modifications, the expression can be simplified into the form

$$\Delta C_1 = \frac{n_h \cdot n_{h'}}{n_h + n_{h'}} \cdot \sum_{j=1}^{p}(\bar{x}_{hj}-\bar{x}_{h'j})^2 \ . \tag{17}$$

This equation is a product of the Euclidean distance between the centroids of clusters considered for the connection and a coefficient depending on the cluster size. The value of this coefficient grows with an increasing size of clusters, and for fixed $n_h + n_{h}'$ it represents the maximum in the case of the same-size ($n_h = n_h'$) clusters. Since we create the connections to ensure the minimization of the criterion ΔC_1, the Ward method tends to eliminate small clusters, i.e. to form those of roughly the same size, which is often a desirable property. Starting from the matrix of Euclidean distances between objects in the process of its modification, we can use the formula

$$D_{gg'} = \frac{1}{n_h + n_{h'} + n_{g'}} \cdot [(n_h + n_{g'}) \cdot D_{hg'} + (n_{h'} + n_{g'}) \cdot D_{h'g'} - n_{g'} \cdot D_{hh'}] \ . \tag{18}$$

The essence of this multidimensional statistical method is explained in detail in [16]. In cluster analysis, there are different approaches and views on how to determine the optimal number of clusters, no definite conclusions being provided since cluster analysis is basically an exploratory method, not a statistical test. Commentary on and interpretation of the resulting hierarchical structure depends on the context, and theoretically there are often several possible solutions. Nevertheless, there are ways that help determine the optimal number of clusters, validation indices in particular. The proven Dunn index is one of them, representing the ratio of the smallest to the largest intra-cluster distance and taking values from zero to infinity; high index values indicating the optimal number of clusters.
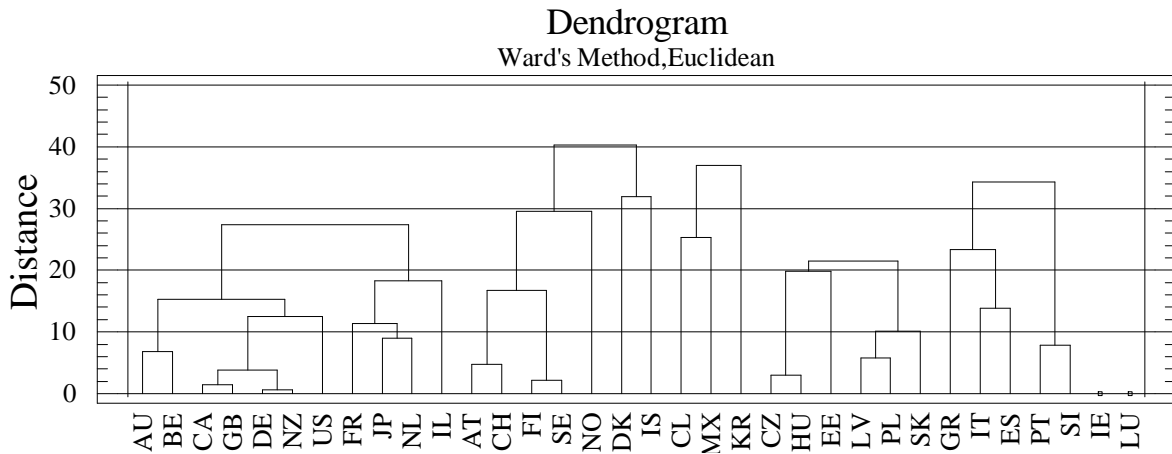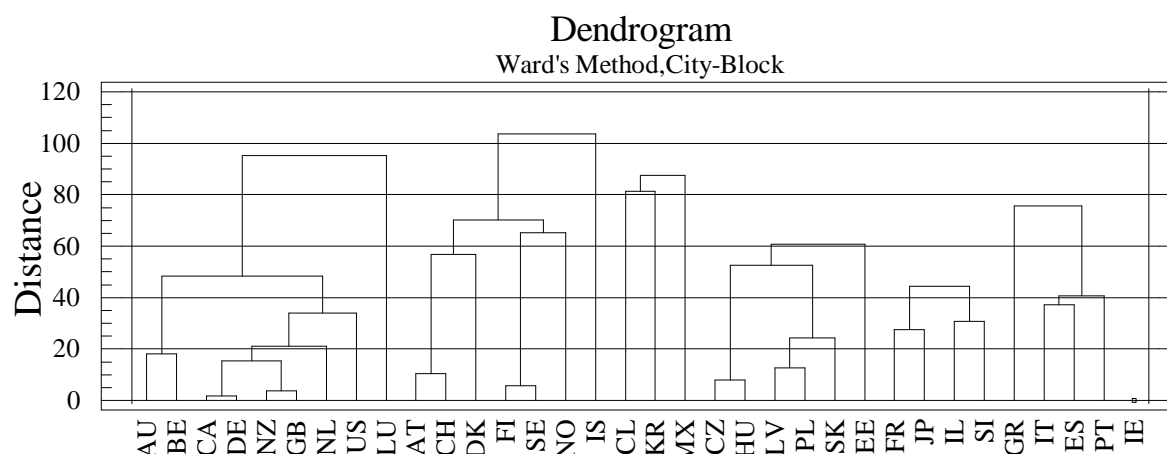

Source: Own research; output from software

**Fig. 1:** *Dendrogram of seven clusters (cluster analysis using Ward method and Euclidean distance)*
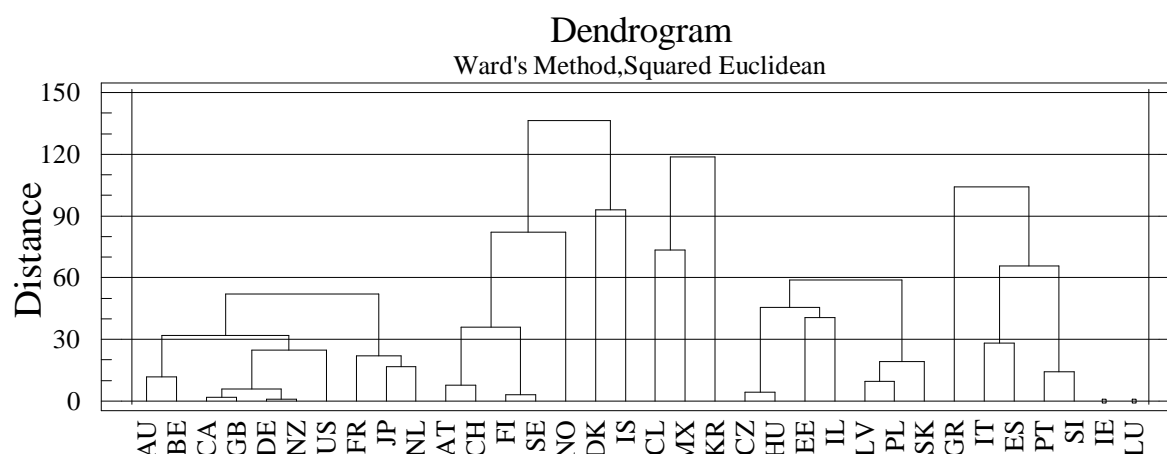
Dendrogram
Ward's Method, Squared Euclidean

Fig. 2: *Dendrogram of seven clusters (cluster analysis using Ward method and squared Euclidean distance)*

Dendrogram
Ward's Method, City-Block

Fig. 3: *Dendrogram of seven clusters (cluster analysis using Ward method and city-block distance)*

As mentioned above, the Ward method tends to remove too small clusters, so there is a tendency to create clusters of approximately the same size, which is a desirable feature in terms of clustering of the OECD countries. This is why the Ward method was utilized in the present clustering analysis. Since there is no need to strengthen the influence of any variable that might have an impact on the sum of squared distances (the points with the same distance from the centre lying on a circle), the Euclidean distance was chosen. It was completed with the square Euclidean and Hemming (city-block) distance metrics, allowing for a comparison of the results obtained. Figures 1–3 represent dendrograms of seven clusters analysed using the Ward method, Euclidean, squared Euclidean and city-block distances.

1.2   Regression and Correlation Analysis and Requirements for Methods Used

The regression and correlation analysis (cf., e.g. [7]) was carried out to examine data for the year 2016. The average wage represents an explained variable, the remaining eleven variables being explanatory ones.

Histogram for Average_annual_wage
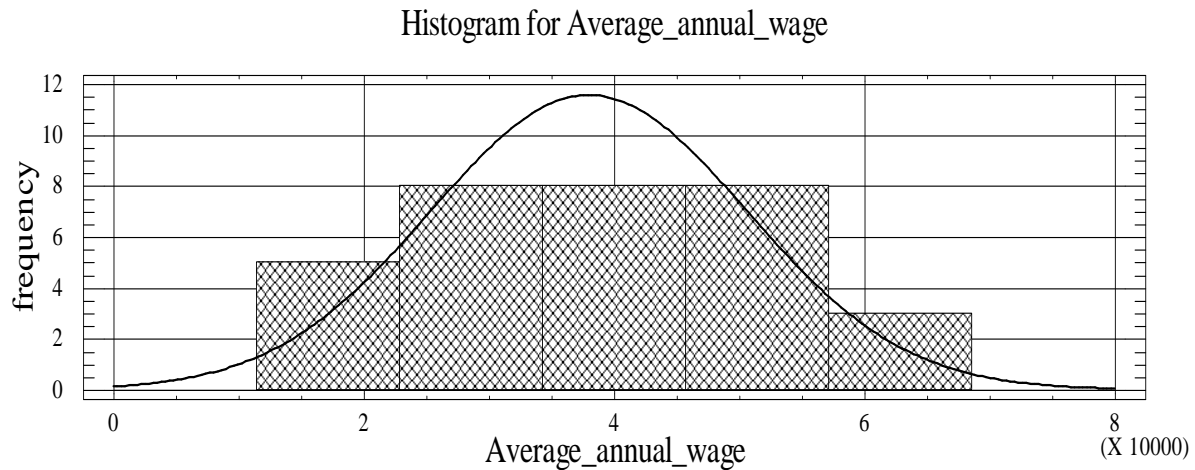
Source: Own research; output from software
Fig. 4: *Frequency histogram of average wage distribution normality (2016)*

The normality of all variables was verified both visually and using Kolmogorov-Smirnov, Chi-Square and Shapiro-Wilks goodness-of-fit tests. Figure 4 and Table 2 illustrate the normality validation procedure for the average wage variable, which is then applied to the other eleven variables. Although the variable "wage" usually follows a lognormal distribution (with a positive skew), the "average wage" has a symmetrical distribution, which is an argument in favour of the normal distribution; see Figure 4. Considering the three goodness-of-fit tests, the smallest P-value is 0.0630961 for the Chi-Square test; see Table 2. This means that the null hypothesis, assuming the normality of the average wage distribution, cannot be rejected at a five percent level of significance. The normality of the remaining eleven variables was verified in the same way.

Tab. 2: *Average wage normality assessment using Kolmogorov-Smirnov, Chi-Square and Shapiro-Wilks goodness-of-fit tests*

Kolmogorov-Smirnov goodness-of-fit test
Statistic: 0.119269
P-value: 0.718792
Chi-Square goodness-of- fit test
Statistic: 21.5294
P-value: 0.0630961
Shapiro-Wilks goodness-of- fit test
Statistic: 0.950289
P-value: 0.15913

Source: Own research; output from software

When constructing a regression model, a regression hyperplane was considered in the first step. The so-called stepwise regression and then forward selection were used to determine a set of explanatory variables that have a statistically significant effect on the explained variable (backward selection leading to the same results); see Table 3. It is obvious from the table that only four explanatory variables exert a statistically significant effect on the average wage at a five percent significance level. They are GDP per capita, income tax, manufacture and retail trade. It can be also seen in Table 3 that all t-tests and the general F-test are statistically significant at a five percent level of significance, the multiple determination coefficient indicating that 86.48 percent of the variability of the observed average wages were explained by the selected regression hyperplane. The Durbin-Watson statistic value is 1.83808, thus being close to the value 2 (in the interval 1.6, 2.4). This means that

autocorrelation does not pose any problem. Figure 5 shows the residues of the corresponding model with all four selected explanatory variables. The nature of these residues can be considered as accidental and therefore satisfactory. Apart from the visual assessment, the Glejser test was conducted, showing no heteroscedasticity present. For these reasons, we can see the selected regression hyperplane with four explanatory variables as satisfactory. Table 4 presents the matrix of simple correlation coefficients between the explanatory variables. None of these correlation coefficients' absolute values is higher than 0.5. Thus, harmful multicollinearity does not occur between the explanatory variables. The resulting regression hyperplane has the following form

$$Average\_wage = 7956.69 + 0.778627 * GDP\_per\_capita + 404.909 * Income\_tax -$$

$$- 183.614 * Manufacture + 154.08 * Retail\_trade.$$

Since GDP per capita was the first explanatory variable inserted into the model, we will still deal with a simple regression analysis of the dependence of the average wage on GDP per capita. Tables 5 and 6 show the results of a simple linear and quadratic regression analysis.

Tab. 3: *Results of multidimensional linear regression analysis using stepwise regression and forward selection*

Multiple regression analysis				
Dependent variable: Average_wage				
Parameter	Estimate	Standard error	T statistic	P-value
CONSTANT	7956.69	8684.74	0.91617	0.0071
GDP_per_capita	0.778627	0.0742635	10.4847	0.0000
Income_tax	404.909	148.992	2.71766	0.0110
Manufacture	–183.614	57.6366	–3.18572	0.0034
Retail_trade	154.08	56.8301	2.71125	0.0111
Analysis of variance				
Source	Sum of squares	D.f.	Mean square	F-ratio	P-value
Model	4.90372E9	4	1.22593E9	46.39	0.0000
Residual	7.66429E8	29	2.64286E7		
Total (Corr.)	5.67015E9	33			

R-squared = 86.4831 percent
R-squared (adjusted for d.f.) = 84.6187 percent
Standard error of est. = 5140.87
Mean absolute error = 3949.32
Durbin-Watson statistic = 1.83808

Stepwise regression

Method: forward selection
F–to–enter: 4.0
F–to–remove: 4.0

 Step 0:
  0 variables in the model 33 d.f. for error
  R-squared = 0.00% Adjusted R-squared = 0.00% MSE = 1.71823E8

 Step 1:

Adding variable GDP_per_capita with F–to–enter = 99.4004
1 variable in the model.   32 d.f. for error.
R-squared = 75.65%   Adjusted R-squared = 74.89%   MSE = 4.31517E7

Step 2:
Adding variable Income_tax with F–to–enter = 7.09553
2 variables in the model.   31 d.f. for error.
R-squared = 80.18%   Adjusted R-squared = 78.90%   MSE = 3.62471E7

Step 3:
Adding variable Manufacture with F–to–enter = 5.08877
3 variables in the model.   30 d. f. for error.
R-squared = 83.06%   Adjusted R-squared = 81.36%   MSE = 3.20234E7

Step 4:
Adding variable Retail_trade with F–to–enter = 7.35085
4 variables in the model.   29 d. f. for error.
R-squared = 86.48%   Adjusted R-squared = 84.62%   MSE = 2.64286E7

Final model selected.

Source: Own research; output from software

Tab. 4: *Matrix of simple correlation coefficients between explanatory variables*

	GDP_per_capita	Income_tax	Manufacture	Retail_trade
GDP_per_capita	1.0000	−0.4060	−0.0485	0.3441
Income_tax	−0.4060	1.0000	0.0869	−0.0822
Manufacture	−0.0485	0.0869	1.0000	−0.3019
Retail_trade	0.3441	−0.0822	−0.3019	1.0000

Source: Own research; output from software
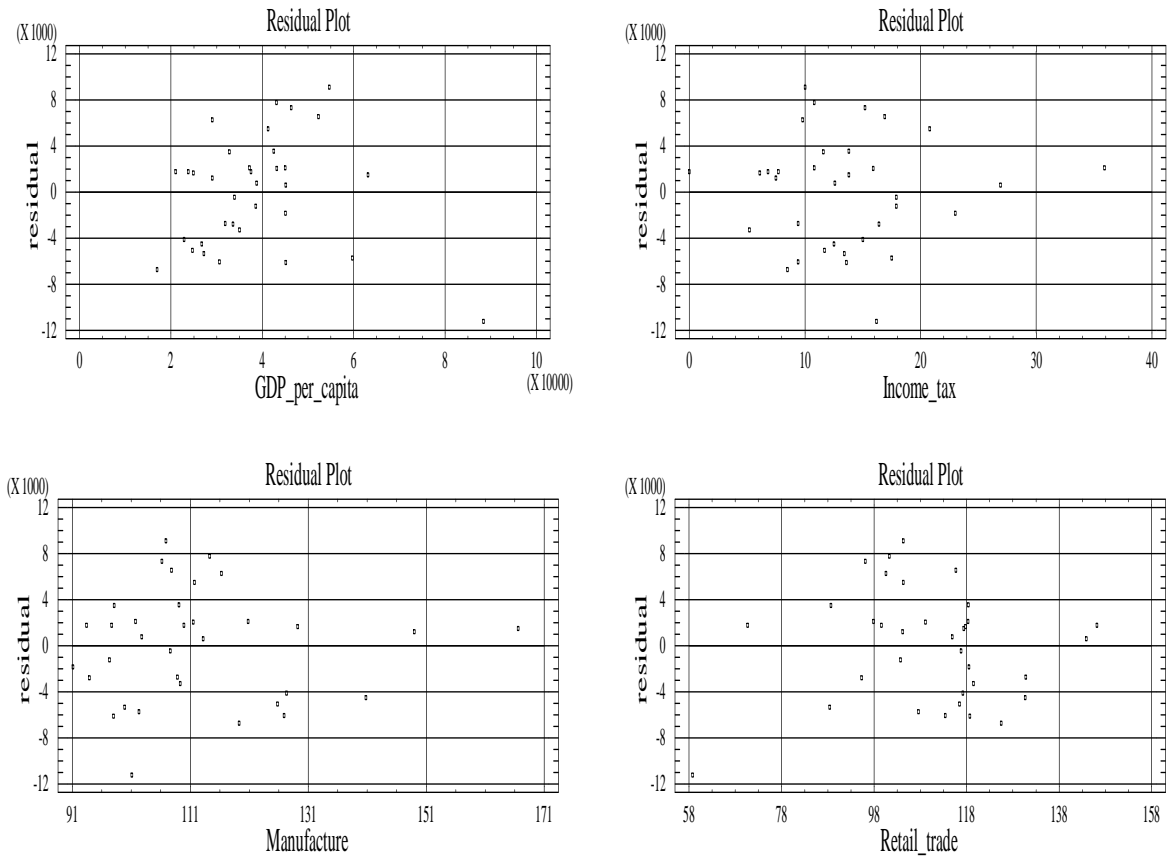
Source: Own research; output from software

Fig. 5: *Residual course of linear model with four selected explanatory variables*

It is obvious from the above tables that all t-tests and general F-tests are statistically significant at a five percent significance level and the Durbin-Watson statistic is near the value 2 for both regression dependencies, i.e. in the interval (1.6, 2.4). The adjusted determination index of the regression line is 74.89 percent, while that of the regression parabola reaches 87.82 percent. Figures 6 and 7 depict the course of the two dependencies considered and Figures 8 and 9 show corresponding residue graphs. The former figure indicates that in the case of a linear regression function, residues follow a non-random pattern. Regarding quadratic regression, the character of residues can be considered random and therefore satisfactory; see Figure 9. In addition to the visual assessment, the Glejser test was carried out, proving the absence of heteroscedasticity. Therefore, the second-order polynomial regression function can be considered as a more appropriate model of the average wage dependence on GDP per capita. The regression parabola is in the form

$$Average\_wage = -19286.0 + 2.13272*GDP\_per\_capita - 0.0000138036*GDP\_per\_capita\text{^}2.$$

Tab. 5: *Results of simple linear regression analysis*

Linear regression analysis				
Dependent variable: Average_wage				
Parameter	Estimate	Standard error	T statistic	P-value
CONSTANT	8573.63	3325.27	2.57833	0.0147
GDP_per_capita	0.808932	0.0811368	9.96998	0.0000
Analysis of variance				
Source	Sum of squares	D.f.	Mean square	F-ratio	P-value
Model	4.2893E9	1	4.2893E9	99.40	0.0000
Residual	1.38085E9	32	4.31517E7		
Total (Corr.)	5.67015E9	33			

R-squared = 75.6470 percent
R-squared (adjusted for d.f.) = 74.8859 percent
Standard error of est. = 6568.99
Mean absolute error = 5347.66
Durbin-Watson statistic = 1.74208

Source: Own research; output from software

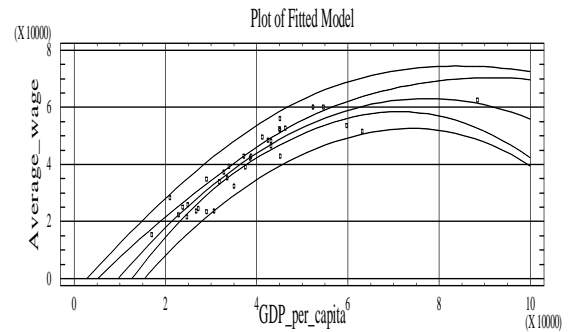**Tab. 6:** *Results of simple quadratic regression analysis*

Polynomial regression analysis				
Dependent variable: Average_wage				
Parameter	Estimate	Standard error	T statistic	P-value
CONSTANT	−19286.0	5247.08	−3.67556	0.0009
GDP_per_capita	2.13272	0.230759	9.24218	0.0000
GDP_per_capita^2	−0.0000138036	0.00000233299	−5.9167	0.0000
Analysis of variance				
Source	Sum of squares	D.f.	Mean square	F-ratio	P-value
Model	5.02164E9	2	2.51082E9	120.02	0.0000
Residual	6.48511E8	31	2.09197E7		
Total (Corr.)	5.67015E9	33			

R-squared = 88.5627 percent
R-squared (adjusted for d.f.) = 87.8248 percent
Standard error of est. = 4573.81
Mean absolute error = 3497.44
Durbin-Watson statistic = 2.24407
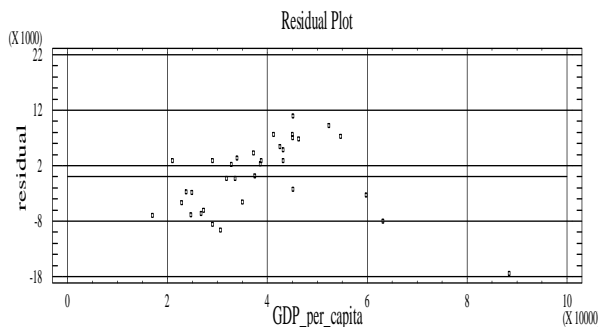
Source: Own research; output from software
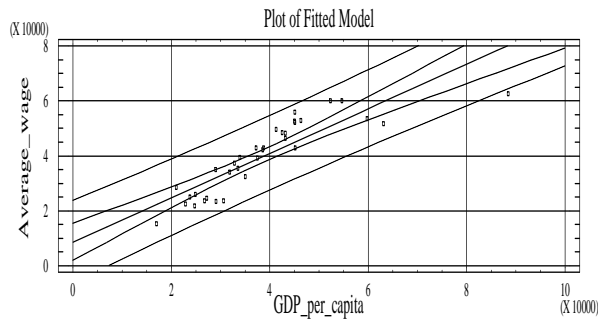
Source: Own research; output from software

Fig. 6: *Course of simple linear regression function*
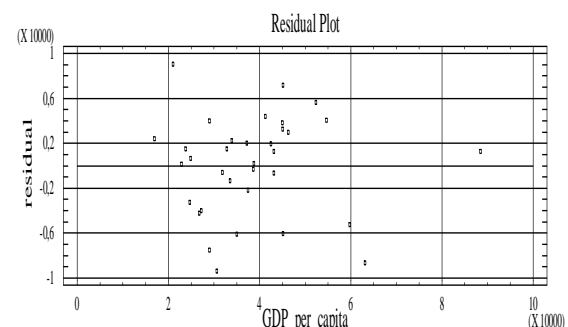

