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CONTENTS

MANAGING THE COSTS OF QUALITY IN A CZECH MANUFACTURING COMPANY

Marie Cermakova, Petr Bris

Abstract

One approach to increasing the quality of products and services in companies is the application of a management system of quality costs. This tool is applied to improve the economic results in the company and is considered also as a tool that identifies key areas where the company should direct investment into quality improvement programs. The following article focuses on markets for optical equipment, using action research. The chosen Czech company's management approach included the implementation of cost management, with the aim of reducting costs of prevention and costs of appraisal and failure. This approach is known as the PAF model. The implementation of the PAF model revealed the true cost structure of quality costs and their real evaluations over time, in this case the period of 2010 – 2014; it also identified key areas for improvement.The greatest potential for improvement was hidden in a category of internal failure costs. In this category the annual costs amount to an average of 7,174 % of sales during the period. In the last part of the article, the costs of quality were analyzed against the sales of company (including material losses). Ultimately, the hypotheses in sections 4.3.1 and 4.3.2 were validated and based on these analyses the current state of the process was assessed and recommendations to streamline were presented.

Keywords: Cost of quality, Management cost of quality, PAF model, Czech Republic
JEL: M11, L60, L69

Introduction

Quality is one of the key factors that has a major influence on the customer decision to purchase a provider of a particular product. The concept no longer just refers to the high quality of products, it also encompasses quality in terms of service delivery, timeliness, after sale services and the production process itself (Ahmed Al Dujaili, 2013). Current globalization pressures, given a wide portfolio of products on the market that can be substituted for each other, is motivating for a company and leads the company to continually seek to raise the level of its production and thus gain a competitive advantage. The company is constantly striving to improve the quality of its production, but that must be a compromise between the right quality and costs which the company added. Quality cost management aims to create a high quality and high performance product or service that meets and exceeds the customers expectations (Ahmed Al Dujaili, 2013). These costs should be used in the most effective manner. So that the company can assess this effectiveness, it uses tools designed to manage the cost of quality. The literature provides many models and approaches to manage the costs of quality (Schiffauerova and Thomson, 2006; Arabian, 2013; Mizla and Puzlo, 2012), but none of these methods and models are standardized. This complicates the application of these methods and models in practice. According to Campanella (1999) a standard applicable to all types of businesses cannot be created. It must always depend on the specific situation and needs of the company.

This paper is focused on the application the cost of quality management in one company focusing on optical products. The main objectives of this paper is

demonstrate that attention only to monitoring costs without proper evaluation of the relative quality in a complex context is not sufficient thereby it also demonstrates the importace of managing the costs of quality. Firstly the system of the cost of quality management is described. In the next part the methodology of the research is showed followed by the results and recommendations. The final part is focused on the discussion and conclusion.

1.Literature review

1.1. Costs of quality

The concept of quality costs originated in 1951 (Pyzdek and Keller, 2013). At that time, the reporting of costs was limited only to inspection and testing and other items were included in overhead costs. When managers started to deal with the full scope of the cost of quality, they were suprised. It appeared that the costs of quality were doubled from 20 % to 40 % (Evans and Lindsay, 2008). Juran (1998) argues that the concept costs of quality has different meanings. Some people perceive it as the costs of poor quality. Others take this term to mean costs incurred by the work of the department of quality management. Mizla and Pudlo (2012) further Juran's opinion and argue that there is no general definition that could specify costs of quality. They justify this by holding that costs depend on the specific situation in the company and its own processes. According to the Ireland (1991), for the proper functioning and improvement of the quality of products and services in any company, term costs of quality must properly be explained and understood. Wood (2013) highlights that understanding the costs of quality helps show how effectively to integrate processes with customer needs, and brings the balance in the value chain that sustains the global economy. Many authors (Juran, 1998; Campanella 1999; Evans and Lindsay, 2008; Arabian, 2013) define the costs of quality as the sum of three main categories: costs of failure (internal and external costs), costs of appraisal and costs of prevention. The meaning of understanding these costs to all the authors is the same, however each author uses a different definition for its explanation.