Source: Own research; output from software

Fig. 7: *Course of simple quadratic regression function*

Source: Own research; output from software

Fig. 8: *Residual course – simple linear regression function*

Source: Own research; output from software

**Fig. 9:** *Residual course – simple quadratic regression function*

1.3   Time Series Analysis and Assumptions

Figures 10–12 represent Brown's linear exponential smoothing of the average wage in Czechia and residual (partial) autocorrelation functions, respectively, each of the figures illustrating an example of the procedure. (The essence of time series analysis is described in detail in [4].)
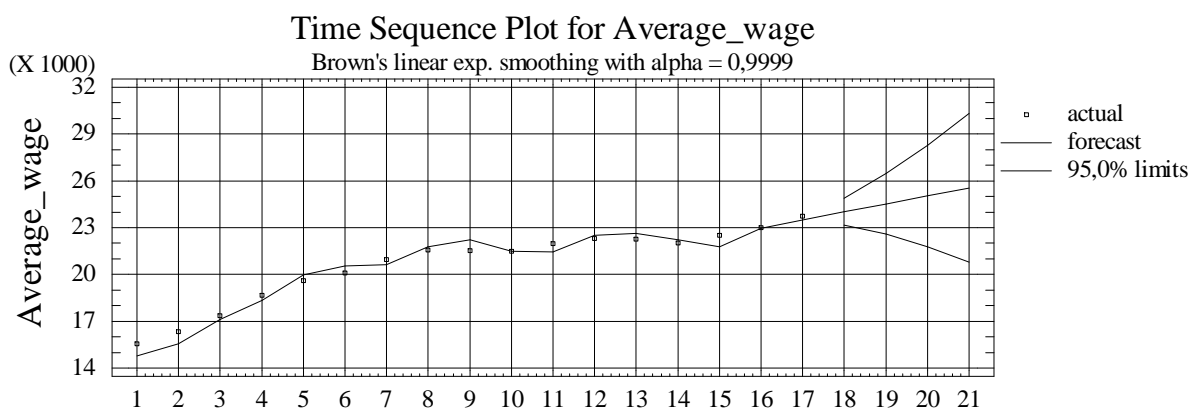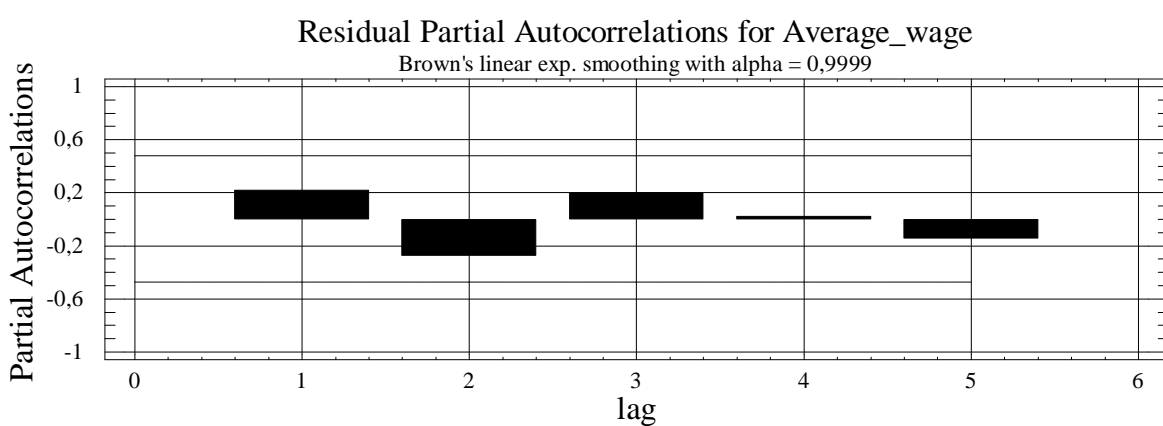

Source: Own research; output from software

Fig. 10: *Brown's linear exponential smoothing of average wage time series for Czechia (α = 0.9999)*

Residual Autocorrelations for Average_wage

Brown's linear exp. smoothing with alpha = 0,9999
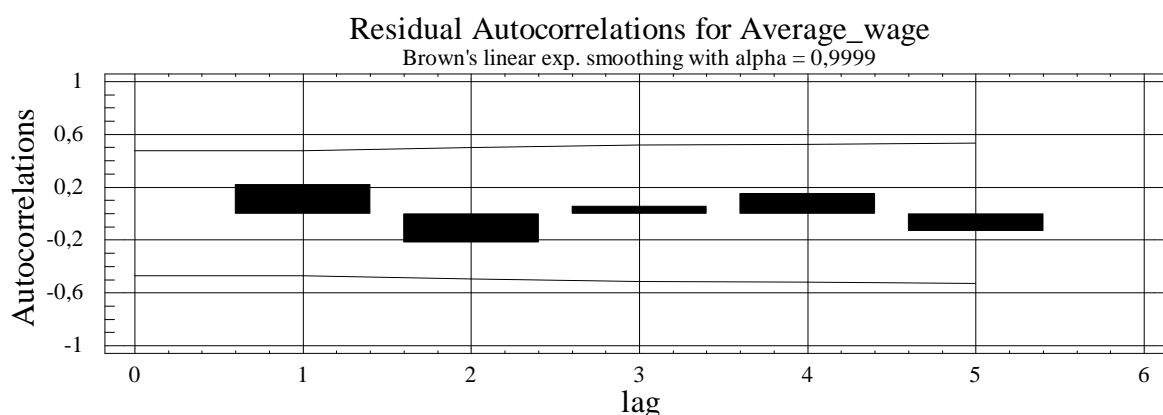
Source: Own research; output from software

Fig. 11: *Residual autocorrelation function for time series of average wage in Czechia*

Residual Partial Autocorrelations for Average_wage

Brown's linear exp. smoothing with alpha = 0,9999

Source: Own research; output from software

Fig. 12: *Residual partial autocorrelation function for time series of average wage in Czechia*

We focus on the average wage development in individual OECD member states over the period 2000–2016. Trend exponential smoothing was applied in time series analysis to construct average wage predictions by 2020. Exponential smoothing is one of adaptive approaches to modelling time series, employing the weighted least squares method, where the weights decrease exponentially towards the past, its advantage being that the most recent observations have the highest weights. Appropriate exponential alignment was selected using interpolation criteria.

As an illustration of the procedure used, Figure 10 shows the outcome of Brown's linear exponential smoothing which was evaluated as the most suitable for average wage time series. The autocorrelation function is a tool for assessing dependence between time series values, estimating correlation coefficients for each pair of equally distant time series values. Figure 11 provides a graphic image of a sample residual autocorrelation function (related to Brown's linear exponential smoothing of average wage time series for Czechia), individual bars representing the estimated correlation coefficients. In this figure, there is a dashed line at a distance of about twice the standard error estimate from zero for each estimated correlation coefficient, this limit being important for determining the significance of particular coefficients. Generally, the correlation coefficients are slightly different from zero if the bars do not overlap the dashed areas (top or bottom). On the other hand, the bars extending into these areas indicate the significance of the respective correlation coefficients. A partial autocorrelation function serves as a tool for assessing the dependence between the values of individual time series, estimating, however, partial correlation coefficients for each pair of values in the time series. Figure 12 displays the sample residual partial autocorrelation

function (related to Brown's linear exponential smoothing of time series of the Czech average wage), the bars representing the estimated partial correlation coefficients. Again, the dashed line plots the distance of approx. twice the standard error estimate from zero for each estimated partial correlation coefficient. This line is important for determining the significance of individual coefficients. Partial correlation coefficients are insignificantly different from zero if the bars do not go beyond the dashed boundaries. Bars which exceed them point to the significance of the respective partial correlation coefficients. It is clear from Figures 11 and 12 that the non-systematic component does not show autocorrelation and so Brown's linear exponential smoothing is satisfactory. The Durbin-Watson statistic value is close to 2, in the range 1.6–2.4. Random faults can be therefore considered as independent.

Tab. 7: *Prediction errors in time series for Czechia*

Year	Reality	Model	Estimate	Error
2000	15,569	14,789.0		
2001	16,349	15,568.8		
2002	17,335	17,128.8		
2003	18,659	18,321.0		
2004	19,592	19,982.9		
2005	20,105	20,525.1		
2006	20,939	20,618.1		
2007	21,584	21,772.9		
2008	21,535	22,229.0		
2009	21,496	21,486.1		
2010	21,996	21,457.0		
2011	22,314	22,495.9		
2012	22,266	22,632.0	22,995.8	729.8
2013	22,028	22,218.1	23,495.7	1467.7
2014	22,495	21,790.0	23,995.6	1500.6
2015	23,003	22,961.9	24,495.5	1492.5
2016	23,722	23,511.0	24,995.4	1273.4
	T_H^2		0.00340752	
	T_H		0.05837393	

Source: Own research

An illustrative example of the model quality evaluation procedure was performed for the average wage in Czechia (cf. Table 7) and subsequently applied to other countries. Based on these models, the average wage predictions for the next four years were made. Annual time series for the period between 2000 and 2016 were shortened to $m = 5$ observations, i.e the period 2012–2016, forecasts for these five years being made using Brown's linear exponential smoothing. The deviations between the predicted and actual values were calculated as

$$\Delta_t(i) = P_t(i) - y_{t+i}, \tag{19}$$

where $P_t(i)$ is the prediction of the monitored indicator at time t of i time units (prediction horizon) shifted forward, and y_{t+i} is the real value of the predicted indicator at time $t + i$. These deviations are called predictive errors for a given time t and the prediction horizon i; see Table 7. If $\Delta_t(i) < 0$, it is the so-called undervalued prediction, and if, on the other hand, $\Delta_t(i) > 0$, an overestimated prediction occurs.

The Theil index is a mismatch coefficient commonly measuring the variability of relative prediction errors

$$T_H^2 = \frac{\sum\limits_{t=1}^{m} [P_t(i) - y_{t+i}]^2}{\sum\limits_{t=1}^{m} y_{t+i}^2}. \tag{20}$$

It can only acquire non-negative values, hitting the lower zero boundary just in the case of a flawless prognosis when $P_t(i) = y_{t+i}$. The more the Theil mismatch coefficient deviates from zero, the more the prediction differs from an ideal flawless forecast. The square root of the Theil index can be interpreted as a relative prediction error.

In the construction of extrapolation forecasts of the average wage, we made an error averaging at 5.84 percent; see Table 7. The Theil mismatch coefficient and relative prediction error values indicate a high quality of the selected model of exponential smoothing. A similar verification of the suitability of the exponential smoothing type models was carried out for the other countries analysed.

2   Results and Discussion

The OECD brings together countries with the most advanced economies which produce more than two-thirds of the world's goods and services, meeting the challenges of economic globalization. Therefore, grouping of OECD countries by selected economic indicators, using the three distance matrices, offers useful insights; see Table 8.

The most advanced countries such as Australia, Belgium, Canada, Germany, the Netherlands, New Zealand, Great Britain and the United States always appear in the same group according to the twelve variables analysed. Scandinavian and other highly developed European countries (Austria and Switzerland) create another cluster. A separate group consists of three non-European countries, namely Chile, South Korea and Mexico. The Czech Republic is always part of a group of other post-communist countries except the more advanced Slovenia. South European countries facing economic problems in recent years constitute another group. Ireland, having also experienced a debt crisis, and Luxembourg always form "groups" of their own. The position of the latter is exceptional, its high GDP and, consequently, the level of wages relating to the small size of the country and the fact that about a third of the labour force commutes for work to Luxembourg from the neighbouring countries, thus not being included in the total population.

In terms of cartograms, this is clear that the Southern European countries (Greece, Italy, Portugal and Spain, designated often by their initial letters GIPS) always appear in the same cluster, as mentioned above. All these countries were primarily agrarian economies until the mid-20th century, and industrialization affected them only marginally. The vast majority of the population lived in rural areas and engaged in cultivation, breeding, fishing and related with this small-scale production.

The Scandinavian countries (Denmark, Finland, Norway, Sweden and Iceland) feature in the same cluster, too. These countries boast the most specific feature in the global context, which is relatively high spending on social systems. This mainly concerns the financing of the health system and old-age pensions. These countries have extraordinary results in a number of areas, such as economics, technology and sports. The economies of the Scandinavian countries are typical examples of a successful small open economy. The inevitable consequence of a strong economy is the high price level, which is extremely high in the Scandinavian countries compared to the rest of Europe. Agriculture, forestry and fisheries form the basis for a substantial part of the Scandinavian countries' production. These countries export a large part of their agricultural products abroad: Norwegian salmon, Swedish wood or Danish salami and cheese are world-famous for their quality.

Tab. 8: *Cluster analysis results*

Euclidean distance			Squared Euclidean distance			City-block distance		
Cluster		Country	Cluster		Country	Cluster		Country
1st	1st	Australia	1st	1st	Australia	1st	1st	Australia
	2nd	Belgium		2nd	Belgium		2nd	Belgium
	3rd	Canada		3rd	Canada		3rd	Canada
	4th	France		4th	France		4th	Germany
	5th	Germany		5th	Germany		5th	Luxembourg
	6th	Israel		6th	Japan		6th	Netherlands
	7th	Japan		7th	Netherlands		7th	New Zealand
	8th	Netherlands		8th	New Zealand		8th	Great Britain
	9th	New Zealand		9th	Great Britain		9th	United States
	10th	Great Britain		10th	United States	2nd	1st	Austria
	11th	United States	2nd	1st	Austria		2nd	Denmark
2nd	1st	Austria		2nd	Denmark		3rd	Finland
	2nd	Denmark		3rd	Finland		4th	Iceland
	3rd	Finland		4th	Iceland		5th	Norway
	4th	Iceland		5th	Norway		6th	Sweden
	5th	Norway		6th	Sweden		7th	Switzerland
	6th	Sweden		7th	Switzerland	3rd	1st	Chile
	7th	Switzerland	3rd	1st	Chile		2nd	South Korea
3rd	1st	Chile		2nd	South Korea		3rd	Mexico
	2nd	South Korea		3rd	Mexico	4th	1st	Czechia
	3rd	Mexico	4th	1st	Czechia		2nd	Estonia
4th	1st	Czechia		2nd	Estonia		3rd	Hungary
	2nd	Estonia		3rd	Hungary		4th	Latvia
	3rd	Hungary		4th	Israel		5th	Poland
	4th	Latvia		5th	Latvia		6th	Slovakia
	5th	Poland		6th	Poland	5th	1st	France
	6th	Slovakia		7th	Slovakia		2nd	Israel
5th	1st	Greece	5th	1st	Greece		3rd	Japan
	2nd	Italy		2nd	Italy		4th	Slovenia
	3rd	Portugal		3rd	Portugal	6th	1st	Greece
	4th	Slovenia		4th	Slovenia		2nd	Italy
	5th	Spain		5th	Spain		3rd	Portugal
6th	1st	Ireland	6th	1st	Ireland		4th	Spain
7th	1st	Luxembourg	7th	1st	Luxembourg	7th	1st	Ireland

Source: Own research

The Baltic countries, i.e. Estonia and Latvia as member countries of the former Soviet Union (Lithuania was not included in the research due to insufficient data), together with other Central European post-communist countries (Czechia, Slovakia, Poland and Hungary) are always in the same cluster. There are the countries where the transformation of the economy from a centrally planned economy to a market economy took place at the end of the 20th century.

American countries like Chile and Mexico, together with South Korea, always form a separate cluster, too. Mexico is the third largest economy on the American continent (after the United States and Brazil). This includes a combination of services, industry and agricultural production and it is based primarily on the export of raw materials and products. The Chilean

economy is one of the most successful in South America. Less labour productivity remains a challenge for the Chilean economy. The government seeks to solve it through reforms aimed at education and modernization, labour law reforms and cutting bureaucracy. An important part of the Chilean economy is the extraction of minerals, predominantly copper. South Korea is the 11th largest economy in the world and the 4th largest economy in Asia. There is a post-industrial economy, the service sector occupies 57.5% of the economy, industry 39.8% and agriculture 2.7%. The South Korean science and technology industry is one of the most advanced in the world. South Korea has a highly digitized economy and is developing a national cyber security strategy in the context of hacker attacks.

Australia, Belgium, Canada, Germany, Netherlands, New Zealand, Great Britain and United States remain in the same cluster, too. Only in terms of City-block distance, Japan and France separate from this group and form a separate cluster with Israel and Slovenia. All they are the most advanced countries in the world.

Only four out of the eleven explanatory variables considered (GDP per capita, income tax, manufacture and retail trade) affect significantly the explained variable (average wage) at a five percent significance level – three of them positively and one (manufacture) in a negative way. Sample regression coefficients (in the "Estimate" column, cf. Tab. 3) indicate the change in the average wage if the value of the corresponding explanatory variable increases by one unit, provided the values of the other explanatory variables remain unchanged. When examining the double dependence of the average wage on GDP per capita, the concave parabola with the peak at 77,252 USD PPP of per capita GDP best describes the dependence of the average wage on GDP per capita. This means that the average wage shows on average a parabolic growth along with GDP per capita rising to 77,252 USD PPP of GDP per capita, and then it starts falling parabolically with rising GDP per capita.

Regarding the predictions of the average wage, Table 9 provides the predicted values for the seven selected countries representing each cluster. It is clear from the table that we can expect a marked rise in Slovenia and the countries of the same cluster by 2020. Only gradual wage growth is likely to appear in other OECD countries, especially in Mexico, Chile and South Korea. Wage level decline is not predicted in any OECD member country over the next years.

Tab. 9: *Average wage prediction for selected countries from each cluster*

Year	Country						
	United States	Norway	Mexico	Czechia	Slovenia	Ireland	Luxembourg
2017	60,207	54,143	15,423	24,019	35,776	51,411	63,042
2018	60,678	54,642	15,504	24,527	36,587	51,732	63,502
2019	61,150	55,142	15,585	25,035	37,398	52,053	63,963
2020	61,622	55,641	15,665	25,543	38,210	52,375	64,423

Source: Own research

Conclusion

In terms of the twelve variables considered, Luxembourg and Ireland have a unique position. The former country (a small inland one, contrary to the latter) reports the highest annual PPP-based GDP per capita. The reason is that about a third of the workforce consists of foreign nationals commuting from neighbouring countries who are not included in the total population of Luxembourg. For example, the authors [2] show that Luxembourg stands apart as one of the richest regions in Europe and that disposable incomes in Luxembourg are some 70% higher than in the neighbouring regions. The cluster analysis shows that Czechia is always grouped along with other post-communist OECD countries, except for Slovenia. The

study [14] shows that the most important economic growth determinants in the Central and Eastern European countries are investment rate, human capital measured by the education level of the labour force, financial sector development, good fiscal stance (low budget deficit and low public debt), economic structure (high services share in GDP), low interest rates and low inflation, population structure (high share of working-age population), development of information technology and communications, high private sector share in GDP and favourable institutional environment (economic freedom, progress in market and structural reforms). Greece and Spain, for example, are clustered together in groups of countries encountering economic difficulties. The research [6] examines the political economies of Greece and Spain and how they affected the industrial policies adopted in either country during the 1980s and 1990s. This analysis suggests that historical legacies, political institutions and industry structure go a long way towards explaining the different industrial policies pursued by either country during the 1980s.

The analysis shows that a gradual, mostly modest increase in the average annual wage in almost all OECD countries can be expected by 2020. This is in line with OECD economic forecasts. Trade and private investment extension has restarted job creation and inflation will grow only slightly. However, new tensions and threats may derail the recovery. The economic outlook highlights a range of policies that can help maintain medium-term growth and ensure that its benefits are widely shared. Wage growth is expected to support household consumption, relatively low interest rates allowing for further capital investment. Overall economic growth will also alleviate the labour shortage.

In terms of indication for orientation of the future research, differences in the quantitative aspect of the standard of living between the G7 countries (the seven most economically advanced countries in the world) on the one hand and the V4 countries (countries of the Viszegrad Four: Czechia, Slovakia, Hungary and Poland) on the other hand will be examined.

Acknowledgements

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Zhodnocení ukazatelů životní úrovně v členských zemích OECD

Výzkumná databáze této práce se skládá ze zemí OECD (s výjimkou Turecka a Litvy). Primárním cílem studie je rozdělit země do skupin podle dvanácti proměnných – průměrná mzda, minimální mzda, HDP na obyvatele, míra nezaměstnanosti, směnná a inflační sazba, daň z příjmu, HDP za odpracovanou hodinu, indexy průmyslu, stavebnictví a zpracovatelského průmyslu, index produkce a maloobchodu, a určit, která z nich významně ovlivňuje průměrnou mzdu, a definuje typ a sílu takového vztahu. Průměrná mzda, minimální mzda a HDP na obyvatele se počítají po jejich převodu na paritu kupní síly, což umožňuje srovnání cenových hladin a PPP v různých zemích. Dalším důležitým cílem je vypracovat prognózy úrovně mezd pro země OECD do roku 2020. S ohledem na seskupení zemí podle výše uvedených kritérií je Česko vždy na úrovni ostatních postkomunistických zemí (kromě Slovinska). Jedinými vysvětlujícími proměnnými, které významně ovlivňují průměrnou mzdu, jsou HDP na obyvatele, daně z příjmu a indexy zpracovatelského průmyslu a maloobchodu, přičemž HDP má hlavní vliv. Jednoduchá regresní analýza závislosti mezi průměrnou mzdou a HDP na obyvatele naznačuje, že její průběh nejlépe zachycuje konkávní parabola s maximem 77 252 PPP USD. Vybraná polynomiální regrese druhého řádu vysvětluje cca 89% variability pozorovaných hodnot průměrné roční mzdy. Růst mezd do roku 2020 se očekává prakticky ve všech zemích OECD.

Bewertung der Indikatoren des Lebensniveaus in den OECD Mitgliedsstaaten

Die Forschungsdatenbank dieser Arbeit besteht aus den Ländern der OECD (mit Ausnahme der Türkei und Litauens). Das primäre Ziel der Studie besteht in der Unterteilung der Länder in Gruppen gemäß bestimmter Variablen: Durchschnittslohn, Mindestlohn, Bruttoinlandsprodukt pro Einwohner, Arbeitslosenrate, Wechsel- und Inflationsrate, Einkommenssteuer, Bruttoinlandsprodukt für die abgeleisteten Stunden, Indexe von Industrie, Bauwesen und verarbeitender Industrie, Indexe von Produktion und Einzelhandel. Ein weiteres Ziel dieser Studie besteht in der Bestimmung, welcher dieser Faktoren den Durchschnittslohn beträchtlich beeinflusst. Sie definiert den Typ und die Kraft einer solchen Beziehung. Der Durchschnittslohn, der Mindestlohn und das Bruttoinlandsprodukt werden nach deren Überführung in die Parität der Kaufkraft berechnet, was einen Vergleich zwischen den Preisspiegeln und der Purchasing Power Parity (PPP) in den verschiedenen Ländern ermöglicht. Ein weiteres wichtiges Ziel besteht in der Ausarbeitung von Prognosen des Lohnniveaus für die Länder der OECD bis zum Jahr 2020. Unter Berücksichtigung der Gruppierungen der Länder gemäß den oben angeführten Kriterien befindet sich Tschechien immer auf dem Niveau der übrigen postkommunistischen Länder (außer Slowenien). Die einzigen erklärenden Variablen, welche einen bedeutenden Einfluss auf den Durchschnittslohn ausüben, sind das Bruttoinlandsprodukt pro Einwohner, die Einkommenssteuer und die Indexe der verarbeitenden Industrie und des Einzelhandels, wobei das Bruttoinlandsprodukt den Haupteinfluss ausübt. Die einfache Regressanalyse der Abhängigkeit zwischen dem Durchschnittlohn und dem Bruttoinlandsprodukt pro Einwohner deutet an, dass deren Verlauf am besten mit einer konkaven Parabel mit einem Maximum von 77.252 PPP USD dargestellt wird. Die ausgewählte Polynomialregression der zweiten Ordnung erklärt etwa 89 % der Variabilität der beobachteten Werte des Durchschnittsjahreslohns. Ein Wachstum der Löhne bis zum Jahr 2020 wird praktisch in allen Ländern des OECD erwartet.

OCENA WSKAŹNIKÓW POZIOMU ŻYCIA W KRAJACH CZŁONKOWSKICH OECD

Badawcza baza danych niniejszego opracowania obejmuje kraje OECD (z wyjątkiem Turcji i Litwy). Głównym celem badań jest podzielenie krajów do grup według dwunastu zmiennych – przeciętne wynagrodzenie, wynagrodzenie minimalne, PKB na mieszkańca, stopa bezrobocia, stopa zmienna i stopa inflacji, podatek dochodowy, PKB na godzinę pracy, wskaźniki przemysłu, budownictwa i przemysłu przetwórczego, wskaźnik produkcji i handlu detalicznego, oraz wskazanie, która z nich znacznie wpływa na przeciętne wynagrodzenie oraz określa typ i siłę takiej relacji. Przeciętne wynagrodzenie, wynagrodzenie minimalne oraz PKB na mieszkańca uwzględniane są po ich przeliczeniu na parytet siły roboczej (PPP), co umożliwia porównanie cen i parytetów siły nabywczej w różnych krajach. Kolejnym ważnym celem jest opracowanie prognozy poziomu wynagrodzeń dla krajów OECD do 2020 roku. W wyniku pogrupowania krajów według ww. kryteriów Republika Czeska jest każdorazowo na poziomie pozostałych krajów postkomunistycznych (za wyjątkiem Słowenii). Jedynymi wyjaśniającymi zmiennymi, które mają znaczny wpływ na przeciętne wynagrodzenie, są PKB na mieszkańca, podatki dochodowe oraz wskaźnik przemysłu przetwórczego i handlu detalicznego, przy czym PKB ma wpływ decydujący. Prosta analiza regresji zależności pomiędzy przeciętnym wynagrodzenie a PKB na mieszkańca wskazuje, że jej przebieg najlepiej odzwierciedla parabola wklęsła z maksimum 77 252 PPP USD. Wybrana regresja wielomianowa drugiego rzędu wyjaśnia ok. 89% zmienności badanych wartości przeciętnego rocznego wynagrodzenia. Wzrost wynagrodzeń do 2020 roku spodziewany jest praktycznie we wszystkich państwach OECD.

SOCIAL CAPITAL AND ENTREPRENEURSHIP IN A REGIONAL CONTEXT

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Abstract

The article is focused on the connection between the willingness to do business and individual capital in the context of the Ústí Region as an example of a disadvantaged region. Social capital is divided into bonding capital, related with family and friendship relations, and mobilizing capital, related to the instrumental solution of situations with the help of social relations. The article has used a secondary analysis of data gained thanks to a questionnaire survey, which was representative of inhabitants of the Ústí Region. The results showed that the willingness to do business was connected with mobilizing social capital, while bonding social capital did not play any role. The analysis, however, also includes other variables as the role of the social capital differs, for instance, regionally: people with a higher education are more willing to do business, and the same also applies to people declaring a willingness to leave the region. The complexity of the variables related to the low level of willingness to do business cannot be reduced to mobilizing social capital. However, it is also necessary to reflect its significant role.

Keywords

Entrepreneurship; Self-employment; Mobilizing social capital; Bonding social capital; Regional diversification.

Introduction

This article will focus on connections between the willingness to do business, the social capital of inhabitants of the Ústí Region and other factors that could influence the decision to do business in the region, which can be an economically disadvantaged market in the framework of the Czech Republic.

In terms of theory, social capital can be divided into social and individual capital. The social approach sees social capital as characteristics of a social organisation including its trustworthiness, reciprocity, norms and networks. They contribute to better efficiency of the operation of society and simplify the coordination of joint activities (Putman, 2001). Individual social capital is a personal source for an individual embedded in their social networks, which can be activated through relations in networks (Lin, 2002). These relations are activated primarily in situations when an individual feels a need to get information or strives for a shift on a social scale. This means that social capital is a competitive advantage when fulfilling personal goals. (Coleman, 1988). The individual social capital can be further divided into bonding, or interaction, capital (available social sources) and mobilisation capital, i. e. the "mobilisation" of the sources, where the first type is a constitutional part of both the individual and the social capital (Šafr & Sedláčková, 2006).

The term "social capital" was originally a sociological term used to describe aspects of social stratification. Currently, however, it is used in all social sciences. In terms of economic literature, social capital as a topic was introduced by Becker (1997). He considers it one part of human capital; it experiences amortisation, and its effects show a characteristic of an externality (Becker, 1997). The influence of individual social capital on an improvement in (economic) power is also researched (Foley & O'Connor, 2013), as well as the access to tangible and intangible resources and the multiplicative effects of social capital on business (Debrulle, Maes, & Sels, 2014). In the framework of economic discourse, it is possible to see social capital in view of know-how distribution with a focus on the information asymmetry and related opportunities for businessmen, where the main barrier for a successful appreciation of social capital and related know-how lies in distribution channels, which can be eliminated by building a diversified portfolio of social relations (Klyver, Evald, & Hindle, 2011). In economy, social capital is approached also as a tool reducing transaction costs (Estrin, Mickiewicz, & Stephan, 2013) and making it possible to resolve problems, contributing to the reduction of risks and simplifying the decision-making process (Bowey & Easton, 2007).

The social capital has also been researched in the regional context. A study focused on peripheral regions in Switzerland has shown that local firms' ability to compete was significantly strengthened by their social capital. A positive impact was recorded particularly for the knowledge of the local environment and political individuals with decision-making rights (Habersetzer, Grèzes-Bürcher, & Boschma, 2019). The existence of the social capital is a basic prerequisite for the establishment of agriculture cooperatives (Apparao, Garnevska, & Shadbolt, 2019) and business in rural areas, however, it seems that a higher rate of the social capital does not lead to an increased business activity in more urbanized localities (Sun et al., 2019).

Despite proliferation of approaches to social capital in economic theory, the authors agree on the basic determination of the term as an investment in social relations with an expectation of future market revenues. Questionnaires or experiments, such as Putman's social capital index (Putman, 2001), summation index ISC, generators of names and positions, and more, are usually used to measure the individual social capital.

However, professional papers also describe other determinants for business activities. The most frequent ones include the unemployment rate (Apergis & Payne, 2016), the business cycle (Scholman, van Stel, & Thurik, 2015), the interest rate development (Chowdhury, Desai, & Audretsch, 2018), or combinations of some of the above-mentioned factors. Foreign direct investments and the business environment described, for instance, by the economic freedom index or the number of administrative operations necessary for the establishment of a business also play an important role in starting a business. The further growth of a company is significantly influenced by circumstances of its establishment, i.e. if it was established due to need (in a situation when employment was not an option) or due to an identified opportunity, where the latter is a stimulus for greater expansion (Dvouletý, 2018), (Farlie & Fossen, 2018).

When researching the influence of social capital on the willingness to do business, it is also necessary to reflect the factors that could have influence on the regional level, i.e. the rate of unemployment, the volume of foreign direct investments and the share of people already doing business. The Ústí Region is the fifth most populated region in the Czech Republic, thanks to the total number of 820,789 inhabitants. The unemployment rate is among the highest, currently at 4.7% (the national average reaches 2%) and there is 1.8 applicants per one available job. It is characteristic for the Ústí Region that people frequently move to Prague and the Central Bohemia Region. There is also a higher rate of internal migration activity in the region due to the geographic settlement patterns. However, the overall

migration balance was positive in the last two years as it was improved thanks to the positive foreign balance of migration. The number of inhabitants, however, decreases due to the negative population growth (CZSO, 2018).

The foreign direct investment is only very loosely integrated in the Ústí Region's economy, as only 2.4% is allocated for the Ústí Region. This also impacts the slow rate of upgrading current production capacities. The register of economic entities for the Ústí region showed 176,111 entities as of the end of last year. This figure included 139,325 self-employed people. This was a below-average value compared to the national average. The share of self-employed people of the total number of economically active people reached only slightly below-average values within the Czech Republic. Only nearly 50% of the registered people really execute activities as self-employed persons (Bisnode, 2017), and the number of active entrepreneurs has been gradually decreasing since 2013. Compared to the current period, the number of entrepreneurs was 6.5 percentage points up in the years 2009 - 2012. The educational structure in the region does not reach the average for the Czech Republic, and primarily, the share of people with a university degree lags behind the national average by 7 percentage points (the year 2017). In terms of business in the Czech Republic, men show a significantly higher share compared to women, and there are two male entrepreneurs per one female. This proportion is more favourable for women in the Ústí Region (CZSO, 2018).

1 Methods of Research

The goal of the research is to identify the role of individual social capital in relation to the willingness to do business and uncover relations tied to the decision either to do business or to consider business activities. With regard to the character of required results, the authors used the possibility of a secondary analysis of data received in the framework of the survey Development Potential of the Ústí Region executed on a sample of 1,362 respondents. It was a quota sampling among inhabitants of the Ústí Region aged 20 – 70 years. Quotas determined variables: age, gender, education, economic activity, the size of a municipality and the structural division of a region. The sample is representative, and it is thus possible to generalise the results of the questionnaire survey to all inhabitants of the Ústí Region. The data was collected in March and April 2018 by face-to-face structured interviews (non-standardised questionnaire). The questionnaire was of an omnibus survey nature. However, only questions focused on the willingness to do business and the dimensions of the individual social capital were intentionally chosen for the purpose of researching the influence of the social capital on business.

The individual social capital in this research was operationalized on two levels – its bonding form as relations to family and friends and faith in help from them and the mobilisation form as instrumental possibilities of help in important situations.

The data were processed with the software SPSS. The authors used exploratory factor analysis and then created summation indices and used multinomial logistic regression.

2 Results of the Research

To be able to deal with the problem of the willingness to do business in the context of social capital and other variables, it is necessary to mention how business activity or the consideration of being involved in some kind of business is distributed across the population. More than two thirds of people (68%) completely reject the idea. 8% of respondents actually do or did business, and 9% of the respondents have admitted considering doing business (categories *I seriously considered that* and *Sometimes I think that* were merged). A total of

15% of respondents have chosen the answer *It came to my mind, however, I have not considered it seriously.*

Social capital, measured as a rate of consent with statements characterising particular shapes of social relations and networks, after the factor analysis application really confirmed the logic of the division to two kinds of social capital. The first factor is formed by parts connected with the instrumental involvement of social relations when solving different life situations and problems. It represents mobilizing social capital. The second factor connects parts of the bonding part of the social capital (relations among relatives and friends).

Summation indices were used in the framework of particular factors (the suitability of their use was verified by Cronbach's alpha), and mobilizing social capital was divided into strong ("I have always or nearly always someone to turn to"), medium, weak, or none ("I have no one to turn to in the given situation"). The bonding family capital reached different values in absolute figures, and all respondents have shown at least some, so the authors used a different labelling – above average, average, and below-average.
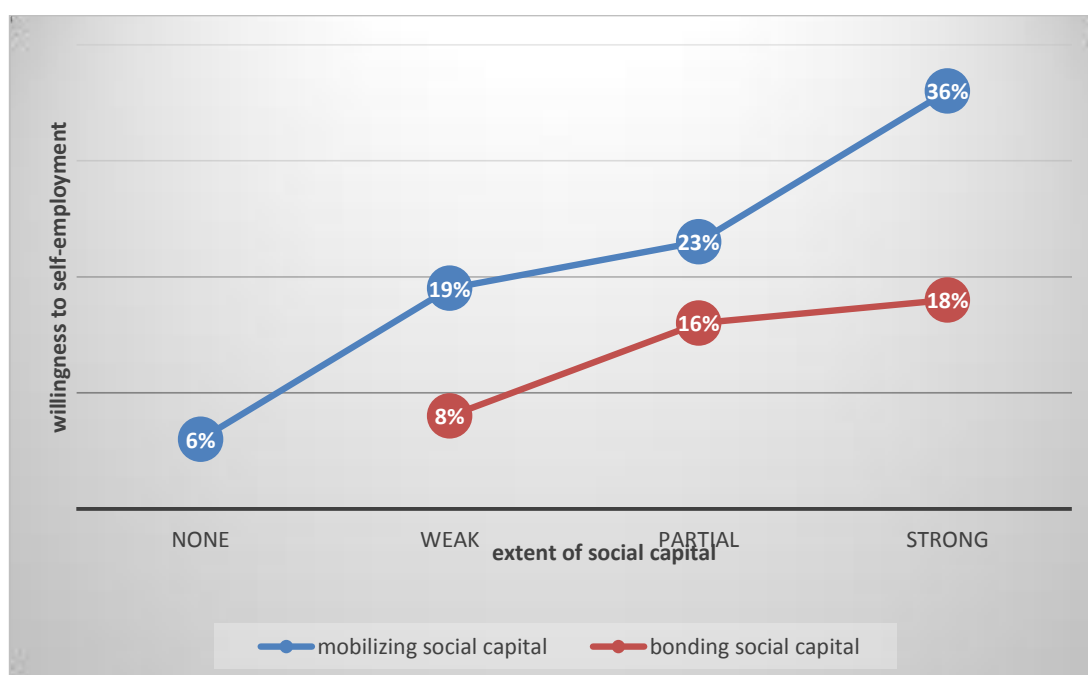
Source: authors' own calculations

Fig. 1: *Willingness to do business depending on social capital*

Such adjusted social capital was put in relation with the willingness to do business or to consider it, as monitored in the questionnaire. When involving particular parts or both factors, the influence of the bonding social capital was insignificant. However, it was possible to see a statistically significant (p-value 0.00) relation with the mobilizing capital. Figure 1 shows that the higher the value of the mobilisation social capital is, the more frequently respondents are willing to consider doing business. The value of the correlation coefficient reaches 0.2, i.e. a medium strength of relation.
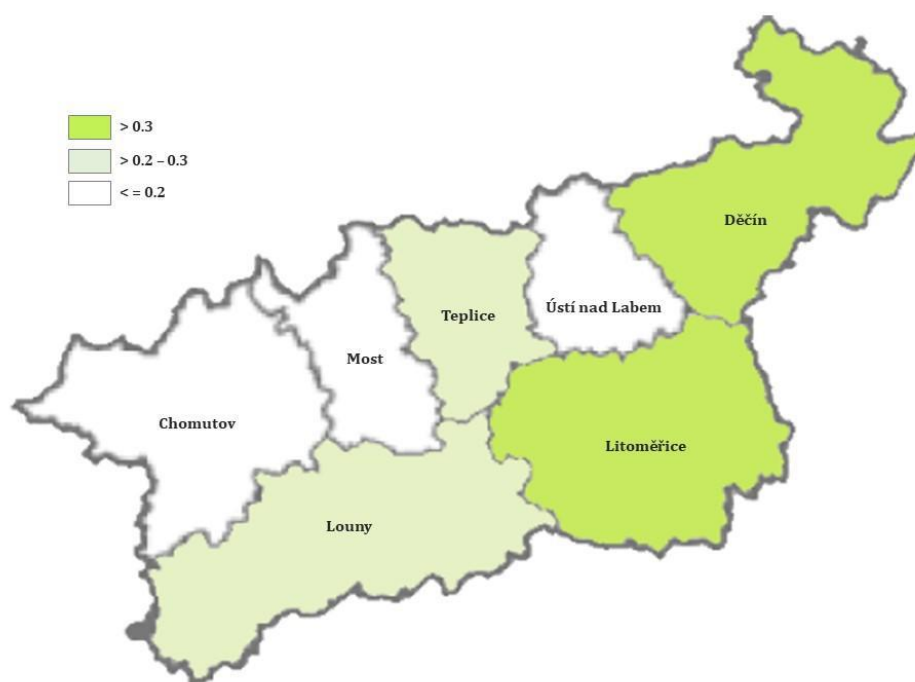
Source: authors' own calculations

Fig. 2: *Relation of the mobilizing social capital with the willingness to do business in particular districts of the Ústí Region (value of correlation coefficient)*

The survey also showed that the influence of the mobilizing social capital on the willingness to do business was different in particular districts (see Figure 2). The correlation shows the highest figures in the districts of Litoměřice and Děčín, where the Kendall's tau coefficient exceeds 0.3, so the correlation is medium high. Each of the districts has a different character of infrastructure. The district of Litoměřice is close to Prague and shows a high development potential, while the district of Děčín has a character of social and regional exclusion (poor infrastructure, low population density). Mobilizing social capital has different roles. It is rather a necessity and expression of a higher level of control over one's economic situation in the case of the district of Děčín, while in the district of Litoměřice it is rather about the perception of a competitive advantage related to the geographic proximity of the economic centre. On the other hand, it is apparent that there is practically no individual social capital in districts characterised by large industrial enterprises and opportunities for employees, such as in Ústí nad Labem, Most and Chomutov. People decided to do business based on different factors there (Kendall's tau coefficient at 0.1).

Additional variables influence the process of making decisions about doing business. A statistical significance (p-value 0.00) was, for instance, registered for the relation with considerations about moving out of the region, which could be a statement about flexibility and also personal dissatisfaction with the situation in the region by respondents mentioning a higher willingness to do business.

A multinomial logistic regression was processed in relation to considerations about what other influences enter into the process of making decision about doing business. It included, as independent variables, not only social capital, but also gender, level of education, involvement in the local politics, size of municipality and region. This also proved that bonding social capital does not relate to making decisions about doing business nor to the size of a municipality. Neither involvement in local politics nor the gender of respondents have proven a relation with the willingness to do business, even though in terms of already active entrepreneurs, the share of male and female entrepreneurs is significantly uneven with

a significant dominance of men. The category of education plays its role; more educated people, who show also a higher mobilizing social capital, consider doing business more often. In the case of the mobilizing social capital, it was necessary to adjust the effect of the category *I already do or did business* first, as the mobilizing social capital can be either the cause or the result of the activity. However, it is possible to find a higher rate of social capital also among those rejecting the idea, so it is possible to talk about a correlation.

3 Discussion

All executed statistical analyses very convincingly prove the fact that social capital is divided into two completely independent parts in the case of the willingness to do business. They are bonding social capital, whose influence can be completely ignored in this regard, and mobilizing social capital, which is, on the other hand, very important in the process of decision-making concerning business activities. This can be interpreted as the main influence of the activity of individuals, contrary to their social status determined by their origin. The role of mobilizing capital can be different, as it is shown, for instance, by the regional diversification. However, it is without doubt that "useful acquaintances" in different fields of life unquestionably strengthen the willingness to do business.

A higher willingness to do business in the district of Děčín provides evidence of a relation with factors other than social capital. The greater willingness to do business in the district of Děčín is caused rather by structural causes related with the region than by the rate of social capital. The results also indicate that a low level of willingness to do business is also influenced by the current favourable situation in the labour market. Even though the unemployment rate in the Ústí Region is more than two times higher than the national average, it is still at its long-term low. Business is thus perceived as an alternative to a more preferred employment, and people are not as interested in self-employment in the environment of a higher offer of employment opportunities. This also explains the fact of why many business entities do not grow, because business caused by "need" does not have such growth potential, contrary to the use of opportunities on the market, as it has also been proven by other papers (Dvouletý, 2018).

The fact that doing business is most often considered by those thinking about leaving the region can be interpreted on two levels. It can be either individual potential including flexibility, a will for a change on any level of life, or maybe dissatisfaction with the conditions of life in the region, which is more visible in more self-confident and independent respondents. Or it can be outer, socio-economic, factors, i.e. that conditions for business in the region are not considered favourable (for instance, due to lower foreign direct investments), or do not reflect the change of the business environment, whose relation with a particular locality decreases and makes geographic flexibility possible for entrepreneurs (for instance in relation with the development of online business).

Conclusion

Even though the business segment has an important position in the Ústí Region, its role could be rather weaker in the future. There is no motivation for business activities in the situation where economic growth is followed by decreasing unemployment. It is possible to expect higher interest in doing business if the situation changes. However, the growth will be low. The remaining newly emerging enterprises based on ideas and developed social relations are threatened by a possible relocation to some other region of the Czech Republic. This could make worse the already unfavourable trend of departures of the educated population (brain drain), the level of which is currently significantly lower compared to other regions. A lower level of attractiveness of the region for foreign direct investments is a factor making the

business activity weaker. The question is: Will the Ústí Region be able to find a way to make conditions for entrepreneurs attractive enough to prevent further outflow of economically active and self-supporting inhabitants?

Acknowledgements

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SOCIÁLNÍ KAPITÁL A PODNIKÁNÍ V REGIONÁLNÍM KONTEXTU

Článek je zaměřen na souvislost mezi ochotou podnikat a individuálním kapitálem v kontextu Ústeckého kraje jako příkladu znevýhodněného regionu. Sociální kapitál se dělí na dluhopisový kapitál spojený s rodinnými a přátelskými vztahy a mobilizující kapitál související s instrumentálním řešením situací pomocí sociálních vztahů. Příspěvek využil sekundární analýzu dat získaných pomocí dotazníkového šetření, které bylo reprezentativní pro obyvatele Ústeckého kraje. Výsledky ukázaly, že ochota podnikat byla spojena s mobilizací sociálního kapitálu, zatímco propojení sociálního kapitálu nehrálo žádnou roli. Analýza však také zahrnuje další proměnné, protože role sociálního kapitálu se liší například v regionech: lidé s vyšším vzděláním jsou ochotni podnikat a totéž platí i pro lidi, kteří deklarovali ochotu opustit region. Komplex proměnných souvisejících s nízkou úrovní ochoty podnikat nelze omezit na mobilizaci sociálního kapitálu. Je však také nutné zohlednit jeho významnou úlohu.

SOZIALES KAPITAL UND UNTERNEHMEN IN REGIONALEM KONTEXT

Dieser Beitrag befasst sich mit dem Zusammenhang zwischen der Bereitschaft zum Unternehmen und dem individuellen Kapital im Kontext des Aussiger Bezirks (Ústecký kraj) welcher als Beispiel einer benachteiligten Region dient. Das Sozialkapital gliedert sich in Schuldscheinkapital, welches mit Familien- und Freundschaftsbeziehungen im Zusammenhang steht, und in mobilisierendes Kapital, das mit der instrumentellen Lösung der Situationen mit Hilfe sozialer Beziehungen zu tun hat. Der Beitrag macht sich die Sekundäranalyse der Daten zunutze, welche mit Hilfe einer Fragebogenuntersuchung eingebacht wurden. Diese Untersuchung war für die Einwohner des Aussiger Bezirks repräsentativ. Die Ergebnisse zeigen, dass die Unternehmensbereitschaft mit der Mobilisierung des sozialen Kapitals verbunden ist, wohingegen die Einbindung des sozialen Kapitals bislang keine Rolle gespielt hat. Die Analyse umfasst jedoch auch weitere Variable, da die Rolle des sozialen Kapitals in den einzelnen Regionen unterscheidet: Menschen mit einer höheren Bildung sind bereit zu unternehmen, und das Gleiche gilt für Leute, die bereit sind, die Region zu verlassen. Der Komplex der mit der niedrigen Unternehmensbereitschaft zusammenhängenden Variablen lässt sich nicht auf die Mobilisierung und das soziale Kapital beschränken. Es ist jedoch notwendig, dessen bedeutende Rolle zu berücksichtigen.

KAPITAŁ SPOŁECZNY I PRZEDSIĘBIORCZOŚĆ W KONTEKŚCIE REGIONALNYM

Artykuł poświęcony jest zależności pomiędzy chęcią prowadzenia działalności gospodarczej a indywidualnym kapitałem w kontekście samorządowego kraju usteckiego, będącego przykładem zdefaworyzowanego regionu. Kapitał społeczny dzieli się na kapitał wiążący związany z relacjami rodzinnymi i przyjacielskimi oraz kapitał mobilizujący związany z instrumentalnym rozwiązywaniem sytuacji przy pomocy więzi społecznych. W opracowaniu wykorzystano wtórną analizę danych pozyskanych w drodze badań ankietowych, które były reprezentatywne dla mieszkańców kraju usteckiego. Wyniki pokazały, że chęć prowadzenia działalności gospodarczej była związana z mobilizacją kapitału społecznego, natomiast więzi kapitału społecznego nie odgrywały żadnej roli. Analiza obejmuje także inne zmienne, ponieważ rola kapitału społecznego różni się przykładowo w regionach: ludzie z wyższym poziomem wykształcenia są bardziej chętni do prowadzenia działalności gospodarczej i to samo dotyczy osób, które deklarowały chęć do wyjechania z regionu. Zespół zmiennych związanych z niskim poziomem chęci do prowadzenia biznesu nie można ograniczyć do mobilizacji kapitału społecznego. Należy jednak uwzględnić jego ważną rolę.

AN ALTERNATIVE APPROACH FOR ESTIMATING GDP GROWTH RATE: FUZZY PREDICTION MODEL

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Abstract

The inaccuracy of the predictions of the future growth rate of output is due to the lack of information needed to eliminate uncertainty. The aim of the paper is to predict the growth rate of the output within a short time period using the fuzzy approach, which is an appropriate tool for analyzing problems burdened by uncertainty. First, we briefly compare the fuzzy approach with the statistical methods in the cases where predictors face a non-deterministic environment. The principles of the fuzzy set theory is described and then applied in the gross domestic product growth rate prediction of Greece for the years 2018 (compared to the reported econometric forecast) and 2020 (a new contribution to the paper). The forecasts lean on the input components of the previous four-year development of three macroeconomic indicators (long-term interest rates, investments and unemployment) published in the OECD.stat, which are the basal input parameters of the task. The fuzzy prediction results showed no significant deviations from the statistical predictions. Nevertheless, the model input data monotonic development enabled us to demonstrate one of the ways by means of which the experts can correct the deficiencies of the fuzzy algorithm. Herein identified deficiency is the missing information originating from the input data, which the fuzzy algorithm did not work with. The appropriate corrective measure of the fuzzy model has been chosen and applied.

Keywords

Short-term prediction; Non-deterministic environment; Fuzzy approach; Expert knowledge.