Tab. 1: Opposing views of the costs of quality

JURAN	GUPTA AND CAMPBELL
Internal costs – These costs were identified before the delivery to the customer and they are associated with the failures that prevent satisfy customer needs. **External costs** – These costs are declared like weaknesses on the products and they are identified by customer. **Appraisal costs** – These costs are incurred determine the degree of compliance with customer requirements. **Costs of prevention** – These costs are incurred to keep the costs of failure to a minimum (Juran, 1998)	**Internal costs** – These costs arise from the connection with production of defective products. They are discovered before the delivery to customer. **External costs** – These costs are associated with products of unacceptable quality. They are discovered after the delivery to customer. **Appraisal costs** – These costs are incurred for the detection of product compliance with the quality requirements. **Costs of prevention** – The company invests these costs to reduce the cost of failure. (Gupta and Campbell, 1995)

BS 6143	CAMPANELLA
Costs of prevention – These costs are determined to reduce the failure costs and the appraisal costs to the minimum. **Costs of appraisal** – These costs are associated with ensuring compliance and fulfillment of the requirements of the customer. These costs exclude the costs of rework or reinspection failure. **Internal costs** – These costs are associated with failure and are identified before to delivery to the customer. **External costs** – These costs are associated with failure and are identified after the delivery to the customer. (BS 6143, 1990)	**Costs of prevention** – These costs are invested to all activities regarding preventive measures. **Costs of appraisal** – These costs are associated with the measurement, evaluation and audits to ensure compliance with the quality standards and with the requirements of performance. **Costs of failure** – These costs are the results of the products or services which are not in conformity with the needs of customers (internal and external). (Campanella, 1999)

Source: Author

1.2. Quality cost models

There are a few models and methods that can be used to analyze the costs of quality. The traditional model is the model PAF which groups costs into three basic categories: costs of prevention, appraisal and failure. The last category is divided into two more categories: internal failure and external failure. (Juran, 1998) Today, there are other types of models. Arabian (2013) identifies the PCM model which is used by a lot of companies. Srivastava (2008) adds still others: Crosby's model, COPQ or ABC. Mateides (2006) sees the main advantages of these models as able to depict with complexity the costs of quality of the enterprise. These models enable classification and linkage analysis with one other, provide an overview of the costs for various levels of management and assist in the development of methodology for monitoring and evaluation of costs. Through these models we can compare other departments across the group.

1.2.1. PAF model

Dr. Armand V. Feigenbaum was the first who developed the concept of measuring the costs of quality in 1956. The principle was oriented to categorize costs into three main section: prevention, appraisal and failure. (Arabian, 2013) This breakdown was adopted by the British Standard Institution (BSI), the United States incorporated it into their standards in BS 6143 and Part 2 via ASQC (American Society for Quality Control). This model is widely regarded as the most widely used for manufacturing and services in practice. (Mizla and Puzlo, 2012)

1.2.2. *PCM model*

PCM model is divided into only two categories: costs of conformity and costs of nonconformity. Ireland (1991) classifies in the category of conformity as the costs of planning, process control, testing and validation, audits, etc. In the second category are included the costs of scarp, rework, warranty service etc. According to the authors Goetsch and Davis (2014) conformity costs include amounts for the provision of products or services to the required standards of a particular process in the most

effective manner. This is the situation where each activity is carried out in accordance with the requirements for the first time. The cost of nonconformity are the costs which are associated with failure. The process model can be applied to each process but it must be identified by the key process steps and parameters that are monitored.

2. Research methodology

This study was prepared in a company which produces optical products. Although the company has a dominant market position, it is under enormous pressure to reduce product prices because the market conditions are rigorous. This situation demands that therefore great attention be paid not only to technical side but also to the economical side. The company recognizes the importace of cost of quality management and they deal with them carefully and in the long term. This system is considered to be the pursuit of continuous improvement. This pursuit has resulted in more efficient processes, reduced costs and increased productivity. In the company quality is considered one of the decisive factors of stable economic growth. It improve the quality of the programs and constantly streamlines it. For the successful implementation, a project team was created which was composed of representatives of the departments of production, finance, accounting, quality, and even the academic sector (as a consulting component). After an agreement between the project team and the company's management, it was decided that one of the financial management models of quality costs would be implemented in the company: the PAF model.

The project was very demanding from the perspective of data collection. The required costs were collected via interviews with management representatives, analyses of financial reports and information from company statements of other internal company records and the information system. However the company records certain items of expenditure quality (cost of irreparable defects, costs of customer complaints, etc.). These data are not registered in any complex system, do not include all sums of costs that really belong into the desired category and are not assessed in relation to the whole. Although they are monitored, they have no meaningful value for the company and it is impossible to manage the costs or optimalize the costs on their base. At the least the model also included cost items which were established on the basis of a qualified estimate by representatives of the company's management based on its experience and also data from previous periods.The main objective of the project was the implementation of the monitoring of four groups of costs according to the PAF model between 2010 and 2014. The model was implemented over a longer period of time precisely because the company had a comprehensive view of the cost of quality over time and that implementation has brought a new perspective to understanding these items to reveal new key areas on which the program can improve the quality of enterprise focus. Last but not least the aim was to demonstrate the fact that only appropriate monitoring of quality costs can demonstrate the importance of using this tool.

For the evaluation data obtained after the implementation of the PAF model the graphical evaluation methods and the descriptive statistics methods – relative and absolute frequency were used. To be draw conclusions from implementation was necessary to make several next analyses. The first was Pareto analysis. It was oriented on the internal failure cost. Further analysis was statistical Regresion analysis which identify the relationship between costs of failure and cost of prevention and the last analysis was Friedman test. This test verify the following hypothesis.

H₁: Between the years which the company has the same level of costs in the category of prevention.

H$_1$: Between the years which the company has the same level of costs in the category of prevention.
H$_2$: Between the years 2010 – 2014 the company has the same level of costs in the cost category for evaluation.

3. Results

The company impemented the PAF model. This model is oriented on the three categories: the costs of failure, the costs of prevention and the costs of appraisal. The concrete items are shown in the tables one to five in the annexes to this article. These items were classified into categories after the appointment of the project team and it respects the methodology recommended by the PAF model. The results of the implementation are summarized in the tables in the annexes and they are shown by the percentage proportion of each unit in relation to the relevant category. For example: from all the costs of internal failure was 35, 250 % of the costs spent on the loss of irreparable defects in 2010. The next table number 2 shows the total costs of quality in the period from 2010 to 2014.

Tab. 2: Costs of quality

	2010	**2011**	**2012**	**2013**	**2014**
Costs of prevention	4,077%	3,763%	3,870%	3,917%	3,611%
Costs of appraisal	44,419%	41,371%	42,715%	43,757%	44,626%
Costs of failure	51,505 %	54,866 %	53,415 %	52,326 %	51,763 %

Source: Author

These data have no predictive value. In order to be able evaluate the data without any disortion and so that they can be evaluated based on their conclusions, it is necessary that the data be evaluated further with the suitable base ratio (Campanella, 1999). The project team was chosen as a suitable base of company sales. The evaluation of quality costs to sales is shown in the following table 3. Data are evaluated by a percentage of the relevant category to total sales of the company in the period from 2010 to 2014.

Tab. 3: Total costs of quality to sales

	2010	**2011**	**2012**	**2013**	**2014**
Total costs of quality / sales	**18,93 %**	**16,61 %**	**18,27 %**	**18,11 %**	**18,12 %**
Costs of prevention / sales	0,72 %	0,59 %	0,67 %	0,67 %	0,62 %
Costs of appraisal / sales	7,83%	6,49 %	7,36%	7,51%	7,65 %
Costs of internal failure / sales	7,15%	6,91%	7,51%	7,17%	7,13 %
Costs of external failure / sales	1,97 %	1,73 %	1,70 %	1,75 %	1,73 %

Source: Author

4. Discussion

4.1. Analysis of costs of quality to sales

According to the data presented in table number 3, the total costs of quality to sales are arround 18 % annually. The only exception is 2011 (16,61 %). This year the

company had sales decline which it was accompanied by the decrease in costs in each category. However according to experts (Crosby, 1979; Hanse let al., 2009) the optimum of costs of quality due to sales should be 2 - 4%. A high percentage of quality costs compared to sales (about 18 %) should alarm the company that they should be more concentrated about the quality of products, processes and performance of the entire system as a whole. The weakest link and the greatest potential for optimalization is the category of internal failure costs, specifically the costs of the repaired defects and the costs of irreparable defects which reach of around yearly average 7 % of the total costs of quality related with respect to sales. One positive aspect here is the reality that internal failure costs are lower by comparision to external failure costs. External failure costs are very dangerous for the company because the high costs in this category can lead to loss of customers to the worsening corporation reputation.