Introduction

The inaccuracy of the outcome of the prediction of the future growth rate of any state output is due to the lack of information needed to the complete elimination of uncertainty we face in every non-deterministic environment. This uncertainty is associated with both the inputs to the prediction model and its functioning. In the first case, we talk about "*external*" uncertainty stemming from the incomplete knowledge of the relevant values of *known* factors entering the prediction model (López-Duarte & Vidal-Suárez, 2010). They, together with the *unknown* values and therefore not considered factors in the model, influence the future growth rate of the output. In the latter case, we talk about the "inner" uncertainty stemming from the approximate character of the formal description of the considered relationships between inputs and outputs of the prediction model (Bloom, 2009). In each of these cases, we can encounter the uncertainty of two different kinds. The uncertainty in terms of randomness, whose *objectively identified* basic statistical characteristics are known, and uncertainty in the sense of "*fuzziness*", which predominantly derives from the vagueness of the terms (e.g., few, little, approximately, a little, essentially, simply, complexly, significantly, analogously, etc.)

occurring in the description of the situation and indicating the *subjective understanding* of intuitive concepts (Herrera & Herrera-Viedma, 2000; Cabrerizo et al., 2015).

Econometrics silently identifies uncertainty with randomness by considering the existing uncertain alternatives as equally probable in the context of the *indifference principle* (see Dubois, 2006) and building the prediction models solely on the basis of the probability theory and mathematical statistics (see e.g., Timmermans et al., 2017 or Vochozka et al., 2019). Observed data sets are represented by a system of impartial point estimates of selected characteristics (statistics) from which the predictive model derives a *statistically* expected value of the result. The sophisticated and complicated multiple regression algorithms help to extract as much information as possible from the available data.

However, a number of system theory authorities (see, for example, Zadeh (1996) or Herrera et al. (2009)) call into question the effectiveness of decision-making and management procedures based on the approximation of uncertainty with randomness. In terms of uncertainty, their works operate with the terms of *linguistic variables* formalized by *fuzzy sets* instead of the numerical values of *random variables*. Zadeh´s work conception of terms as representatives of intuitive concepts is in line with Kahneman´s conception of the functioning of the human mind (see Kahneman, 2003).

The aim of the paper is to present the fuzzy algorithm of the short-term prediction of the output growth rate operating under conditions of inner uncertainty and formulated within Zadeh´s fuzzy approach offering *subjectively* expected values as an alternative to *statistically* expected values. It deals with the fuzzy algorithm of the progression of the time series, specified in the methodological part, which is preceded by a brief discussion of the basic principles of the fuzzy approach. In the application section, the fuzzy algorithm is used for the estimation of the GDP growth rate of Greece in 2018 (the comparison with the published econometric forecast) and 2020 (a contribution to the paper).

1 Methods of Research: The Fuzzy Approach

The *fuzzy approach* can be traced in different versions of fuzzy logic, which was formed by adapting the binary numerical characteristics of the proposition operators to the interval $\langle 0.1 \rangle$ (Hašková & Fiala, 2019). The fuzzy logic performs a tool for handling fuzzy sets, the theory of which was published by Zadeh (1973).

1.1 Principles of the Fuzzy Set Theory

Let the set U be a field of consideration or discussion. Let $\mu_{\underline{A}}: U \to \langle 0,1 \rangle$ be a membership function and let $\underline{A} = \{(y, \mu_{\underline{A}}(y)): y \in U\}$ be a set of all pairs $(y, \mu_{\underline{A}}(y))$ in which the numbers $0 \leq \mu_{\underline{A}}(y) \leq 1$ assign to the given $y \in U$ a membership degree of the pair $(y, \mu_{\underline{A}}(y))$ to the set $\underline{A}$. Then $\underline{A}$ is a *fuzzy subset* on the universe U. The significant characteristic of fuzzy subset $\underline{A}$ is its support $U_{\underline{A}} = \{y: 0 < \mu_{\underline{A}}(y) \leq 1, y \in U \} \subset U$. In terms of fuzzy logic $\mu_{\underline{A}}(y) = |y \in U_{\underline{A}}|$. The element $y \in U$ with $\mu_{\underline{A}}(y) = 0.5$ is called the *crossover point* in $\underline{A}$. In the case of values greater than 0.5, the element y rather belongs to $U_{\underline{A}}$, in the case of the smaller ones it rather does not belong to it (Dubois & Prade, 1996).

In this paper, the numerical fuzzy sets are formal representations of terms of linguistic variables. For our purpose, the model with one internal and two border fuzzy sets for the terms *low* (*L*), *common* (*M*), and *high* (*H*) value is suitable. Interval U is divided with the points a, b, c, d into five sections with the following membership functions (1):

(L)
$$\mu L(y) = 1 \text{ for } y < a,$$
$$\mu L(y) = (b - y) / (b - a) \text{ for } a \leq y < b,$$

$$\mu L(y) = 0 \text{ otherwise.}$$

(M)
$$\mu M(y) = (y - a) / (b - a) \text{ for } a \leq y < b,$$
$$\mu M(y) = 1 \text{ for } b \leq y < c,$$
$$\mu M(y) = (d - y) / (d - c) \text{ for } c \leq y < d,$$
$$\mu M(y) = 0 \text{ otherwise.}$$

(1)

$$\mu H(y) = 0 \text{ for } y < c,$$
(H)
$$\mu H(y) = (y - c) / (d - c) \text{ for } c \leq y < d,$$
$$\mu H(y) = 1 \text{ otherwise.}$$

The expert determines the position of the points a, b, c and d in the universe U. In the case of their regular distribution, we get the courses of the functions μ shown in Figure 1 in section 2. From it we see that the linguistic variable acquires the values at two levels: at the level of the basal values y in the universe U and at the level of terms (intuitive concepts) as fuzzy subsets of $\underline{L}$, $\underline{M}$, $\underline{H}$ in the universe U. Each of these terms is defined by its membership function $\mu_{\underline{L}}$, $\mu_{\underline{M}}$, $\mu_{\underline{H}}$ over the field of its support, which is a subset of U.

Another important tool of the fuzzy set theory is the *rule*. In our considered model with n input linguistic variables and one output linguistic variable it is an element $((\underline{A}_1,\ldots, \underline{A}_n), \underline{C})$ of the relation $F \subset (\{\underline{L}_1, \underline{M}_1, \underline{H}_1\} \times \ldots \times \{\underline{L}_n, \underline{M}_n, \underline{H}_n\}) \times \{\underline{L}, \underline{M}, \underline{H}\}$, which is a projection $F: (\{\underline{L}_1, \underline{M}_1, \underline{H}_1\} \times \ldots \times \{\underline{L}_n, \underline{M}_n, \underline{H}_n\}) \rightarrow \{\underline{L}, \underline{M}, \underline{H}\}$ in the form of $F(\underline{A}_1,\ldots, \underline{A}_n) = \underline{C}$, where $\underline{C} \in \{\underline{L}, \underline{M}, \underline{H}\}$ and $\underline{A}_i \in \{\underline{L}_i, \underline{M}_i, \underline{H}_i\}$, $i = 1,\ldots,$ n. The n-tuple of terms $(\underline{A}_1,\ldots, \underline{A}_n)$ is the left side of the rule, the term $F(\underline{A}_1,\ldots, \underline{A}_n)$ is the right side of the rule. The relation F has a maximum of n^3 elements. We call it a set of *inferential* rules (Běhounek & Cintula, 2006).

One of the basic concepts of the fuzzy set theory is the so-called extension principle (in detail see Kahraman, 2008). Our modification of the extension principle is based on the following steps:

- *Fuzzification* in which the input vector $x = (x_1,\ldots, x_n)$ converts each inference rule from the set P into the *logical* notation mode.
- *A set of partial results* is a set $B = \{\min\{\min\{\mu_1(x_1),\ldots, \mu_n(x_n)\}, \mu_{\underline{B}}\}: (\min\{\mu_1(x_1),\ldots, \mu_n(x_n)\}, \mu_{\underline{B}}) \in P*\}$.
- *Aggregation* or summation of functions of set B into a compact unit and its aggregate μ_{agg} detection; this compact unit is a fuzzy subset on the universe V with $\mu_{agg} = \max\{\min\{\min\{\mu_1(x_1),\ldots, \mu_n(x_n)\}, \mu_{\underline{B}}\}: (\min\{\mu_1(x_1),\ldots, \mu_n(x_n)\}, \mu_{\underline{B}}) \in P*\}$.
- *Defuzzification*, which transforms the result from the level of terms (the function $\mu_{\underline{AGG}}(y)$ of the fuzzy set $\underline{AGG}$) into $y_0 \in Y$ in the space of basal values of the output linguistic variable. We ascertain the basal value y_0 as the horizontal coordinate of the center of gravity of the area under the course of the function $\mu_{\underline{AGG}}(y)$. Thus:

$$y_0 = \int y \cdot \mu_{\underline{AGG}}(y)\mathrm{d}y / \int \mu_{\underline{AGG}}(y)\mathrm{d}y \qquad (2)$$

where $\int$ is the symbol of a certain integral over the universe Y.

Since the resulting constant y_0 is largely the result of the subjective experience and opinions of experts who created the model, we call it a *subjectively* expected value.

1.2   Task Assumptions and Input Data

The formulation of the fuzzy prediction model of the next time series member has its own specificity consisting of the fact that previous members of the resulting series are known (the historically measured values). Specifically, in the case of the GDP growth prediction it is

possible to estimate the phase of the current GDP development (decline, depression, growth, stable boom, etc.). We also know the previous part of the baseline values of several linguistic variables, on which GDP depends (albeit, largely vaguely). This is reflected in the values of the extreme limits within which we look for the result of the prediction.

Table 1 lists the baseline values of LTI (long-term interest rate), INV (percentage increase in investment), UNE (percentage of unemployment) and the output linguistic variable ΔGDP% (the GDP growth rate) of Greece between the years 2010 and 2017 and their econometric forecasts in 2018 and 2019 (the color-highlighted columns in Tab. 1).

Tab. 1: *Input macroeconomic data for the fuzzy short term prediction model of GDP growth rate in Greece*

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
LTI	9.1	15.7	22.5	10.1	6.9	9.7	8.4	6.1	5.3	5.1
INV	-19.3	-20.5	-23.5	-8.4	-4.7	-0.3	1.6	3.3	7.2	7.5
UNE	12.7	17.9	24.4	27.5	26.5	24.9	23.5	21.5	20.1	18.4
ΔGDP%	-5.5	-9.1	-7.3	-3.2	0.7	-0.3	-0.2	1.4	2.3	2.0

Source: OECD Data: Gross domestic product (GDP), 2018; Investment (GFCF), 2018; Long-term interest rates, 2018; Unemployment rate Total, 2018 – own processing

The opinion of a knowledgeable expert is an important specificity of the fuzzy model formulation; the expert takes his/her knowledge and experience into account through qualified interventions in the model structure and the inference rule formulation (Krueger et al. 2012).

The model works with the *dimensionless* basal values of the output universe Y and the input universes U_{LTI}, U_{INV}, U_{UNE} located within the interval $\langle 0, 100 \rangle$ and obtained by *converting the given basal values* of the respective linguistic variables. The conversion of the inserted basal value x of the universe of the *output* linguistic variable to the dimensionless value $y \in Y$ is given by the formula $y = 100 \cdot (x - x_{min}) / (x_{max} - x_{min})$, where x_{max} and x_{min} is the highest and the lowest a priori (subjectively) expected result value respectively. For the conversion in the opposite direction $x = (y \cdot (x_{max} - x_{min}) / 100) + x_{min}$ applies.

If the predominant element strategy is chosen in formulating the system of inferential rules with three inputs, then for the conversion of the value x of the universe of the *input* linguistic variable having a positive or featureless influence on the output linguistic variable it applies that $u = 100 \cdot (x - x_{min}) / (x_{max} - x_{min})$. In the case of a negative influence on the output linguistic variable, $u = 100 - (100 \cdot (x - x_{min}) / (x_{max} - x_{min}))$ holds.

In both of the latter mentioned cases x_{max}, or respectively, x_{min} is the highest, or respectively, the lowest given value x within the monitored period.

In our case, the output linguistic variable is the growth rate of the GDP in the year immediately following the monitored period. The percentage increase in investments (INV) increases the growth rate of GDP (a positive effect); high value of interest rates (LTI) tends to decelerate the GDP growth rate (a negative impact); unemployment (UNE) in connection with the real product at the level of its potential has a rather vague effect on the GDP growth rate.

2   Results of the Research

The course of the ΔGDP% (see Table 1) during the period 2014 - 2017 shows a recession phase with a subsequent recovery in 2017 of the Greek economy. The economic growth is expected to continue in the coming years (see European Economic Forecast, 2018). The formulation of the **predictive fuzzy model for the year 2018** is based on the characteristics of this period.

A priori expected value of ΔGDP% for the year 2018, according to the expert's opinion, is searched for within the limits of the given values $x_{min} = 1$, $x_{max} = 2.5$; e.g., the conversion of the ΔGDP% value given in 2017 is $y_{17} \approx 27$ ($100 \cdot (1.4 - 1) / (2.5 - 1) = 26.66$). Analogously, for the converted values in 2017 of the given inputs the following applies:

- $u_{LTI} = 100 - (100 \cdot (6.1 - 6.1) / (9.7 - 6.1)) = 100$;
- $u_{INV} = 100 \cdot (3.3 + 4.7) / (3.3 + 4.7)) = 100$;
- $u_{UNE} = 100 - (100 \cdot (21.5 - 21.5) / (26.5 - 21.5)) = 100$.

These outcomes result from the fact that all data uploaded in 2017 are the extreme values (maxima or minima) of the period under consideration. Generally, we can write:

- $u_{LTI} = 100 - (100 \cdot (x_{min} - x_{min}) / (x_{max} - x_{min})) = 100$;
- $u_{INV} = 100 \cdot (x_{max} - x_{min}) / (x_{max} - x_{min})) = 100$;
- $u_{UNE} = 100 - (100 \cdot (x_{min} - x_{min}) / (x_{max} - x_{min})) = 100$.

Thus, the triple $(100, 100, 100) \in U = U_{LTI} \times U_{INV} \times U_{UNE} = \langle 0, 100 \rangle^3$ of internal (converted) input values has been created (see point 1 in section 1.1).

Because of the high *external* uncertainty (e.g., the uncertain impact on the Greek economy resulting from the approval of the reform package requested by creditors in the framework of the international rescue program – see Council of the European Union, 2018) and *internal* uncertainty of the model we choose the points a, b, c, d within the interval $\langle 0, 100 \rangle$ evenly distributed (a = 20, b = 40, c = 60, d = 80), (see formula (1) in Section 1.1). Therefore, the courses of the membership functions of the converted output and all the converted inputs are identical (Fig. 1, in which these courses are plotted above the domain of universe Y of converted values of the output linguistic variable):
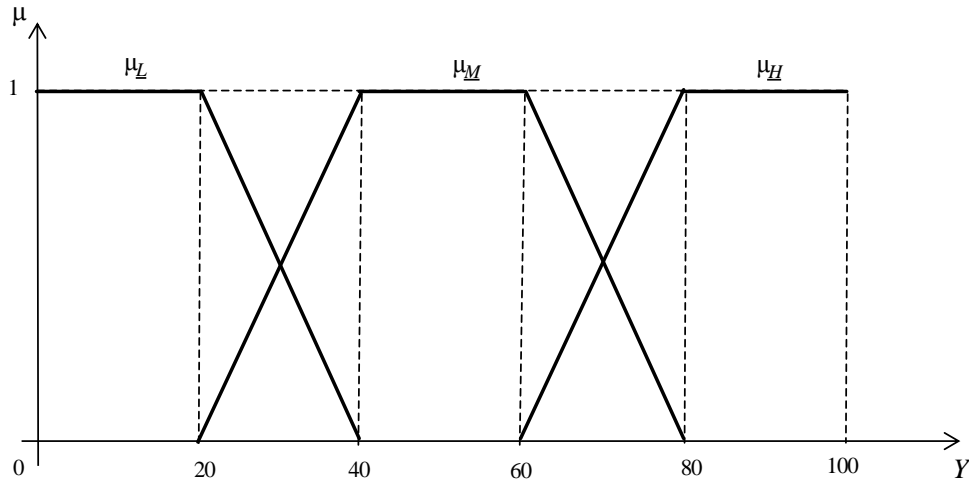
Source: Courses of the membership functions with even distribution of the points a, b, c, d within the interval values y ∈ Y = <0, 100>
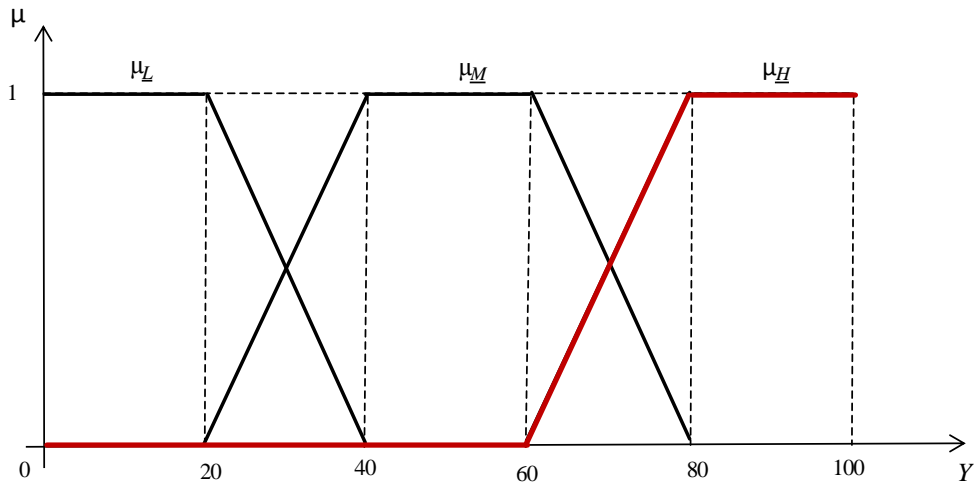
Fig. 1: *Courses of the membership functions with even distribution of the points a, b, c, d within the interval values y ∈ Y = <0, 100>*

The following *fuzzification table* valid for i = LTI, INV, UNE, whose elements are the values $\mu_{Ai}(u_i)$, where index $\underline{A} \in \{\underline{L}, \underline{M}, \underline{H}\}$, is derived from the above stated equations and inequalities:

Tab. 2: *Fuzzification table valid for i = LTI, INV, UNE*

Interval	$u_i < 20$	$20 \leq u_i < 40$	$40 \leq u_i < 60$	$60 \leq u_i < 80$	$u_i \geq 80$
L_i	1	$(40 - u_i) / 20$	0	0	0
M_i	0	$(u_i - 20) / 20$	1	$(80 - u_i) / 20$	0
H_i	0	0	0	$(u_i - 60) / 20$	1

Source:Own

In the *fuzzification table*, only non-zero elements are taken into account, with the help of which the input vector $(100, 100, 100) \in U$ generates the set $X = \{(\underline{H}_{LTI}, 1), (\underline{H}_{INV}, 1), (\underline{H}_{UNE}, 1)\}$. From its three elements only one element set $LF = \{(\underline{H}, \underline{H}, \underline{H})\}$ can be created. The triad $(\underline{H}, \underline{H}, \underline{H})$ of the input fuzzy sets of the projection F assigns the output fuzzy set $\underline{H}$ according to the already mentioned strategy of the predominant element. For $\mu_{AGG}(y) = \max\{\min\{\min\{\mu_{A1}(x_1),\ldots, \mu_{An}(x_n)\}, \mu_C(y)\}: \underline{C} = F(\underline{A}_{1,\ldots,} \underline{A}_n), (\underline{A}_{1,\ldots,} \underline{A}_n) \in LF\}$ it then applies $\mu_{AGG}(y) = \max\{\min\{\min\{1, 1, 1\}, \mu_{\underline{H}}(y)\}\} = \max\{\min\{1, \mu_{\underline{H}}(y)\}\} = \mu_{\underline{H}}(y)$ (see the highlighted course of line in Fig. 2).

Source: Own
Fig. 2: *The course of the membership function μ_{AGG}*

For the certain integers values above the universe Y in the formula (2) it applies: $\int y \cdot \mu_{AGG}(y)dy = 2\ 533$, $\int \mu_{AGG}(y)dy = 30$, therefore $y_0 = 2\ 533 / 30 = 84.4$. After recalculation y_0 to $\Delta GDP\%$, we get the predicted value of $\Delta GDP\% = (84.4 \cdot 1.5 / 100) + 1 \approx 2.27$.

The **predictive fuzzy model for 2020** is based on the data of the 4-year period 2016-2019, with 2018 and 2019 (the highlighted columns) recording the econometric predictions of the respective values. For the conversion of the values of inputs given in 2019 in a general formula the same applies as we already encountered in 2017; again, we get the same vector $(100, 100, 100) \in U$ of recalculated inputs. All the operations with the fuzzy sets described above are repeated, μ_{AGG} coincides with $\mu_{\underline{H}}$ (see Fig. 2), with the result $y_0 = 84.4$, from which we get $\Delta GDP\% = 2.27$.

3   Results Discussion

Both of the predictive tasks had a trivial solution from the fuzzy model point of view. This results from the fact that in the monitored period the values of the observed variables accelerating the GDP growth rate increased monotonically and the values of the observed variables slowing the growth rate of GDP declined monotonously.

Nevertheless, some differences can be identified in predictive fuzzy models for 2018 and 2020. The econometric forecast predicts a moderate deceleration in the GDP growth rate for 2019 compared to 2018. This deceleration is not signaled by the uploaded data and thus, they did not enter in the fuzzy model.

The interpretation of this situation is that the econometric model utilizes the information that the fuzzy model does not work with. Regardless of whether or not experts who form the fuzzy model have this information, they should respond to the predicted slowdown according to experience gained by changing the interval of a priori expected values of ΔGDP%. For example, by reducing x_{max} to 2.2 and increasing x_{min} to 1.1. Then, by the reverse conversion of y_0 to ΔGDP% we obtain the predicted ΔGDP% = (84.4 · 1.1 / 100) + 1.1 ≈ 2 for the year 2020, i.e., at the level of the econometric forecast for 2019.

Conclusion

The aim of the paper was to present a general fuzzy system for solving managerial problems operating under conditions of internal uncertainty of the model of the solved task and formulated within the Zadeh's fuzzy approach, offering subjectively expected values as an alternative to statistically expected values. The fuzzy system works in conjunction with knowledgeable experts who, inter alia, based on experience gained, determine the limits of the interval in which the resulting value can be a priori expected; within these limits, the fuzzy algorithm then finds the "right" value.

The theoretical basis of the fuzzy algorithm leans on the transformation of one of the important concepts of fuzzy logic, the so-called extension principle, to the level of the linguistic variables and their terms in which the problem is solved. The fuzzy algorithm is applied in predicting the GDP growth rate of Greece in 2018 (compared to the reported econometric forecast) and 2020 (a new contribution to the paper). The forecast default data are the components of the previous four-year evolution of the three macroeconomic indicators (long-term interest rates, investments and unemployment). These are used in the fuzzy model formulation phase within which experts get the opportunity to take into account their knowledge and experience. The process of solving a task is purely mechanical and independent of the human factor in which the data play the role of external inputs to the fuzzy algorithm.

Both of the predictive tasks had a trivial solution from the fuzzy model point of view that did not enable adequate demonstration of the technical complexity of the respective fuzzy operations. It resulted from the fact that in the monitored period the values of the observed variables accelerating the GDP growth rate increased monotonically and the values of the observed variables slowing the growth rate of GDP declined monotonously. However, they allowed the demonstration of one of the ways through which the experts can correct the deficiencies of the fuzzy algorithm. The deficiency here was the missing information originating from the source which the fuzzy algorithm did not work with; the correction option was a change of interval limits of a priori expected result values.

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Alternativní přístup k odhadu tempa růstu HDP: Fuzzy predikční model

Nepřesnost předpovědí tempa růstu HDP je způsobena nedostatkem informací potřebných k odstranění nejistoty. Cílem příspěvku je v krátkém období předpovědět tempo růstu HDP fuzzy metodou; ta je vhodným nástrojem pro analýzu problémů zatížených nejistotou. Za tím účelem bude nejprve stručně diskutována vhodnost fuzzy přístupu v porovnání se statistickými metodami v nedeterministických případech. Základní principy teorie fuzzy množin jsou popsány a následně použity v predikci tempa růstu HDP v Řecku pro roky 2018 (ve srovnání s oficiální ekonometrickou prognózou) a 2020 (přínos příspěvku). Krátkodobá prognóza se opírá o vstupní složky předchozího čtyřletého vývoje tří makroekonomických ukazatelů (úrokové sazby, investic a nezaměstnanosti), které jsou základními vstupními parametry modelu. Výsledky fuzzy predikce neprokázaly významné odchylky od statistických předpovědí. Nicméně monotónní vývoj vstupních dat modelu nám umožnil demonstrovat jeden ze způsobů, jak mohou odborníci korigovat nedostatky fuzzy algoritmu.

Ein alternativer Ansatz zur Schätzung der Wachstumsrate BIP: Das Fuzzy-Prädikationsmodell

Die Ungenauigkeit der BIP-Wachstumsprognosen ist auf den Mangel an Informationen zurückzuführen, die zur Beseitigung der Unsicherheit erforderlich sind. Das Ziel der Artikel ist die BIP-Wachstumsrate unter Verwendung der Fuzzy-Methode kurzfristig vorherzusagen; es ist ein geeignetes Instrument zur Analyse von mit Unsicherheit verbundenen Problemen. Hierzu wird zunächst kurz auf die Eignung des Fuzzy-Ansatzes im Vergleich zu statistischen Methoden in nicht deterministischen Fällen eingegangen. Die Grundprinzipien der Fuzzy-Mengen-Theorie werden beschrieben und anschließend in der Vorhersage der BIP-Wachstumsrate in Griechenland für 2018 und 2020 verwendet. Die kurzfristige Prognose basiert auf den Inputkomponenten der vorangegangenen vierjährigen Entwicklung von drei makroökonomischen Indikatoren, die grundlegenden Inputparameter des Modells darstellen. Die Ergebnisse der Fuzzy-Vorhersage zeigten keine signifikanten Abweichungen von den statistischen Prognosen. Die monotone Entwicklung der Eingabedaten des Modells hat es uns jedoch ermöglicht, einen Weg aufzuzeigen, wie Experten Unzulänglichkeiten von Fuzzy-Algorithmen korrigieren können.

Alternatywne podejście do szacowania tempa wzrostu PKB: Rozmyty model prognostyczny

Niedokładność prognoz wzrostu PKB wynika z braku informacji niezbędnych do usunięcia niepewności. Celem artykułu jest prognozowanie tempa wzrostu PKB w krótkim okresie przy użyciu metody fuzzy; jest odpowiednim narzędziem do analizy problemów związanych z niepewnością. W tym celu w skrócie zostanie omówiona przydatność podejścia rozmytego w porównaniu z metodami statystycznymi w przypadkach niedeterministycznych. Podstawowe zasady teorii zbiorów rozmytych zostały opisane, a następnie wykorzystane w prognozowaniu tempa wzrostu PKB w Grecji na 2018 r. i 2020 r. Prognoza krótkoterminowa opiera się na elementach wejściowych poprzedniego czteroletniego rozwoju trzech wskaźników makroekonomicznych, które są podstawowymi parametrami wejściowymi modelu. Wyniki prognozy rozmytej nie wykazały istotnych odchyleń od prognoz statystycznych. Jednak monotonne opracowanie danych wejściowych modelu pozwoliło nam zademonstrować jeden ze sposobów, w jaki eksperci mogą poprawić niedociągnięcia algorytmu rozmytego.

GENERATIONS Y AND Z IN THE WORKPLACE: PERCEPTION OF TEAMWORK

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Abstract

The article presents a literary review focused on the definition of generations and perception of teamwork and communication by two chosen generations – Y (Millennials) and Z. The analysis of teamwork was subsequently carried out on the basis of a questionnaire survey conducted in 2019 on a sample of 266 respondents in the Czech Republic. The questionnaire survey was supplemented by a content analysis of company job adverts from 2016–2019 in a total of 667 analyzed adverts. One research hypothesis and two research questions were formulated. Pearson's Chi-square Independence Test was used to evaluate the hypotheses. Based on data analysis, no dependence between the selected generations and teamwork preferences was found. The data imply that respondents prefer to work in teams with people they know personally. From the content analysis of the job fair catalogs, the receding tendencies in reporting on the possibilities of teamwork in the workplaces are evident.

Keywords

Team work; Millenials; Generation Y; Generation Z; Communication.

Introduction

Teamwork is one of a series of management tools and methods which is expected to create more efficient, productive and creative organizational units. The introduction of teamwork entails, in addition to the traditional challenges of establishing team roles etc., the challenge in the form of acceptance by the employees themselves [1]. Even though this is a very subjective attitude of individuals themselves, it is possible to observe long-term trends in the approach to teamwork and cooperation. These tendencies can be observed on the basis of attitudes of individual age generations. The generations whose representatives are economically active (15–64 years old) include the generation of Baby Boomers, X, Y and Z [2]. The analysis of teamwork in this article focuses on the two youngest generations, Generation Y and Generation Z.

As can be seen from many characteristics and definitions [2], [6], [7], the age classification of individual generations is very dependent on the selected authors and specific territories (and associated historical events). The accurate age classification also alludes to the fact that it is not possible to specify by the year to which generation an individual belongs. Especially in a situation where generations are defined in addition to the yearly classification also by the specific characteristics of the members of the generations. It is therefore possible to encounter individuals who, according to the age classification, fall into a different generation than according to characteristics, personal attitudes and demands. Nevertheless, mainly for the uniform methodology of evaluation of the research, the age span classification was determined as follows:

- Baby Boomers (1946–1964)

- Generation X (1965–1982)
- Generation Y (1983–2000)
- Generation Z (2001–2010) [2], [6], [7], [8], [9].

According to a research by the personnel company ManpowerGroup [3], the share of the two youngest economically active generations will be almost 60% of the world's labor force in 2020. However, this share will be about 41% (to 2022) in the Czech Republic. In both cases it is almost a half of the workforce whose opinions, attitudes and values will largely influence the work environment and processes [4]. In addition to the positions of the Generation Y and Z, it is also necessary to compare changes between these generations. These changes can be represented by a full change of values as well as a partial change. For example, money (wages, salaries, etc.) is still the biggest motivator despite the fact that there are intergenerational differences in perception (security vs. gaining respect, ways of satisfying desires). Nevertheless, literature mentions reducing intergenerational differences, especially among young generations [5].

1   Perception of Teamwork by Generations

Changes in attitude towards teamwork are evident across all generations. According to Bencsik [10], there is a development from understanding teamwork as a natural environment in international working groups (Generation X) through confidence in success as a result of teamwork (Generation Y) to understanding teamwork at the virtual level (Generation Z). A similar conclusion is also found in the Adecco study [11]. The results of the study show that the youngest Generation Z prefers work alone and does not like to engage in teamwork tasks and collaboration. This fact is a consequence of the already mentioned cooperation on the virtual level. Similar outcomes also result from the Half˙s research [12], according to which 2/3 of the respondents prefer collaboration in a small team. The research was focused on American and Canadian students (representatives of Generation Z).

Different results were obtained in Iorgulescu's research [13], which carried out a survey on about 150 Romanian students (Generation Z). According to the conclusions, less than a half prefer work in large offices and teams. On the contrary, 1/3 of the respondents would choose a separate office and 10% of the respondents could imagine cooperation in a small team. The results are supported or influenced by the fact that 44.9% of respondents would like to work in a large international corporation. Among other things, the expectations of Generation Z that are needed for a successful career have also been explored. It was the ability to work in a team with a score of 4.28 (scale 1-5) that was placed fourth. Respondents consider it more important than the knowledge of 2-3 foreign languages or the knowledge of project management. The importance of teamwork is also confirmed by Bencsik's research [10], in which a positive relationship to teamwork is evaluated on the Likert scale (1−5) of 3.38. This fact ranks it among the top six characteristics expected from both Generation Y and Generation Z representatives.

The issue of the size of teams and offices is also analyzed by Miller [14]. Based on the research among US teenagers, the study concludes that the Millennials generally prefer a collaborative environment. In fact, many companies have removed separate offices for greater interaction and collaborative development. On the other hand, it is also mentioned that with the onset of Generation Z - on the basis of its characteristics - individualism and competitive nature begin to rise. The result is a return from open-plan offices back to a more individualistic and competitive environment. This return is also confirmed by a study by Puiu [15], according to which almost 95% of Generation Z representatives prefer individual over group approach. At the same time, the results of the research show that almost 40% of

respondents prefer "*ability to work in a team*" as one of the most important things (most, 50.5%, prefer "*problem solving*").

Despite the fact that the representatives of the Generation Z tend to be more independent, it does not mean that they cannot imagine teamwork. There is a retreat from large teams towards smaller teams where the individuals meet with long-familiar colleagues. This fact is also supported by the results of the study by Csehpapp et al. [16], according to which cheerful teams are required by 95% of Generation Z respondents (the second highest priority). Similar results have also been obtained from the ManpowerGroup's study [3], according to which 80% of the Generation Y respondents (the fourth highest priority) want to work with a team of great colleagues. Inclination for teamwork among representatives of the Generation Y is also confirmed by Oblinger and Oblinger [7].

As noted above, the different approaches of a selected generation's representatives often differ according to the locations of research. Different results were obtained from studies investigating Romanian or American Generation Z [12], [13]. It is the geographical aspect that has a great impact on the research of the characteristics of individual generations [5]. Havlíček et al. [17] apply international research to a total of 600 representatives of the Generation Z in 7 European countries. One of the researched issues is what kind of abilities the respondent prefers. Below is presented a list of country-specific "*team skills*" results:

- Cyprus: 20% of respondents,
- Czech Republic: 66% of respondents,
- Hungary: 30% of respondents,
- Poland: 7% of respondents,
- Portugal: 31% of respondents,
- Spain: 40% of respondents,
- Ukraine: 23% of respondents [17].

Of the total of 11 possibilities, the ability of *teamwork* was most often placed on 2. – 4. position. The same research included an analysis of a preferred size of a work team. The most frequent answer across all of the countries was *working in a small team*. Furthermore, the addressed representatives of the Generation Z preferred the *mostly separately* as a response. Conversely, about 5-10% of the respondents chosen the answer *work with a large team* or the answer *completely separately*. [17]

Equally important issue correlated with teamwork is also communication and information sharing in a workplace or in teams. According to Miller [14], the Generation Z representatives prefer personal communication (43%), followed by text messages (24%), telephone (14%), e-mail (11%) and social media (8%). Moreover, Bejtkovsky et al. [2] also mention that e-mail is one of the most important means of communication for Generation Y. It is evident that with the onset of the youngest Generation Z, there is a return to personal communication, which was crucial for older generations – X and Baby Boomers. Unlike the older generations, both generations (Z and Millennials) prefer communication only when needed, and it should be done more quickly and easily [10].

2   Research Methodology

The aim of the article is to analyze and outline teamwork issues in relation to selected generations, specifically to Y (Millenials) and Generation Z. Through the use of databases (Web of Science; EBSCO database) the current publishing activities related to the theme of teamwork in relation to generations are analyzed and compared. These domestic and world

studies produced good information backup for the creation of the questionnaire survey and content analysis as a primary research of the article.

2.1 Questionnaire Survey

The questionnaire survey was carried out at the beginning of 2018 among representatives of the selected Generations Y and Z, who were divided according to their years of birth (see yearly anchoring in the introduction of the work). An anonymous questionnaire survey was applied among students of the Faculty of Economics of the University of West Bohemia in Pilsen. In order to avoid homogeneity of the sample as much as possible, students of the first year of bachelor study program were selected as representatives of the Generation Z (modus 19 years). On the contrary, the students of the last fifth year of the follow-up master's study program were addressed as representatives of the Generation Y (modus 25 years). Given the fact that most students of the last year have at least partial work experience, this has also an impact on the possible undesirable increase in homogeneity of the selected sample of students. Nevertheless, it is necessary to mention that the homogeneity of the sample is one of the limitations of the research.

The questionnaire was distributed among the students using the electronic form Google documents. In addition to socio-demographic questions, the questionnaire consisted, inter alia, of the following questions: Do you prefer to work in a team or alone? (closed answers option); What kind of communication would you prefer / prefer in the work environment? (open answers option). For cleaning and processing data for further analysis, the Excel program (filters and Contingency tables) was used.

Based on the theoretical background, the following research hypothesis and research question were evaluated:

The research hypothesis: There is a statistically significant dependence between the attitudes to teamwork on the basis of membership of the selected generation (Y and Z) in the Czech Republic.

The research question (2): What correlation can be observed in communication medium preferences for selected Generations Y and Z in a workplace?

2.1.1 Structure of the Sample

A total of 266 respondents participated in the questionnaire survey. The distribution according to age and gender is shown in Table 1 below. Representation is distributed almost evenly, both in terms of the various generations and gender.

Tab. 1: The age structure of the questionnaire survey

Generation	Age span	Sex		Absolute frequency	Relative frequency
		Female	Male		
Generation Y	1983–2000	83	69	152	57%
Generation Z	2001–2010	56	58	114	43%
Total	**–**	**139**	**127**	**266**	**100%**

Source: Own questionnaire survey, 2019

2.2 Content Analysis

The second part of primary research was the content analysis. The aim of the content analysis was to identify references to teamwork in job fair advertisements. Due to the fact that the labor market is currently gradually being filled by representatives of Generation Z, the job fair catalogs of the Job Fair at the University of West Bohemia in Pilsen was subject to content

analysis. The results of the analysis can indicate a possible gradual transition in the perception of teamwork (in accordance with Generation Z) in job fair catalogs that are intended for students. To evaluate the results of the content analysis, the following research question was set.

The research question (1): *What trends in relation to teamwork can be seen in company job fair advertisements?*

Using content analysis, 667 published job advertisements were processed. All business advertisements for the years 2016-2019 were analyzed regardless of their focus (all fields were represented in the advertisements without distinction and there is no distortion of results due to the influence of specific job requirements for certain job positions). Four years are analyzed, namely the years 2016, 2017, 2018 and 2019. In those years (chronologically) 149, 165, 185 and 168 job adverts are explored. The fields of job adverts were the following: Applied Sciences, Economics, Electric Power Industry, Design, Humanities, IT, Law, Construction, Civil Engineering and IT.

Regarding the size of analyzed companies, according to the methodology of the European Union [21], the largest number of companies was represented by large companies (> 250 employees), followed by medium-sized companies (50-250 employees) and small companies (10-49 employees). For example, in 2017 and 2018, this ratio was 76% for a large business, 23% for a medium business and 1% for a small business. The dominance of large companies is mainly due to their financial possibilities to participate in job fairs.

2.3 Chi-Square Independence Test

Descriptive statistics tools, such as average, share etc. are used to evaluate the research. To evaluate other hypotheses, the results are subjected to the Pearson's Chi-square independence testing. The online statistical tool of the Social Science Statistics is used for the evaluation.

The Pearson's Chi-square test is based on the idea of comparing the observed frequencies and the so-called expected frequencies (calculated on the assumption of validity) of individual combinations of random variables X and Y. The following statistic has for the null hypothesis of independence chi-square probability distribution with parameter $(r-1)$x$(s-1)$, that is, the following applies $\chi^2 \sim \chi^2(r-1)$x$(s-1)$ [18].

$$\chi^2 = \sum_i \sum_j \frac{(n_{ij} - e_{ij})^2}{e_{ij}} \tag{1}$$

where:
X^2 – test criterion value
n – range selection
e_{ij} – expected frequency
n_{ij} – observed frequency
r – number of contingency table rows
s – number of contingency table columns [18].

The basic conditions for using this test include that the individual observations summarized in the Contingency table are independent, so each element of the sample is included in only one cell of the table. Additionally, at least 80% of the Contingency table cells have an expected frequency greater than 5, and all table cells (100% of the cells) have an expected frequency greater than 2. This assumption is related to the asymptotic properties of statistics [19].

3   Research Results

To fulfill the aim of this article one research hypothesis and two research questions were set. In this chapter, the results of the statistical processing of the data collated from the research are presented.

The research hypothesis: *There is a statistically significant dependence between the attitudes to teamwork on the basis of membership of the selected generation (Y and Z) in the Czech Republic.*

The research hypothesis, which verifies the validity of the theoretical background, focuses on the analysis of the relationship between attitude toward teamwork and generations. Respondents answered the question whether they prefer rather work in a team or alone. There were three choices: *Alone; In the team (with close people); In the team (even with strangers).* The absolute frequency of individual responses can be seen in Table 2 below. In both analyzed generations it is possible to observe that respondents prefer to work in a team with people they know personally. Working alone or in a team with unknown people / colleagues is then preferred at a similar level.

Tab. 2: *Teamwork preferences (percentages indicate the relative share related to the given generation)*

	Of one's own	Team (with close people)	Team (even with strangers)
Generation Y	34 (22%)	85 (56%)	33 (22%)
Generation Z	23 (20%)	64 (56%)	27 (24%)
Total	57	149	60

Source: Own questionnaire survey, 2019

The obtained data were further subjected to the test of independence for which the following hypotheses have been determined.

- **H_0**: *There is no relationship between the preferences of teamwork and given generation.*
- **H_A**: *There is a relationship between the preferences of teamwork and given generation.*

In other words, the alternative hypothesis claims that there is no difference between generations and their relationship to teamwork.

Tab. 3: *Verification of hypothesis by Pearson's Chi-square test*

H_1: There is a statistically significant dependence between the attitudes to the teamwork on the basis of membership of the selected generation (Y and Z) in the Czech Republic.	
The statistical method	Pearson's Chi-square test
Chi-square	0.259
Degrees of freedom (d.f.)	2
Probability (*p*-value)	0.878

Source: Own questionnaire survey, 2019

Based on the Pearson's Chi-square test of independence, which shows the *p*-value of 87.8%, we do not reject the null hypothesis at the 5% significance level. The resulting value shows a very strong independence of data, which can be interpreted as follows. The distribution of individual responses is not dependent on the generation of respondents. At the same time, on the basis of the independence test, we reject research hypothesis, which assumed the significant dependence of the variables examined.

If the data from the questionnaire survey is filtered according to the current work experience, the following outputs are obtained. The results are very similar for students. *P*-value test of independence reaches 62.2% (Chi-square = 0.9486, d.f. = 2). It indicates a slightly lower but still very strong independence statistically examined data.

On the contrary, when analyzing the data of respondents with work experience, the p-value of the Pearson's Chi-square test is 10.4% (Chi-square = 4.5236; d.f. = 2). Despite the fact that we still reject the alternative hypothesis at the 5% significance level, the results are diametrically different and cannot be marked as statistically significant.

The research question (1): What trends in relation to teamwork can be seen in job adverts?

The research question aims to analyze what changes have been made to company job adverts over the past 4 years in publishing on teamwork opportunities in the workplace. The review of the studies shows that the generation of the Millennials perceive teamwork as one of the core competencies and skills they expect in their working lives. They also expect teamwork in the workplace.

Slightly different tendencies can be observed in the Generation Z, in which a shift towards individualism becomes apparent. However, it is necessary to mention that the Job Fair at the University of West Bohemia in Pilsen focuses on recent graduates - representatives of Generation Y. The oldest representatives of Generation Z are 19 years old and are therefore not the main target group of the analyzed job adverts [2], [6], [7], [8], and [9].

The company job fairs have been subject to a content analysis that focuses on two groups of terms. The first group contains specific terms that are directly related to teamwork (*teamwork; teamwork collaboration; team player; teamwork ability; international teams; team spirit; expert teams and team communication*). These terms are often found in the requirements for a candidate or under the heading "*What we offer*". The second group contains terms that are related to teamwork rather indirectly (*join our team; our team is looking forward to you; our team of experienced colleagues is waiting for you etc.*).

Tab. 4: *Content analysis of job fair catalogs focusing on teamwork (number of companies)*

Year	Direct mention	Indirect mention	Mentions overall	Number of job adverts
2016	32	25	57	149
2017	32	34	66	165
2018	34	29	63	185
2019	25	32	57	168

Source: Own content analysis, 2019

As shown in Figure 1 below, the direct mentions of teamwork in job adverts are reduced by about two percentage points each year. Thus, companies are increasingly less inform about the possibilities or capabilities of teamwork and collaboration. Currently (2019), the term teamwork appears in only one of seven job adverts. If there is a focus on indirect mentions, no clear tendency can be observed. The results tend to oscillate around a relative value of 18%. The overall relative comparison of mentions to teamwork in job fair catalogs shows that there is a gradual decline, driven mainly by a steady decline in direct mentions.

Fig. 1: *Relative shares of results of the content analysis (%), 2016-2019*

The research question (2): *What relation can be observed in communication medium preferences for selected Generations Y and Z in a workplace?*

According to the results of the questionnaire survey shown in Table 5, it is clear that personal contact is the most preferred form of communication for both analyzed generations – particularly among Generation Z. Conversely, e-mail communication is more preferred by the Millennials. Telephone communication (text messages and calls) prefer both generations at a similar level. The results also show a gradual diversion of the youngest generation from social networks (e.g. Facebook) and a move to communication through applications that can be used on various media (PC, mobile phone).

Tab. 5: *Selection of communication media*

	Generation Y		Generation Z	
Personal	135	44%	105	50%
E-mail	74	24%	40	19%
Phone	51	16%	34	16%
Social network	26	8%	10	5%
Apps (e.g. WhatsApp)	24	8%	22	10%
Total	310	100%	211	100%

When comparing the results of the survey with the results of the Miller study (United States) [14], there is a consensus on the distribution of the resulting data. The results of the theoretical research are also confirmed by the fact that Generation Y prefers the e-mail communication or that Generation Z is gradually strengthening its preferences in personal communication [2].

4 Discussion

This article focuses on the issue of age groups, i.e. generations. The aim was to examine teamwork issues in relation to selected generations, specifically to Y (Millenials) and Generation Z. It is these two generations that will strengthen their labor market influence over the coming years. Specifically, they will account for about 40-60% of the workforce [3], [4]. On the basis of the theoretical background, the researched issue was introduced and the chosen generations were defined according to the age spans. The analysis of studies implies

that representatives of the older Generation Y have more positive relationship to the teamwork. They also support the so-called open space, which enable faster flow of information and encourage collaboration. On the other hand, Generation Z representatives show a gradual return to individualism, which is also typical for the older generations (X and Baby Boomers) [20].

The analysis also shows that various studies come to contradictory results. This difference is mainly due to the geographic point of view, where the greatest differences can be seen intercontinental (Central Europe vs. North America etc.) [12], [13]. However, according to Havlíček et. al [17], it is possible to identify certain differences also across the Europe. The results of the analysis shows that the ability in the form of teamwork and cooperation is rated by representatives of both generations as one of the most important. According to research hypotheses validation, the representatives of both generations rather prefer to work in a small team with people they know personally. These results correlate directly with the results of international research by Havlíček et al. [17], which also came to the conclusion that respondents prefer teamwork in the team with people they know personally.

Primary research in this article is represented by the questionnaire survey and content analysis. Based on an analysis of the summary questionnaire survey conducted by Pearson's Chi-square independence test, it is not possible to statistically confirm the dependence between teamwork preference and selected generations. According to the results, there is a discrepancy between the results of the questionnaire survey and the theoretical framework of the article, where differences between the preferences of individual generations were recorded on the basis of a secondary data analysis [13], [14], and [16]. A weaker dependence (near the 10% significance level) can be confirmed on data obtained from respondents with work experience. This fact may indicate that the difference in preferences of generations may be reflected only in the professional life of individuals. In the meantime (e.g. in the student years) inter-generational differences may be wiped out.

The content analysis of the job fair catalogs focused on the analysis of the issue from the perspective of employers. According to 667 analyzed job adverts for the period 2016–2019, it is possible to confirm the downward trend in references to the possibilities or abilities of teamwork in the workplace. Direct mention (see definition above) about the teamwork occurred in only 18% and 15% job adverts in the last two years. The decline can be driven by the gradually rising Generation Z, which is typical of a return to the individualism [14], [15]. For the verification or falsification of Generation Z influence, it will be necessary to continue the content analysis in the coming years. Another option is to extend the subject of analysis to other job advertisements (other job fairs). However, it should be noted that a large proportion of advertising companies operate throughout the Czech Republic, and therefore job advertisements often coincide across various job fairs.

As regards communication in the workplace, which strongly correlates with teamwork, both generations prefer a personal form. These results are also supported by the mentioned studies [2], [14]. An important finding for the setting of personnel processes and the type of communication in the workplace is that with the advent of the Generation Z, despite their considerable individualism, there is a return to personal form of communication. This was typical especially for older generations [14], [15], [16]. Representatives of Generation Y, compared with representatives of Generation Z, prefer more e-mail communication and communication on social networks. Conversely, more representatives from Generation Z prefer communication via applications like the WhatsApp and others.

5 Limitations

The research contains several limitations. First, despite its size, the research sample cannot confirm the trends of generations examined in the Czech Republic. However, the results may indicate certain patterns of behavior, which can then be verified in further research. The representativeness of the research sample is also a limitation. This was mainly due to financial possibilities limited to students of the University of West Bohemia, which had an impact on the homogeneity of respondents. They differed by about 6 years (on the range of examined Generations Y and Z), which may affect the similarity in the perception of teamwork.

Conclusion

The present article illustrates the results of research that is focused on the perceptions of the teamwork among selected Generations Y and Z. Based on the research results, it can be argued that there are no significant differences in perception and attitude of teamwork by selected generations. Although it should be noted that the validity of the hypothesis is justified only in the context of the presented research, which cannot be considered representative.

Nevertheless, the study highlights several thought-provoking issues. For example, the study shows that, when verifying the independence of data aimed only at individuals with work experience, the results of the research indicate a significantly stronger dependence of perception of teamwork across generations. This may support the idea that the perceptions and attitudes of generations in relation to the working environment are created only after gaining certain job opportunities. At the same time, on the basis of content analysis of job fair advertisements, there is presented the fact that over the past 4 years companies have not reacted in the perception of teamwork in their advertisements for the coming-in of the new Generation Z on the labor market. These results are valid with the results of a questionnaire survey, which did not confirm the difference between the examined generations in the perception of team cooperation. However, it is precisely the gradual coming-in of Generation Z into the labor market that can change the attitudes and beliefs that businesses will have to accept in their business processes.

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Ing. Jiří Kutlák

GENERACE Y A Z NA PRACOVIŠTI: VNÍMÁNÍ TÝMOVÉ PRÁCE

Článek předkládá literární přehled, který je zaměřen na vymezení generací Y (Millennials) a Z a jejich vnímání týmové práce a komunikace. Analýza týmové práce byla následně prováděna na základě dotazníkového šetření uskutečněného v roce 2018 na vzorku 266 respondentů na území České republiky. Dotazníkové šetření bylo doplněno obsahovou analýzou veletržních firemních inzerátů z let 2016–2019 v celkovém počtu 667 analyzovaných inzerátů. Byla formulována jedna výzkumná hypotéza a dvě výzkumné otázky. Pro vyhodnocení hypotéz byl využit Pearsonův chí-kvadrát test nezávislosti. Na základě analýzy dat nebyla zjištěna závislost mezi vybranými generacemi a preferencí týmové spolupráce. Z dat dále vyplývá, že respondenti upřednostňují spíše práci v týmech s lidmi, které osobně znají. Z obsahové analýzy veletržních katalogů je pak patrná ustupující tendence v referování o možnostech týmové práce na pracovištích.

DIE GENERATIONEN Y UND Z AM ARBEITSPLATZ: WAHRNEHMUNG DER TEAMARBEIT

Dieser Beitrag legt einen literarischen Überblick vor, welcher auf die Definition der Generationen Y (Millennials) und Z sowie auf deren Wahrnehmung von Teamarbeit und Kommunikation ausgerichtet ist. Die Analyse der Teamarbeit wurde anschließend auf Grundlage einer Fragebogenaktion durchgeführt, welche im Jahre 2018 am Muster 266 der Befragten auf dem Gebiet der Tschechischen Republik realisiert wurde. Die Fragebogenuntersuchung wurde durch eine umfangreiche Analyse von Firmenmesseinseraten aus den Jahren 2016-2019 ergänzt. Die gesamte Anzahl der Inserate beträgt 667. Es wurden eine Forschungshypothese und zwei Forschungsfragen formuliert. Bei der Auswertung der Hypothesen kam Pearsons Chi-Quadrat-Test zur Anwendung. Auf Grundlage der Datenanalyse wurde keine gegenseitige Abhängigkeit zwischen den ausgewählten Generationen und der Präferenz der Zusammenarbeit im Team festgestellt. Aus den Daten geht weiter hervor, dass die Befragten eher Teamarbeit mit persönlich Bekannten bevorzugen. Aus der inhaltlichen Analyse der Messekataloge wird eine rückläufige Tendenz im Referieren über die Möglichkeiten der Teamarbeit an den Arbeitsplätzen ersichtlich.

POKOLENIE Y I Z NA STANOWISKU PRACY: POSTRZEGANIE PRACY ZESPOŁOWEJ

Niniejszy artykuł przedstawia przegląd literatury, określający pokolenie Y (Millennials) i Z oraz ich postrzeganie pracy zespołowej i komunikacji. Analizę pracy zespołowej przeprowadzono w oparciu o badania ankietowe zrealizowane w 2018 roku na próbce 266 respondentów na terenie Republiki Czeskiej. Badania ankietowe uzupełniono przedmiotową analizą firmowych ogłoszeń o pracę z lat 2016-2019, przy czym łącznie przeanalizowano 667 ogłoszeń. Sformułowano jedną hipotezę badawczą oraz dwa pytania badawcze. W celu oceny hipotezy wykorzystano test niezależności chi-kwadrat Pearsona. Na podstawie analizy danych nie stwierdzono zależności pomiędzy wybranymi pokoleniami a preferowaniem współpracy zespołowej. Ponadto z danych wynika, że respondenci bardziej wolą pracę w zespole z ludźmi, których osobiście znają. Z analizy przedmiotu katalogów firmowych wynika zaś widoczna znikająca tendencja prezentowania możliwości pracy zespołowej na stanowiskach pracy.

CHALLENGES FOR ACHIEVING COMPETITIVENESS IN THE EU AUTOMOTIVE INDUSTRY

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Abstract

A clear understanding of customer's needs is an essential aspect in the pursuit of competitiveness in companies. Answering the question which one delivers the best product or service becomes harder as the time flows, as all of them are in pursuit of achieving the same goal: truly understand how the market behaves. It is a fact that competitiveness and benchmarking process among automotive companies are challenging in a stable global economic scenario. How would those processes look like in a global economic crisis? Which challenges will companies have to address in order to be competitive in this scenario? This article presents a case study of a global automotive supplier and the challenges it faced during the 2008-2009 economic crisis over statistical analysis of its demand and downtimes, where many lessons learned from this scenario could be studied for better prediction and handling future ones.

Keywords

Benchmarking; Competitiveness; Automotive industry; Global financial crisis.

Introduction

The question which company delivers the best product or provides the best service becomes harder as the time flows, as all of them are in pursuit of achieving the same goal: truly understand which the customer's needs are. Due to the evolution of humanity and its faster means of knowledge dissemination throughout the globe, those demands become more complex to fulfill, as products and services need to be more customizable, adaptable and, at the same time, reliable, robust and with great quality evaluation. These aspects seem to be very subjective when different markets are analyzed but there is certainly one aspect that needs to be taken into consideration so that a product, a service and, consequently, a company be competitive: the lowest selling price possible. And taking it deeper into the production or aggregate value chain, the statement becomes a matter of who actually delivers the lowest cost possible.

In order to compare companies of a same market, the process of benchmarking has been used since its first publication in 1989, where the ones which are rated as market leaders or detain the biggest market share or also considered a reference according to a determined comparison parameter (e.g. Quality control, cost, lead time, reliability, robustness, service level and others) set the level for the other competitors (Delbridge, 1995 et al). It also provides support for comparison of different plants and processes of one company, finding possible gaps and improvement opportunities within the production processes.

Leading the discussion to the automotive industry, competitiveness and benchmarking processes are even more sensible, as its processes and products have a high complexity level and a huge impact on the world economy (Žižka, 2016). It's not only a matter of which company has the lowest production costs, but also a very detailed quality control program (mostly implemented with Total Quality Management), maintenance of production machinery and aftersales, spare parts control, internal and external logistics, administration of the supply chain and a very important, key aspect: the environmental impact (Sulírová et al., 2017). Clearly, it's not a simple process to determine which automotive brand would be called as the "best-in-class". It's mainly a matter of which parameter(s) is (are) taken into consideration for comparison. Another important aspect worth mentioning is the geographical effect of the market, which is deeply related to the customer profile. Despite the fact that automotive market widens its global effect each year, it would be accurate to compare equally how competitive a vehicle is in different markets without understanding customer's car preferences? It would deliver inaccurate information for the company.

All those approaches properly address the fact that competitiveness and benchmarking process between automotive companies are challenging in a stable global economic scenario. How would those processes look like in a global economic crisis? Which challenges must companies address in order to be competitive in this scenario?

To understand this question, this paper brings an analysis of which challenges an automotive supplier from European Union (EU) faced during the 2008-2009 global crisis in its maintenance process.

Before focusing on the company's data, it's necessary to understand the impacts of the global economic crisis on the automotive industry presented in the next chapter of this paper.

The paper is divided into five sections. Chapter 1 shows relevant literature research regarding benchmarking and competitiveness. Chapter 2 presents relevant information about the studied company. Chapter 3 brings conclusions and future possible works from this research.

1   Brief Literature Review: Benchmarking

Since the early 80's the concept and application of the benchmarking process have been studied and published in literature, including the discussion of Xerox Corporation practices comparing operational costs between US and Japanese plants (Delbrige et al, 1995). The concept was originally adopted by the Westinghouse Productivity and Quality Care, when Xerox won the Malcolm Baldrige National Quality Award in 1989. It correlates the pursuit of better practices to improve competitive performance, quoted as:

"Benchmarking is a continuous search for an application of significantly better practices that lead to superior competitive performance." (Camp, 1989)

During the 90's and early 2000's, a few publications discussed the concept brought in 1989, bringing guidelines, relationship with practicability, improvement opportunities resulting from the benchmarking process. Dattakumar (2003) presents these perspectives over the concept shown in Table 1.

Tab. 1: *Outcome of earlier literature reviews*

#	Paper Title	Outcome
1	"Roadmap to current benchmarking literature", by Jackson et al. (1994)	The paper gives a guideline for the classification of literature on benchmarking, based on the types of benchmarking and associated issues and comments on each article in terms of these criteria
2	"Review of key publications on benchmarking: part I and part II", by Zairi and Youssef (1995c, 1996)	The papers spell out in detail about the contents of only books on benchmarking in terms of the practicability and applicability of the resource material. Publications in journals and conferences are omitted in this paper
3	"Benchmarking: a select bibliography", by Vig (1995)	The paper is targeted towards personnel in libraries, to enable them to track author wise classification of articles on benchmarking
4	"A framework for benchmarking in the public-sector literature review and directions for future research", by Dorsch and Yasin (1998)	In the paper, the authors have identified that the academic community is lagging in terms of providing and advancing models and frameworks that integrate the many facets of organizational benchmarking. The authors also mention that most of the benchmarking know-how available are the results of practitioners' efforts.
5	"The theory and practice of benchmarking; then and now", by Yasin (2002)	The paper summarizes that despite the increasing scope of benchmarking activities and the number of organizations utilizing benchmarking, the field of benchmarking remains to a large extent without a unifying theory to guide its advancement. Also, a call is given to developing innovative methodologies to guide benchmarking practices in e-commerce and supply chain management

Source: Adapted from Dattakumar (2003)

Recent publications explore the definition of a framework (Deros et al. 2006), bringing the need of a set of parameters or aspects delimiting the benchmarking process, i.e. the base data for comparison between companies (e.g. lowest lead-time, highest service level, biggest Mean Time Between Failures (MTBF) and others). Deros et al. (2006) present some models for generic benchmarking processes (as cited in Spendolinni, 1992 and NPC, 1999), where the main steps for their implementation are explained, as shown in Figures 1a and 1b. The first one shows in a PDCA-like cycle the phases and their benefits of the comparison process. The second one is a flowchart of the main phases of this process.
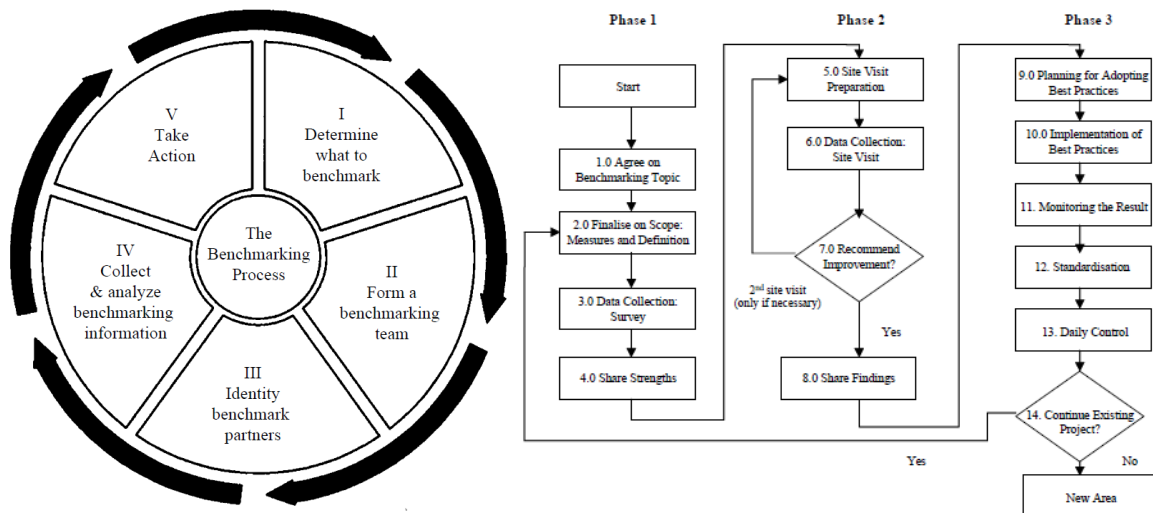
Source: Baba (2006) (as cited in Spendolinni 1992 and NPC 1999)
Fig. 1: *a (left) and b (right): Models for the benchmarking process*

Other authors bring classification and differentiation inside the benchmarking process (Freytag and Hollesen, 2001), giving it a better practical and applicable approach. They divide the whole process into three main definitions:

- **Benchmarking** as an independent growing process of efficiency, which relies on analysis of performance levels of what is in examination compared to other levels inside the organization and identification of root causes of performances problems to proper guide corporate activities reconfiguration (as cited in Kruteen 1999);

- **Benchlearning** associated with the previously mentioned "best-in-class" company or object in order to absorb those practices in all company, also known as "learn from the best" and

- **Benchaction** as the work plan for implementation of all changes obtained from benchmarking and benchlearning, and also to improve employees with training and development.

Freytag and Hollesen (2001) also define some types of benchmarking, depending on what the company wants to compare:

- **Internal**: related to processes and units that have similar functions, identifying the best internal practices and expanding to the other units;

- **Industry** (also called by the authors as functional): This is an internal or external comparison, which measures the company's functional operations and then compares to similar measures from other companies, mostly with market leaders or which detains the biggest market share. It's also not a direct competition, mostly intended to share information for processes improvements within a market or multinational company;

- **Competitive**: External comparison used against direct competitors, in order to change the market share between them, pointing failures and advantages of concurrent products and services. Information is harder to be obtained from this process and generally involves high costs and

- **Process** (also called as generic by the authors): this one compares similar procedures at dissimilar companies and it's very hard to implement, because it needs a very solid and

broad understanding of process and procedures, in order to extrapolate to other markets or industries.

They also compare advantages and disadvantages of the benchmarking process within and across industries, shown in Table 2.

Tab. 2: *Advantages and disadvantages of benchmarking within and across industries*

Benchmarking within the industry	Benchmarking across industries
Advantages: similarity of the competitive situation eases the transfer of experience	Advantages: inspiration to improve processes, etc. In which areas are the advantages best and/or easy to realize
Drawbacks: the perception of the competitive situation is too narrow which makes it difficult to catch up with other companies as regards competition	Drawbacks: it is difficult to transfer experience across industries. Perhaps eliminate focus from the obvious problems in the company

Source: Adapted from Dattakumar (2003)

2 Results of the Research

2.1 The Studied Company

Due to confidentiality, the name of the company won't be presented in this article. However, for this research, the data analyzed on next subchapters were obtained from a global automotive exterior parts supplier, mostly from its activities in the Czech Republic operations facilities. According to its 2016 annual report, it registered a net revenue of US$ 2.78 billion, with more than 155,000 employees allocated in 29 countries around the world.

The Czech facility is responsible for production and assembly of front and rear bumpers, energy management systems, polycarbonate modules, spoilers for aerodynamics and many other parts inside a vast product portfolio for the global automotive market.
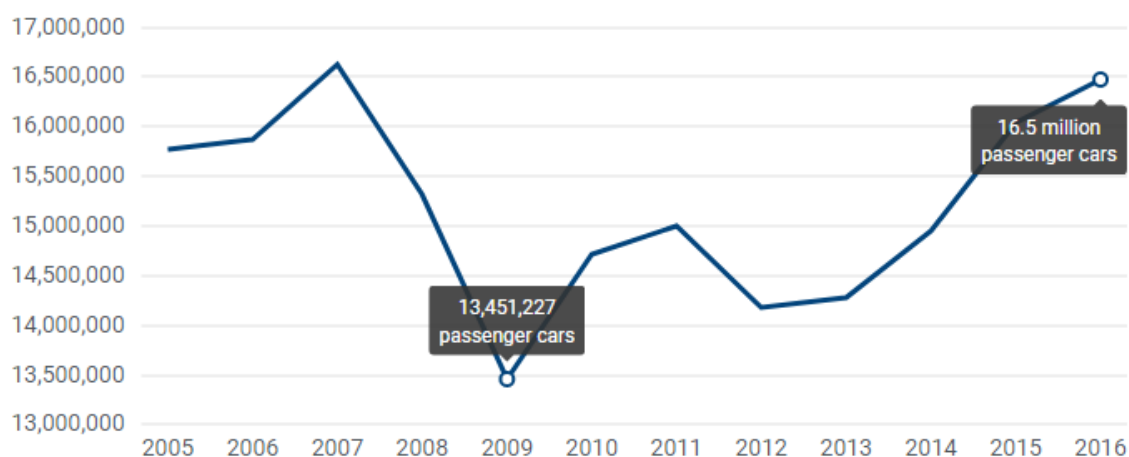
Source: AIE (2016)

Fig. 2: *Comparative demand for passenger cars in European Market*

As the demand of passenger cars has substantially decreased in 2009 and reached the lowest value in the horizon of the last 10 years, as shown in Figure 2 for the whole European market, many challenges have appeared to its operation: stock management and its increased cost, as predicted demand was expected to be much bigger, a new pattern for seasonal demand, increase of machinery non production and many others, bringing the company a big reduction

of its net revenue by the end of the year as a reflex of this global crisis and increasing of variable and fixed costs. In the next subchapter the main focus of the case study is described in detail.

2.2   Research Objectives

The data analysis conducted by the statistical SW Minitab aims to check the statistical correlations between some parameters in the automotive industry, such as seasonal demand and stoppage time. It is important to highlight that the conclusions presented here are related to the year of 2009, which, as said before, was a turbulent period for the world and also the European automotive industry.

2.3   Discussion

In Figure 3 below, it is possible to observe that the number of maintenance, which is strongly related to problems occurred in-line production, probably due to demand. It is clear to observe that maintenance at the beginning and at the end of the year is quite lower than the rest of the year, also it is not varying close to the mean, as the other results. It is important to highlight that the data provided for January start on the day 26, so many data are probably lost or the production faced a long recession.
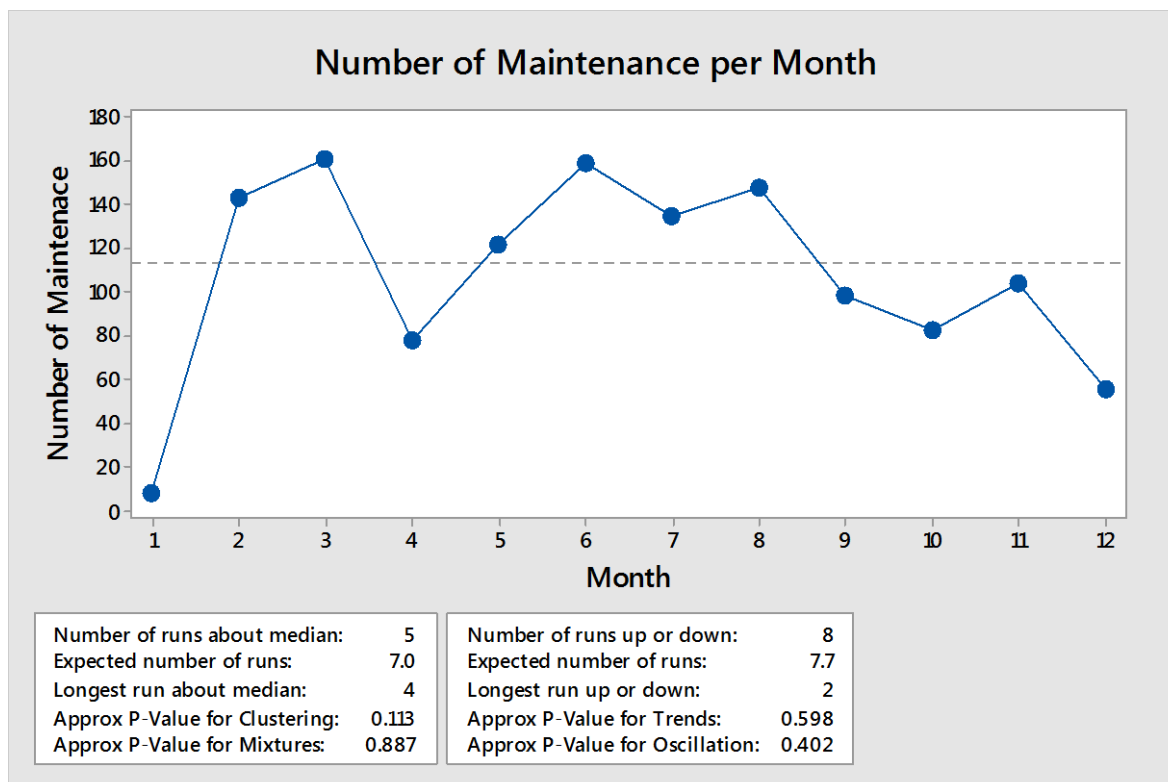
Source: Own

Fig. 3:   *Number of maintenances per month in 2009*

Besides the number of maintenance for January and December are not close to the mean, as it can be observed in Figure 4, they are still into the confidence level of 95%. It means that the process is in steady-state – p-value for oscillation is above alpha of 0.05 – and there are no outliers in this production line. So, for this period of time, special causes can be neglected. This fact is justified by the p-value for clustering above alpha value. Also, variation in number of maintenance shows a downward trend from month 6 – p-value for trends of 0.598 – which

can be caused by implementation of a better production control of equipment or decrease in production.
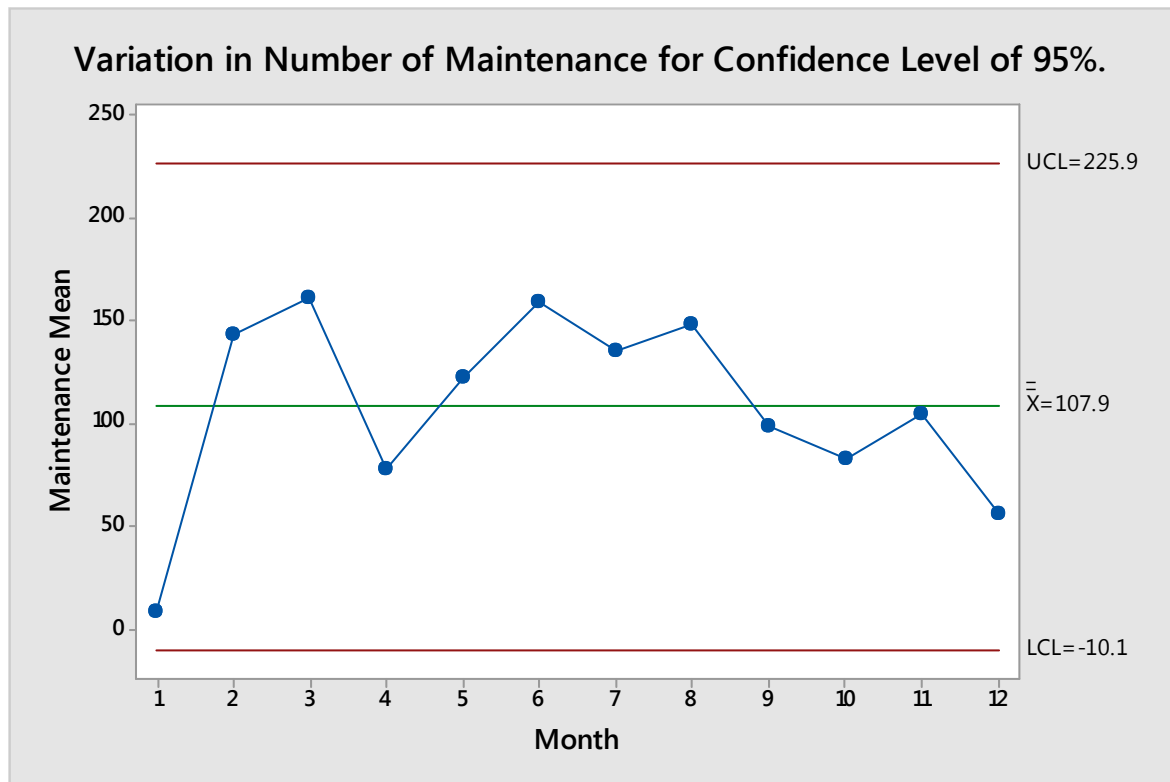
Source: Own

Fig. 4: *Variation in number of maintenance for a confidence level of 95% in 2009*

In order to complete the evaluation of these data, a normality test was conducted and the results are shown in Figure 5. As the data are not far from the fitted distribution line (red line) and the p-value is higher the alpha value, the null hypothesis, which the data do not follow a normal behavior, can be neglected by lack of information to prove it. However, it's not possible to affirm that it presents a normal behavior.

It is also important to analyze the duration of each maintenance, since it affects the profits and probably the whole production chain. Figure 6 shows the variation in time for each month. In January, the variation occurs due to the lack of date, which means that the data will not converge to the mean value, as the other results.

In relation to months from February to December, the duration of maintenance time varies approximately to a mean. When the January data are excluded, it is possible to note that the variation in maintenance time is approximately of 100 minutes.
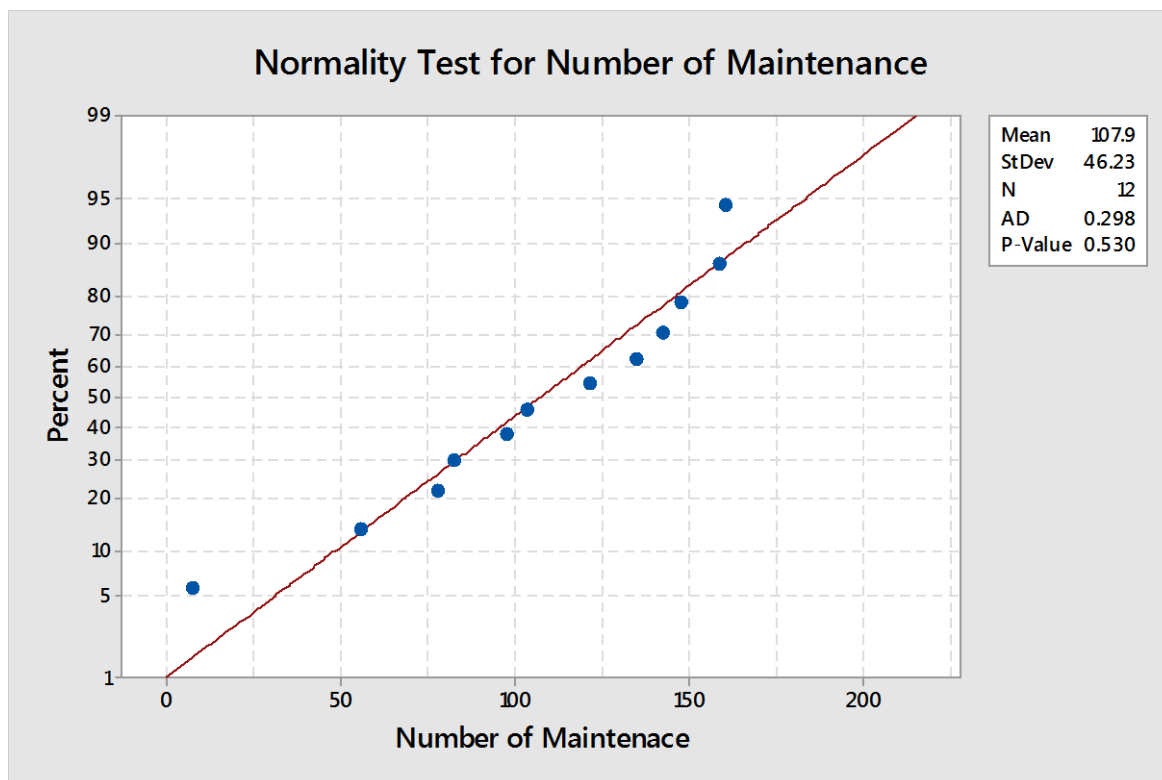
Fig. 5: *Normality test for number of maintenance in 2009*
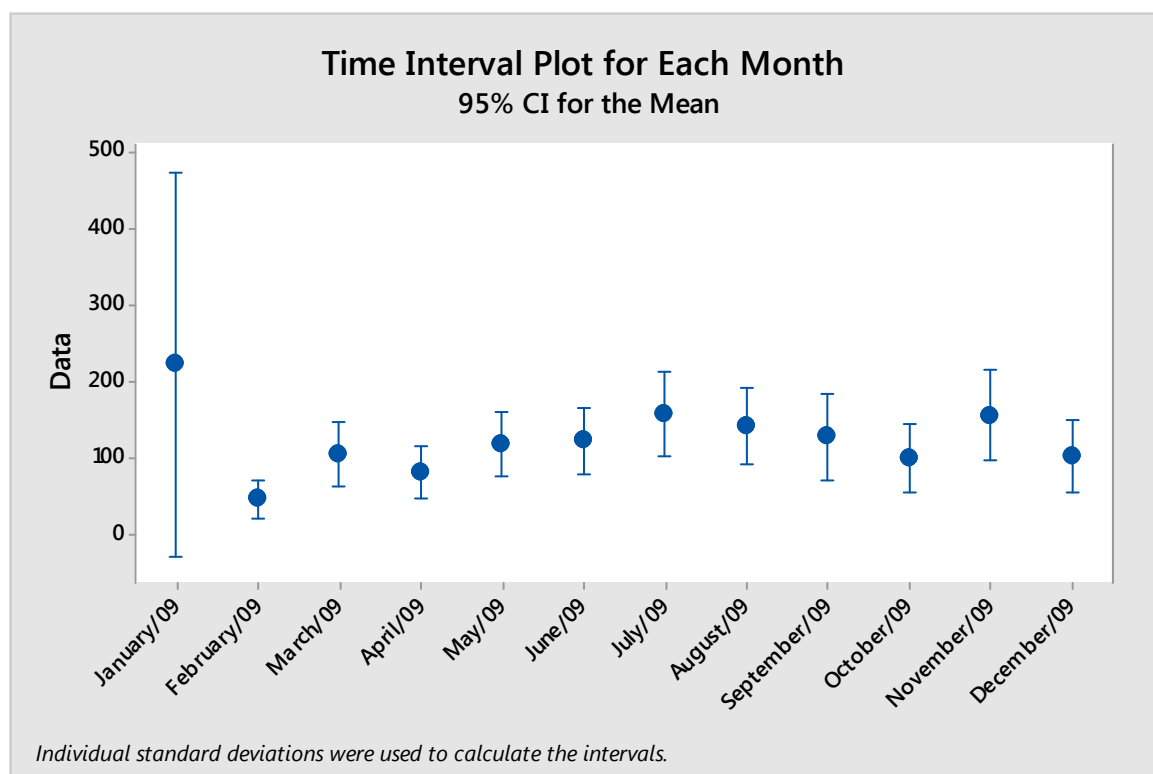
Fig. 6: *Interval plot for maintenance time for each month in 2009*

Conclusion

This article has been intended to discuss and present challenges faced by companies from the automotive sector during the 2008-2009 global crisis, focusing on the European Market. Chapter 1 explores relevant concepts on the benchmarking process, presenting ongoing and past models and explanation of its fundamentals. Chapter 2 presents the main contribution of this article, discussing the effects of the crisis in a global automotive supplier company in Europe, presenting some statistical analysis over seasonal demand and stoppage time.

After a brief introduction and a literature review of relevant concepts and topics of benchmarking, it is clear that achieving competitiveness is a constant need for major multinational companies, especially in a crisis scenario, where available resources are at its lower level, costs at higher, demand as minimum as ever and many operational problems come ahead to make this process even harder.

What is important to sustain is that all lessons learned that came from intermittency and seasonal effect of demand in a crisis environment are even more sensitive than a regular economic scenario and serve as a base for improvement of demand forecast and prediction patterns for the future. Who knows when the next economic crisis comes? It's not 100% guaranteed to predict, but it is definitely necessary to be ready when it comes again.

Future research on the topic discussed in this article is possible, as individual aspects of maintenance, size of stocks, demand forecast and so on and so forth can be discussed based on the data collected for this article, as a consequence of how relevant it is to understand the effects of a global economic crisis from all perspectives in companies and its impact and challenges for achieving competitiveness.

Acknowledgements

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Výzvy k dosažení konkurenceschopnosti v automobilovém průmyslu v EU

Pokud firmy chtějí být konkurenceschopné, základním požadavkem je jasné pochopení potřeb zákazníka. Odpověď na otázku, která firma nabízí nejlepší produkt nebo službu, se v průběhu času ztíží, protože všechny se snaží dosáhnout stejného cíle: pochopit, jak se trh doopravdy chová. Je skutečností, že proces konkurence a srovnávání kvality mezi automobilovými společnostmi je ve stabilním globálním ekonomickém scénáři náročný. Jak by tyto procesy vypadaly v globální hospodářské krizi? Jaké výzvy budou firmy muset řešit, aby byly v tomto scénáři konkurenceschopné? Tento článek představuje případovou studii globálního automobilového dodavatele a problémy, kterým čelil během ekonomické krize v letech 2008-2009, týkající se statistické analýzy jeho poptávky a prostojů. Ze získaných zkušeností se lze poučit a lépe předpovídat a řešit problémy v budoucnosti.

Herausforderungen zur Erlangung der Konkurrenzfähigkeit in der Automobilindustrie in der EU

Wenn die Firmen konkurrenzfähig sein wollen, müssen sie die Bedürfnisse des Kunden klar im Blick haben. Die Antwort auf die Frage, welche Firma das beste Produkt oder die beste Dienstleistung anbietet, fällt im Laufe der Zeit immer schwerer, weil alle versuchen, das gleiche Ziel zu erreichen, nämlich zu begreifen, wie sich der Markt tatsächlich verhält. Es ist eine Tatsache, dass der Prozess der Konkurrenz und der des Vergleichens der Qualität unter den Automobilgesellschaften in einem stabilen globalen ökonomischen Szenarium anspruchsvoll ist. Wie sähen diese Prozesse in einer globalen Wirtschaftskrise aus? Vor was für Herausforderungen werden die Firmen gestellt, um in einem solchen Szenarium konkurrenzfähig bleiben zu können? Dieser Artikel bietet eine Fallstudie eines globalen Automobillieferanten und schildert die Probleme, mit denen er es während der ökonomischen Krise in den Jahren 2008-2009 zu tun hatte und welche die statistische Analyse ihrer Nachfrage und Ausfallzeiten betreffen. Aus den gewonnen Erfahrungen kann man Lehren ziehen und die Probleme in der Zukunft besser vorhersehen und lösen.

Wyzwania dla osiągnięcia konkurencyjności w przemyśle motoryzacyjnym w UE

Jeżeli firmy chcą być konkurencyjne, to podstawową przesłanką jest jasne zrozumienie oczekiwań klienta. Odpowiedź na pytanie, która firma oferuje najlepszy produkt lub usługę, z biegiem czasu staje się utrudniona, ponieważ wszystkie starają się osiągnąć ten sam cel: zrozumieć, jak rynek naprawdę się zachowuje. Faktem jest, że proces konkurencji i porównywania jakości pomiędzy przedsiębiorstwami motoryzacyjnymi jest w stabilnym globalnym scenariuszu ekonomicznym trudny. Jak by procesy te wyglądały w czasie globalnego kryzysu gospodarczego? Przed jakimi wyzwaniami będą stały przedsiębiorstwa, by przy takim scenariuszu zachować konkurencyjność? W niniejszym artykule przedstawiono studium przypadku globalnego dostawcy samochodów oraz problemy, z jakimi borykał się w czasie kryzysu gospodarczego w latach 2008-2009. Obejmuje ono analizę statystyczną popytu na jego produkty i przestojów. Ze zdobytych doświadczeń można wyciągnąć wnioski, by lepiej przewidywać i rozwiązywać problemy w przyszłości.

Systematic Literary Research

INITIAL COIN OFFERING AS A FUNDING SOURCE FOR PROJECTS

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Abstract

Each company is looking for the best way to raise capital. Nowadays there are a lot of modern possibilities of fundraising, and the development of cryptocurrencies and crowdfunding has made it possible to create new ways of financing projects. This article seeks to present the Initial Coin Offering (ICO) concept, which is an alternative and modern source of funding. It is similar to the Initial Public Offering (IPO) and crowdfunding. The aim of this article is to present the advantages and disadvantages of Initial Coin Offering. This concept is often associated with risky funding sources, but every business should be able to get acquainted with this form of financing.

Keywords

Initial coin offering; Funding source; Cryptocurrency; Crowdfunding; Initial public offering.

Introduction

Nowadays the world experiences a rapid development of technology which affects many areas of economic life. The development of the Internet and globalization enables contact with investors around the world. All this influences the development of many modern forms of financing business. Blockchains as systems enabling the creation of new virtual currencies such as bitcoins and the Ethereum system enabling the easy creation of smart contracts contributed to the increase in the popularity of Initial Coin Offering. In addition, it is influenced by greater interest in crowdfunding, which, thanks to the Internet, is a more and more frequently used form of obtaining financing. Initial Public Offering, like ICO, is a way to raise capital through investor input, but in the case of ICO there are fewer legal requirements and less financial costs. This article aims to present the ICO concept and its purpose is to indicate the advantages and disadvantages of this source of funding. Research methods which were used were mainly the study of literature, the analysis of documents and the descriptive analysis.

1   Capital in the Enterprise

Enterprises should strive for development. That allows them to create additional values such as creating new products or seeking new markets. Companies can also develop through innovation, which will enable them a better identification of markets. In addition, enterprises, due to their flexibility, can implement creative solutions and operate in a better and more modern way. All this can be facilitated by capital, which consists not only of financial resources, but also the entrepreneur's knowledge and skills. [1]

The capital resources consist of all physical resources, for example: devices, buildings, machines, materials, raw materials, products and financial resources, which are owned by

enterprises as well as those that can be acquired. [2] It is necessary to accumulate capital to complete the company's development program. It follows from this that the investment possibilities of an enterprise depend on the value of capital as well as its costs. That is why it is important to determine the sources of capital, which can be divided into own and foreign ones. Equity comes from retained profits and is usually used by already operating enterprises. Then, instead of paying out the profits generated to the capital owners, the companies invest in it to maintain or strengthen their position in the market. Capital owners approve this because of the opportunity to increase the value of the company and also the possibility of greater profits in the future. The source of equity may also be an additional capital acquisition from current or new owners. This way of raising capital may differ depending on the legal and organizational form of the company. [3] However, funds provided by creditors are called foreign capital. The demand for them results from limited possibilities of raising own capital. The sources of foreign capital are bank loans, loans, trade loans, leasing, factoring, debt securities, subsidies, other assistance funds.[4] In order to accomplish the financial goals properly, one should simultaneously acquire capital from own and foreign sources and determine the optimal proportions between them. The company is not always able to shape the capital structure, which can be associated with its various sources and difficulty in obtaining them. In addition, one should always pay attention to the level of financial risk. [5]

Capital structure theories assume that the level of indebtedness grows with the size of the company. Many factors contribute to the fact that the involvement of foreign capital is higher than in small enterprises. Large companies, thanks to their capabilities, can conduct more diversified activities than small enterprises, which translates into smaller chances of liquidation. For this reason, greater security affects lower bankruptcy costs and greater ability to incur liabilities. Large companies also have lower costs of issuing financial instruments, which allows them greater freedom to shape the capital structure.[6] The cost of capital is very important in its selection. It is possible to distinguish the cost of foreign capital, which is associated with paying interest on the debt incurred, it can be called the average interest rate on debt. It is more difficult to analyze the cost of equity, which is most often perceived as an alternative cost. One should analyze the rate of return for owners in the case of investments in substitution projects. [4] Cost analysis is very important especially nowadays. The development of technology has allowed for the creation of many alternative and modern forms of financing projects.

2   Blockchain and Cryptocurrencies

The concept of blockchain is an innovation that has a big impact on the Internet, enterprises and the economy. It is a new generation of technology that threatens older constructions. Blockchain is a form of introducing trust in the network, thanks to which it is possible to cut off many intermediaries or disrupt their actions. These are computer systems that work all the time and offer great flexibility, which allows the creation of a new generation of services and applications. Most often, blockchains are used to create independent computer programs called intelligent contracts. It all facilitates to create financial instruments, speed up payments, organize data exchange and also facilitates interaction between machines and people. [7]

Bitcoin cryptocurrency was first described by Satoshi Nakamoto in 2008. It is described as a decentralized system of electronic payments using peer-to-peer networks that allows transactions to be made with mutual trust. Bitcoin is the first completely decentralized virtual money. The network is created by users and is not coordinated by either the bank or the payment procedure. Such decentralization is the basis for security and freedom which was the cause of the phenomenon of cryptocurrencies. [8] Otherwise, bitcoin is the first virtually verified currency, which is based on generally available source code, which operates within a

system characterized by the emission scattering, the verification of correctness and the registration of transactions used for payment and investment purposes. [9]

After the introduction of bitcoin in 2009 the tools and infrastructure to transact digital tokens of value appeared on the Internet without trusted intermediaries. There are two ways to create a new token. Firstly - a person needs to deploy and scale a new blockchain network and secondly, issue tokens on top of an existing blockchain network. However, the concept of decentralized smart contracts appeared with the introduction of next cryptocurrency Ethereum in 2015. The Ethereum blockchain provided the infrastructure for transacting digital tokens and the capability for easy creation and autonomous management of other secondary digital tokens of value without trusted intermediaries in the open public Internet. Using the concept of smart contracts tokens can be made to be more easily tradable, created and allocated to users. This process of creating tokens and distributing them to users is called an Initial Coin Offering(ICO) process, and can be seen as a novel distribution channel for assets.[10] Tokens have turned out to be a successful way for startups to raise financing. Companies have started to make Initial Coin Offerings (ICOs) instead of going to the expense of making an Initial Public Offering (IPO) or the trouble of convincing a venture capitalist to back the company.[11] The development of modern technologies has allowed not only the development of ICO, but also crowdfunding.

3 Crowdfunding

The term crowdfunding is a combination of crowd and funding words. It can be described as gathering funds from an online crowd. In other words, it is social funding. The funds are obtained from a large, usually networked population with unitary small shares. A person investing in a project can sometimes count on acquiring small material prizes or obtaining profits from sales, shares and shares in ventures. There are numerous ways to define crowdfunding in the literature on the subject. Another definition states that the essence of this form of raising capital is the use of the crowd to finance small enterprises, for which it is not possible to raise capital through traditional methods. For these needs, electronic crowdfunding platforms or social networks should be used. [12]

Crowdfunding and its idea is described in foreign literature by its goal, i.e. gathering funds for a project among the Internet community. It is an alternative to raising capital from small groups of experienced, professional investors. Crowdfunding is a form that goes to an unlimited group of investors, and each of them transfers money of a relatively low value. Another definition presents crowdfunding as making investments in various enterprises and projects using online social platforms outside the regulated capital exchange market. [13]

Crowdfunding, being a new mechanism of raising funds, is distinguished by certain features that allow it to be distinguished from public collections, donations or other traditional forms. The first feature of such crowdfunding is the transfer of cash. There is no possibility of support in any other form than money. The whole process of raising capital takes place using ICT solutions. The goal of the project is determined by the purpose of the funds and the effects of their spending. This form of obtaining funds does not require the consent of any state body and may be carried out for personal, business and public purposes. A wide community of addressees is characteristic of crowdfunding - the information about the project can reach a very large group of recipients. In addition, the opportunity to support the project is presented in an open manner, is directed to an unmarked addressee. The last important feature that distinguishes crowdfunding is the occurrence of a returnable benefit for providing financial support.[14] It may be a product at an early stage of production or finished after the completion of collecting funds or some other form, for example a discount on the price of a finished product or service.

Crowdfunding is about obtaining financing from a certain crowd – it has its counterpart in a more traditional form of raising capital. Namely, the Initial Public Offering, where a company acquires funds through the issue of shares. And the person buying shares gains shares that translate into certain shareholder rights.

4   Initial Public Offering

Acquiring equity through the issue of shares is a form of public listing on the stock exchange. Such a possibility is reserved for joint-stock companies, but it is quite a popular form of running a company. Typically, changing the legal form for companies with an interesting business profile is not a serious obstacle. [15] The stock market is a very important way to raise equity. Companies entering their public market with their shares carry out initial public offering. Each subsequent offer from the same company is called a secondary offering and they can dilute their existing capital by issuing new shares or they do not dilute when the shares are sold to existing shareholders. [16]

To get to the stock exchange, a company has to complete many procedures. The company must obtain the appropriate permits, conduct a public broadcast and fulfill all information obligations. Everything begins with the preparation of a resolution of the general meeting of shareholders about the intention to introduce shares on the stock exchange. Then, select a brokerage house, investment advisers and prepare documents in line with the prospectus. Only after the approval of the prospectus by the Financial Supervision Authority, the company may submit relevant documents and applications to register the issued shares. Then, it carries out the public issue of shares. The board of the Stock Exchange decides whether these shares can be introduced to stock exchange and after the positive verification of the documents allows for debut on the stock exchange. [17]

The issue of shares allows to obtain a large capital from many small investors. The issuer usually does not undertake to return the received funds, and in the event of the company's liquidation, they are returned only after all other liabilities have been met. A shareholder may sell their shares on the secondary market for cash. A share is a security which states the share of a shareholder in the company's assets. This is proof of co-ownership of part of the company's capital. A joint-stock company is responsible for its liabilities with its own assets, while shareholders can lose most of their contribution. The shareholder has property and corporate rights along with the purchase of the shares. They have the right to participate in the company, in the general meeting, they can get the right to participate in the annual profit through a dividend. In addition, a shareholder has the right to purchase a specified number of shares from new issues, as well as the right to a part of the company's assets in the event of its liquidation.[18] Issuing shares on the stock exchange is preferred by those companies that already have experience and have used such a source of financing. There are many restrictions and costs associated with the issue of shares. Most often, the companies fear the need of spreading information about their company to the competition, and the burden of information obligations. In addition, companies are exposed to financial costs when they issue shares, they may lose control of the company through the sale of shares and must comply with complicated legal provisions. [19]

5   Initial Coin Offering

Initial Coin Offering (ICO) is a rapidly growing innovation in funding sources that uses blockchain technology and cryptocurrency. ICO makes it possible to raise funds by issuing tokens that can be re-sold on the secondary market or used in the future to receive products or services of a given company. It should be noted that tokens can be understood and used in various ways. ICO also has its formal requirements – it requires the issuer to develop such

documents as "white paper" or "terms of sale of tokens", in which the most important information about the protocols and blockchains must be included. The documents must also contain the delivery method and the mechanisms for the valuation of tokens and data on the financed project, usually in the form of a business plan. The first ICO issue took place in 2014 in the USA and concerned the DAO fund and Ethereum cryptocurrency. The biggest problem related to ICO are legal regulations and the legality of such a source of obtaining funds. However, regardless of whether it is a legal way, ICO fills a certain gap in the access to capital in an innovative way in terms of technology, product and process. [20]

ICO is also the first issue of the cryptocurrencies created by the company. The simplified procedure for obtaining financing through ICO is as follows: [21]

- the creation of a new cryptocurrency,
- the introduction to the selected exchange of virtual currencies,
- ICO promotion,
- the sale of tokens and receiving traditional money or a more popular cryptocurrencies.

In addition to the virtual market introduction phase, the company may take advantage of ready-made solutions, e.g. platforms enabling the creation of its own cryptocurrency. This form of raising capital is new and the decision to implemented should be carefully considered and preceded by appropriate analyzes.[21] Komisja Nadzoru Finansowego (KNF) – Polish Financial Supervision Authority informs that investing in tokens (ICOs), is highly hazardous. Entities are using this form to raise funds. Famous people are more frequently engaged in promoting ICOs investment offers in order to make them more reliable. The KNF would like to make potential investors and entities interested in offering such products to pay attention to risks connected with ICOs. Potential buyers should be especially aware of the possibility of losing all invested capital and the possible lack of legal protection. The KNF announced the following risks: prone to frauds and other irregularities, high risk of loss of some of the invested funds, inadequate documentation and flaws of the used technology. [22]

ICOs are usually carried out by companies or organizations that want to implement projects related to modern technology. Unlike IPO, they are carried out without the supervision of market regulators and the issuer does not have to meet many formal requirements. The ICO process usually takes a short time and is available globally to all concerned. The buyer can count on an increase in the value of tokens when the financed project is successful in the market. Funds collected in such a way can be allocated to the development of an already operating project as well as in the phase of the concept itself. All these features of ICO make them very risky investments, but at the same time with a potentially very high rate of return. The risk results from the fact that the financed project may fail. In addition, there is not enough information about the company that carries out tokens. Some ICO offers are frauds - issuers do not plan to implement any projects other than collecting funds. Among the completed projects, which brought profits of several hundred thousand percent, there is Ethereum mentioned, for the preparation of 16 million dollars, as well as cryptocurrencies IOTA, NEO. [23]

Just like in crowdfunding, with which ICO has many common features, the first tokens buyers can be rewarded with discounts or bonuses in the form of additional funds allocations as well as other incentives. The token price can be fixed in the whole collection process, but there are also ICOs using other mechanisms, usually a division into tranches. The IPO can be associated with the method of distribution of a token pool - often a predetermined part goes to the originators of campaigns and other "insiders". [24]

Earlier analyzes of other sources of financing projects show many differences and similarities of ICO to IPO or crowdfunding. Each of these forms is aimed at raising capital in relatively small amounts, but from a large number of people, which allows to obtain a large amount of financial resources. Each form has its advantages and disadvantages. In the case of Initial Coin Offering, the following advantages can be distinguished:

- using a blockchain system that allows cutting off many intermediaries,
- these systems offer great flexibility and work all the time,
- there is no limit to the organizational form of the activity as in the case of IPO,
- fewer procedures and requirements compared to IPO,
- access to capital in a technological, product and process innovative way,
- allows to create a new cryptocurrency,
- there are platforms that facilitate the creation of cryptocurrency,
- the ICO process is short,
- anyone interested in the global nature of ICO can participate in the purchase of tokens,
- funds collected in this way may be allocated for the development of a working project and also in the concept phase.

The disadvantages are primarily connected with the risk for the investor and the following can be mentioned:

- formal requirements in the form of developing a white paper and the conditions of the sale of tokens,
- the lack of or little legal regulations,
- financial supervision authority warnings about high danger of investment in ICO,
- many ICOs are carried out in order to raise funds without carrying out the project,
- there is no legal protection for companies or investors,
- many ICO are scams,
- defects of used technology - the possibility of hacker attacks,
- a project financed in this way may fail,
- tokens can be distributed among project originators or other important persons.

Conclusion

Today, many financing sources can be selected for financing projects. It is necessary to analyze what capital will be more suitable for the company, whether its own or foreign. At the same time, the proportion between these capitals is important. For this reason, it is important to know the different forms of obtaining funds in order to be able to choose the right one. Initial Coin Offering is a relatively new form that does not yet have adequate legal regulations, which creates many threats both for companies and investors. However, thanks to this it is a more accessible way for more companies. This is due to less tight requirements and the possibility of using easily accessible internet. ICO is undoubtedly an interesting alternative for IPO and crowdfunding. The opportunities for further development of this form may be the creation of certain global regulations, which could increase investor confidence. Such a solution would be extremely difficult due to the general availability of conducting ICO. This article has achieved the goal by presenting the advantages and disadvantages of this form of project financing. The most important disadvantages relate primarily to the fact that it is a very new and little controlled source of financing. However, it is a modern form that arouses great interest. Many companies and investors are very interested in ICO and it would probably be more interesting if the disadvantages of this source of financing projects were limited.

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Agnieszka Wis, M.A.

INITIAL COIN OFFERING JAKO ALTERNATIVNÍ ZDROJ FINANCOVÁNÍ

Každý podnik hledá nejlepší způsob, jak získat kapitál. Dnešní doba přináší spoustu moderních možností, a rozvoj kryptoměn a crowdfundingu umožnil vznik nových způsobů financování podnikání. Tento článek je snahou prezentovat koncepci Initial Coin Offering (ICO), která je alternativním zdrojem financování. Je podobná Initial Public Offeringu (IPO) a crowdfundingu. Cílem tohoto příspěvku je představit výhody a nedostatky ICO. Tato koncepce je často popisována jako rizikový zdroj financování, ale každý podnik by měl mít možnost se s touto formou financování seznámit.

INITIAL COIN OFFERING ALS EINE ALTERNATIVE QUELLE DER FINANZIERUNG

Jedes Unternehmen sucht nach einer optimalen Form des Kapitalerwerbs. Heutzutage gibt es dazu viele moderne Wege. Die Entwicklung von Kryptowährungen und Crowdfunding ermöglichten die Entstehung neuer Wege zur Finanzierung der Wirtschaftstätigkeit. Der vorliegende Beitrag stellt einen Versuch dar, die Konzeption des Initial Coin Offering (ICO) zu präsentieren, die eine alternative Quelle der Finanzierung stellen kann. Diese Finanzierungserwerbsform hat eine ähnliche Struktur wie das Initial Public Offering (IPO) oder das Crowdfunding. In dem vorliegenden Beitrag werden die Vor- und Nachteile des ICO dargestellt. Diese Konzeption wird zwar oft als eine ziemlich risikoreiche Finanzierungsquelle beschrieben; nichtsdestoweniger sollte jedes Unternehmen die Möglichkeit bekommen, sich mit dieser Finanzierungsform vertraut zu machen.

INITIAL COIN OFFERING JAKO ALTERNATYWNE ŹRÓDŁO FINANSOWANIA

Każde przedsiębiorstwo szuka najlepszej formy pozyskania kapitału. Dzisiejsze czasy dają wiele nowoczesnych możliwości, rozwój kryptowalut i crowdfundingu umożliwił powstanie nowych sposobów finansowania działalności. Niniejszy artykuł jest próbą zaprezentowania koncepcji Initial Coin Offering (ICO), która jest alternatywnym źródłem pozyskania finansowania. Jest ona zbliżona do Initial Public Offering (IPO) oraz do crowdfundingu. Niniejszy artykuł ma na celu przedstawienie zalet oraz wad ICO. Koncepcja ta jest często opisywana jako ryzykowne źródło finansowania, jednak każde przedsiębiorstwo powinno mieć możliwość zapoznania się z tą formą pozyskania kapitału.

Excellent Dissertations

PARTICIPATION OF THE YOUNG GENERATION IN FAMILY-OWNED BUSINESSES

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Abstract

The article is based on research which was focused on students in their last year of studies at secondary vocational schools, high schools, vocational colleges, and, subsequently, at public universities in the Liberec Region. The author's doctoral thesis deals with the complex decision-making process of young people leading to taking over the family business [1]. Based on the results of the analysis, a basic scheme of participation of young people in family business in the Liberec Region was created. The factors that influence the individual stages of the decision-making process are identified and summarized, taking into account the type of municipality in which the family business is run. It also considers the type of family business, i.e. whether it is a Family Business Corporation or Family Business of Natural Persons.

Keywords

Family business type; Student; Decision process; Succession; Municipality; Liberec Region.

Introduction

Family-owned businesses are considered a significant part of every country's economy. They represent tradition and stability [2]. Passing this type of business down to the next generation is one of its greatest and most fundamental traits, as well as its greatest potential pitfall. Nowadays in the Czech Republic, the issue of succession is at the forefront of many people's minds, as, in many cases, this is the first intergenerational transfer (the first generation to pass on the family business to the next). Studies focusing on succession in family businesses have revealed a prevalent unwillingness of the young generation to take over their family businesses. This unwillingness may bring about disappearance of the family element of entrepreneurship and the advantages linked to it, such as acquiring tacit knowledge which will not be passed on by the existing generation to the next, thus preventing it from being further enhanced.

Examining the aspects of business entities (regardless of their family aspect) requires considering the place of business of the entrepreneur. The doctoral thesis is focused on the differentiation of businesses from this perspective, i.e. on whether an entrepreneur is engaged in business in rural or urban areas. Based on an evaluation of the current state of research in respect of family businesses, including the issue of succession, the principal objective of the doctoral thesis was determined, i.e. *developing a scheme of the participation of young people in family businesses within an area, focusing on their willingness to take over the business*.

The definition of family business and family business types is based on the definition of AMSP ČR [3] and Rydvalová et al. [4] in this research. These approaches have been identified on the basis researches and discussions in this field in the Czech Republic. Definitions of family businesses were simplified by the author in the survey to make them understandable to respondents.

The key characteristic is the involvement of at least two family members in the business. In terms of this research, the following are considered to be family businesses:

1) **Family Business Corporation** (FBC): a business corporation in which the family holds at least a 50% ownership interest and in which 2 family members are involved, whether through work or ownership.

2) **Family Business of Natural Persons** (FB NP) where are included:

   a) Family Enterprise: A family member does business as a natural person under the Trade Licensing Act or other laws, and at least 1 other family member helps without any contract/agreement.

   b) Family Agglomeration:

      i) A family member does business as a natural person under the Trade Licensing Act or other laws, and at least 1 other family member helps pursuant to a contract/agreement;

      ii) Multiple family members do business as natural persons under the Trade Licensing Act or other laws and they cooperate.

It is also important to know what is considered as rural-type municipality and rural area in the research. A municipality of up to 2 000 inhabitants is considered a **rural-type municipality** [5]. **Rural area** is considered to be an area in which more than 50% of the population lives in rural-type municipalities. The boundaries of this territory are set at the highest order of the municipality, i.e. administrative district of municipality with extended powers [6].

1   Methodology

The research is based on a questionnaire survey (in written and electronic form), where the target group are students of the last years of middle and upper degree study of the Liberec Region, meeting the definition of a young person according to the Ministry of Education [7], i.e. a person aged 15 to 29 years. Due to the lack of selection support, a judgmental technique was used in the sampling. Participation factors mentioned in the questionnaire were determined on the basis of literature search and realized focus groups.

The final survey was attended by 84.44% of secondary vocational schools, high schools and vocational colleges in the Liberec Region, as well as students of the Technical University of Liberec (TUL). The completed questionnaires represent approximately 42.90% of all potential respondents from secondary vocational schools, high schools and vocational colleges in the Liberec Region. About 1 200 students were approached at TUL, with a return of about 13%.

The data were evaluated in MS Excel and the statistical program Statgraphics Centurion. Descriptive statistics and dependency analysis of selected variables were used. The dependency analysis used the following tests: independence test of categorical variables, analysis of variance (or its non-parametric variant Kruskal-Wallis test), and marginally also regression analysis. In the case of data absence, the pairwise deletion was used: a method whereby only those rows that refer to at least one of the variables in the currently running calculations are discarded. Exploratory factor analysis was used to determine the participation factors of the young generation in family business. In this case, the listwise deletion was used.

A decision-making process has been defined for the participation of a young person in family business, which is divided into three phases. The first phase concerns the involvement of young people in family business during their studies. The second phase is the work of young people in family business after graduation. The third phase involves taking over the family business (succession). Based on these opportunities for young people to participate in family

business, eight decision-making processes for participation have been identified and the **participation matrix** was created, see Table 1.

Tab. 1: Participation matrix

Participation phase	1. Involvement during studies	2. Work in FB after studies	3. FB succession
Decision process	YES	YES	YES
	YES	YES	NO
	YES	NO	YES
	YES	NO	NO
	NO	YES	YES
	NO	YES	NO
	NO	NO	YES
	NO	NO	NO

Source: Own

The first option, "YES-YES-YES", indicates that a young person is involved in family business during their studies and wants to be involved in this business after graduation and plans to take it over once. This decision-making process is called **full participation**.

The last option, "NO-NO-NO", points to a young person who did not engage in family business while studying, who does not want to work in the family business, and who does not even consider taking it over. Such a decision-making process was described as **zero participation**.

2 Results and Discussion

The topic of the doctoral thesis was to compile factors influencing participation of young people in family business leading to their willingness to take over the family business. Succession is a key issue for family business. In the Czech Republic, family business is also defined in terms of natural persons [8] but according to the results of group interviews it has emerged that students do not always realize that their relatives´ business could be defined as family business. Furthermore, the context of the municipality in which the family business is run is omitted. Small crafts and services are typical in the countryside, for example in the hospitality industry [9].

The research has revealed that females tend to be more formally educated and respondents from rural villages have lower educational aspirations. It has been found out that female entrepreneurs are more likely to be self-employed (FB NP). In this type of family business there is often the same locality (municipality) of the business operation and the residence of the interviewee.

Within the Participation Matrix differences were found in the meaning of evaluated statements related to the participation or non-participation of students in family business. These differences were noted especially in the case of positive participation (involvement in family business), where some students participate in their family businesses because of tradition and a sense of family responsibility (e.g. full participation), for some of them it is often a sense of assurance which plays an important role.

In terms of the involvement of young people in family business, most of the interviewees did not participate in family business during their studies, nor did they want to work there or take it over. This is confirmed by the situation recorded for example by Zellweger [10] or in the Czech Republic by Antlová et al. [11]. However, young people who are already involved in

family business during their studies want to work there after their graduation and then take it over. Therefore, if the owner of the company involves the young person in the business while studying, the young person will be more likely to take the family business over. Of course, opinions may change over the years. For example, Overbeke et al. [12] states that even those who had refused to work in their family businesses and to take over the family business during their youth, eventually became successors in family businesses. On the other hand, there may be situations that might affect the young person's willingness to take over the family business in their future. These reasons may be, for example, difficult relationship with new partners and family, conflicts that might occur within the family, etc.

As regards the characteristics affecting participation in family business, it has been found that men with lower ambitions to get formal education are generally more involved. This indicates craft orientation. Generally, higher involvement is more often observed in rural-type municipalities, especially in full participation. Furthermore, the influence of rural areas (administrative district of municipality with extended powers Jilemnice, Turnov and Železný Brod), in which succession is discussed more frequently than in urban areas, has also been shown. The discussion of succession in the family businesses is an underestimated issue. The indisputable influence, through all three phases of participation, have of course also family relationships, i.e. whether the student is in the direct family line of the family business incumbent. For some students, the reason for choosing their field of study has also been the existence of their family business. They plan to take it over in most cases.

As far as the involvement of women in family business during their studies is concerned, the role of a family business runner is important. In the case of male entrepreneurs, their female offspring are significantly less involved in family businesses than in the case of female entrepreneurs or cooperation of both genders. Higher educational ambitions often lead to the fact that students do not want to take over the family business. Such students would then be motivated to work in a Family Business Corporation rather than in a Family Business of Natural Persons. The type of family business has a particular impact on succession. More often, those with a family business corporation want to take over the family business, regardless of the type of municipality.

A problem with the gradual involvement of young people in entrepreneurship (and then with succession) has been identified especially among women, students with a higher ambition for education and Family Business of Natural Persons. See the basic scheme of participation in Figure 1 below. There are also scheme explanatory notes in Table 2.

Tab. 2: *Scheme explanatory notes*

FB	Family business
FB NP	Family Business of Natural Persons
FBC	Family Business Corporation
⟶	Is influenced.
⟶	Stronger dependence.
–·–·–⟶	It leads to a discussion of succession.
▬·▬·▬	Insufficient succession communication.
⟷	Positive influence of rural municipality at the phase participation.
⟷	Positive influence of rural area at the phase participation.

Source: Own
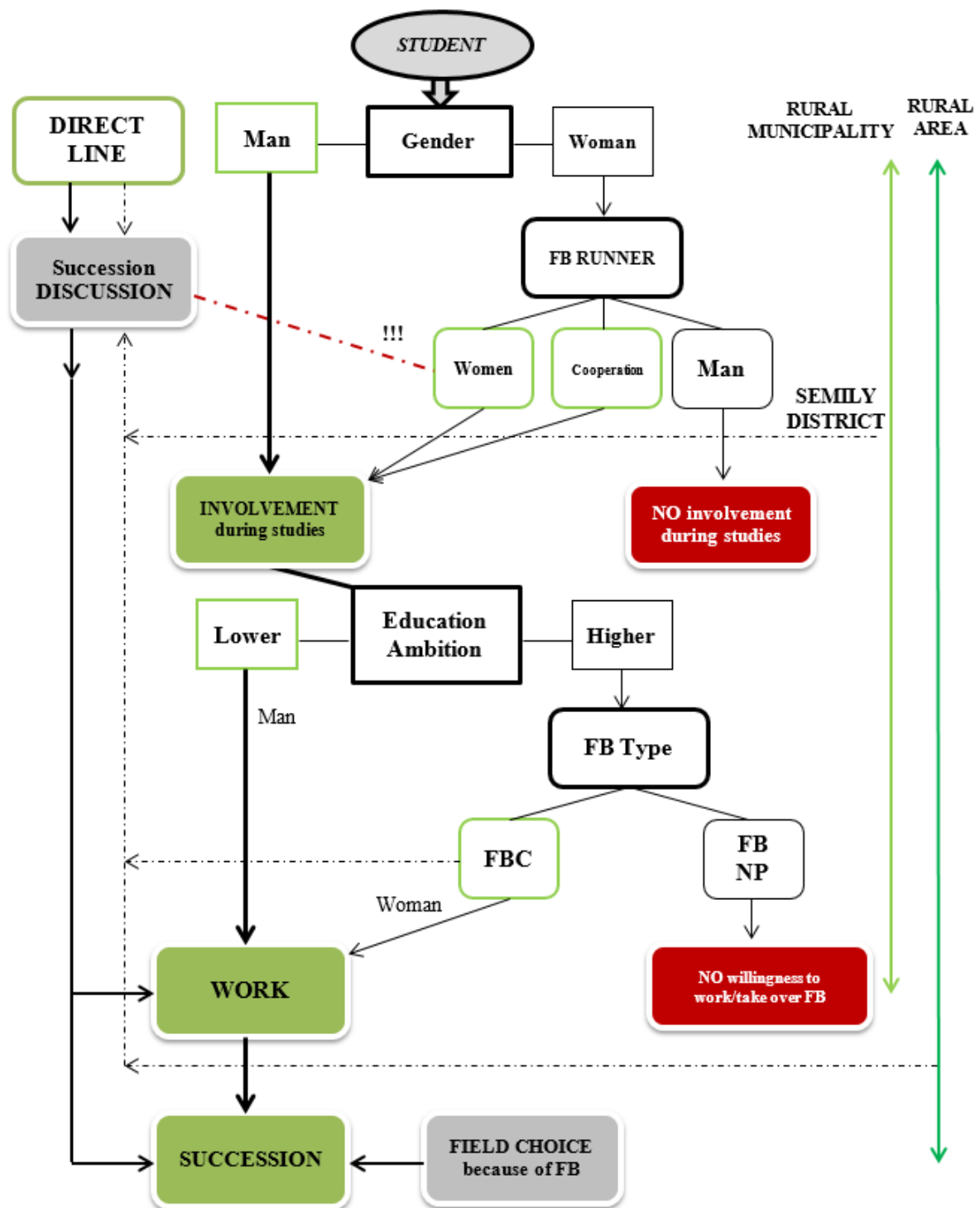
Source: Own
Fig. 1: *Basic scheme of participation*

Using explorative factor analysis of data, **nine factors** have been identified that influence the **full participation** of young people in family business. These factors are: *assurance; pleasure from the field; emotional commitment; normative commitment; appeal to family; time flexibility; family relationships; management; property.*

Furthermore, factors influencing **zero participation** of young people in family business were identified. The identified **eleven factors** include: *non-entrepreneurship; family relationships;*

uselessness; time demands; location; relationship; development opportunities; lack of interest in the field; state of business; succession; ambitions.

Based on the identified correlations of factors and characteristics of both respondents and family businesses, it is possible to draw recommendations for the underlying scheme of participation.

For women who tend to have higher formal education and are likely to want to take over the business in the case of a Family Business Corporation, it is recommended to strengthen the emotional and normative commitment (generally family aspects) and sense of assurance for the Family Business of Natural Persons. Furthermore, it is important to enable the use of the studied field in the business, for example, by diversifying the product portfolio or by cooperation. Especially in rural municipalities it is important to enable the business development according to their ideas and to enable them to lead staff. In this type of municipalities, in case of Family Business of Natural Persons, it is particularly important to strengthen family relationships. In urban-type municipalities, it is recommended to strive to strengthen the emotional commitment factor also for students where a family business runner is a woman.

In young people with a higher ambition to achieve formal education, efforts should be made to promote development opportunities, which can begin, for example, by transforming the legal form of entrepreneurship and the current owner's efforts for business growth. However, this aspect is already rooted in the entrepreneurial mindset of the existing runner. Another possibility is to try to stimulate a young person to develop the business in order to capitalize on the experience of the current owner.

Entrepreneurship needs to be developed in urban areas, as fear of responsibility and administrative demand has been observed mainly in this type of area.

Conclusion

The research presented in the doctoral thesis was devoted to the complex decision-making process of young people pointing towards to succession in the context of the type of family business and the type of municipality. The factors that influence the phases of the decision-making process are listed above.

The research found that men are more involved in family business, in particular those with lower ambitions to achieve formal education. Furthermore, a greater influence of rural areas and rural municipalities was found compared to urban-type municipalities and areas. This fact is obvious for the countryside, because the crafts are rooted in tradition there.

Research has shown that women are more likely to engage in family business if the main incumbent is also female (or cooperation of both gender). However, women's desire to engage in business after graduation seems to be very weak. This is mainly because women have higher ambitions for formal education. Women are more likely to engage in business in case of Family Business Corporation. The research also revealed the absence of discussion on succession among female entrepreneurs, mainly in relation to female students. The absence of this discussion is related to women's negative approach to taking over family businesses.

Research in this area will continue, especially with regard to the field of family business studies and other fields of study chosen by young people, whose family member are engaged in family businesses.

Furthermore, the relation of young people (students) to the municipality, their will to stay in the municipality, and whether this approach differs for persons with a family business

background, will also be examined. The basic scheme of participation should also be extended in the future.

The challenge for further research is to find out the role of main and secondary activity in family business. Does the proportion of non-family businesses with main or secondary business activity differ from the family business? Is participation of the young generation in family business different in the case of main and secondary activities? Are there different or identical factors of participation in these types of activities?

The research results are currently valid for the Liberec Region. However, each region has its own specifics. Another challenge for the future is the possibility of applying this research in other regions of the Czech Republic, then comparing the results and finding differences.

Acknowledgements

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Ing. Zuzana Horčičková, Ph.D.

Participace mladé generace na rodinném podnikání

Výzkum byl zaměřen na studenty/studentky posledních ročníků učilišť, středních škol, vyšších odborných škol a dodatečně i veřejné vysoké školy v Libereckém kraji. Disertační práce se věnuje komplexnímu rozhodovacímu procesu mladých lidí vedoucímu k převzetí rodinného podnikání. Na základě výsledků analýz byl vytvořen základní schéma participace mladých lidí v rodinném podnikání v Libereckém kraji. Jsou zde zjištěny a shrnuty faktory, které jednotlivé fáze rozhodovacího procesu ovlivňují, přičemž je brán zřetel na typ obce, ve které je rodinné podnikání provozováno. Dále je zohledňován i typ rodinného podnikání, tj. zda se jedná o rodinnou obchodní korporaci či o rodinné podnikání fyzických osob.

Die Mitwirkung der jungen Generation beim Familienunternehmen

Die Untersuchung galt den Schülerinnen und Schülern von Berufsschulen, Mittelschulen, Fachoberschulen und zusätzlich auch den Hochschulstudenten im Reichenberger Bezirk (Liberecký kraj) der letzten Jahrgänge. Die Dissertation widmet sich dem neuen komplexen Entscheidungsprozess der jungen Leute, welcher zur Übernahme eines Familienunternehmens führt. Auf Grundlage der Ergebnisse der Analyse wurde ein Grundmodell der Beteiligung junger Leute an Familienunternehmen im Reichenberger Bezirk erstellt. Es werden hierin die Faktoren fest- und zusammengestellt, welche die einzelnen Phasen des Entscheidungsprozesses beeinflussen, wobei der Typ der Gemeinde Berücksichtigung findet, in welcher das jeweilige Familienunternehmen betrieben wird. Weiter wird auch der Typ des Familienunternehmens berücksichtigt, d. h., ob es sich um eine Familiengeschäftskörperschaft oder um ein Familienunternehmen physischer Personen handelt.

Udział młodego pokolenia w biznesie rodzinnym

Badania obejmowały studentów/studentki ostatnich roczników zasadniczych szkół zawodowych, szkół średnich, policealnych szkół zawodowych a także publicznych szkół wyższych w kraju libereckim. Praca dysertacyjna poświęcona jest kompleksowemu procesowi decyzyjnemu młodych osób prowadzącemu do przejęcia rodzinnego biznesu. Na podstawie wyników analiz opracowano podstawowy model udziału młodych osób w rodzinnym biznesie w kraju libereckim. Są tu wskazane i zebrane czynniki, które wpływają na poszczególne etapy procesu decyzyjnego, przy czym uwzględniono typ gminy, w której firma rodzinna jest prowadzona. Ponadto uwzględniono także typ rodzinnej działalności, to znaczy czy jest to rodzinna spółka prawa handlowego czy rodzinna firma prowadzona przez osoby fizyczne.

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