4.2. Analysis of costs due to material wastage

Internal failure costs include the biggest cost item (see table 1 in Annex Article). In order to develop its evaluation, it is necessary that this category is submitted to further analysis. Due to the constantly changing and evolving conditions in production, the analysis was prepared for the year 2014, where the latest information about production are available. To reduce the costs of internal failure was used the Pareto analysis shown in the following figure.

Fig. 1: *Pareto analysis of the internal failure costs*
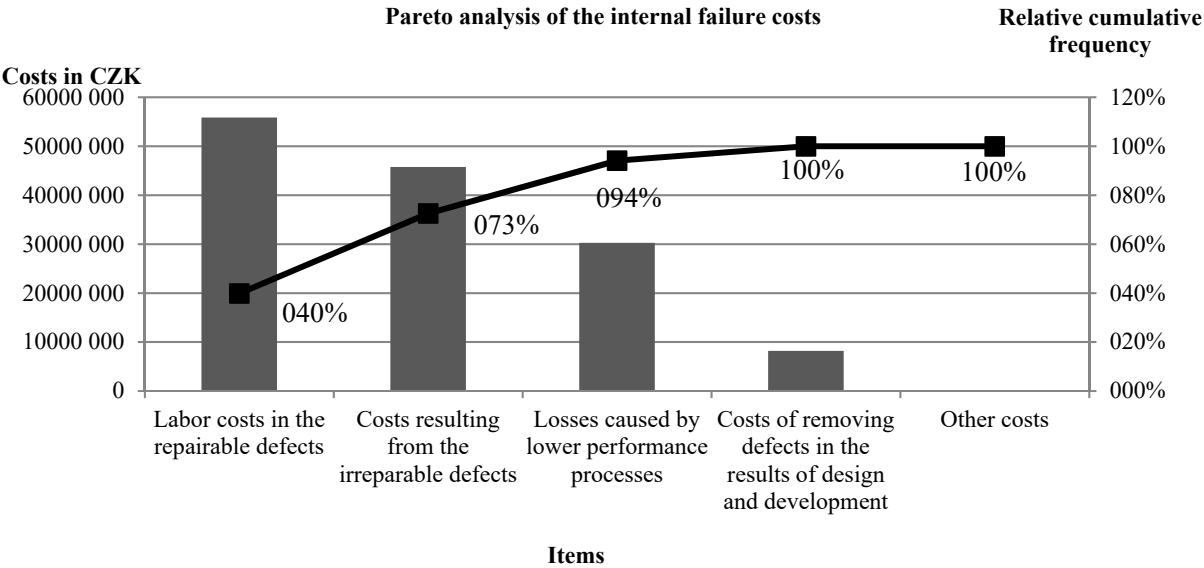
Source: Author

As you can see in figure number 1, almost 80% of the total costs of internal failure are due to: the costs of repaired defects and the costs of irreparable defects. This company is a larger company and it is divided into division A, division B and division C. After consultation with the project team, the detailed analysis was oriented on division B. This division was chosen because it assembles parts of division A and division C. This division brings the company the greatest added value. In this division was applied the Pareto analysis and the results are shown in the next figure. As is

visible, the biggest problems are impurties and defects from division A. The next analysis in the form of an Ishikawa diagram, where it is shown that the most likely cause of impurties of the material is the bad deburring of the material. Deburring process takes in the company in various ways. The first can be deburring done by CNC machine. The second manner is the removal of the needles at the end of the material by rolling in the beat (steel or ceramic). The third way can be cooled material. According to the attachment of the project team, it was suggested to the company that it invest in a new machine that would perform material deburring in division B. The costs associated with the incorrect deburring of one piece were estimated at 733 CZK. By properly deburring correctly the first time, the company save almost 3 325 179 CZK annually. The return on investment would be 5,3 years. The average life of the machine is 15 – 20 years. This investment could certainly pay off for the company.

Fig. 2: Pareto analysis in the division B

Pareto analysis in the division B
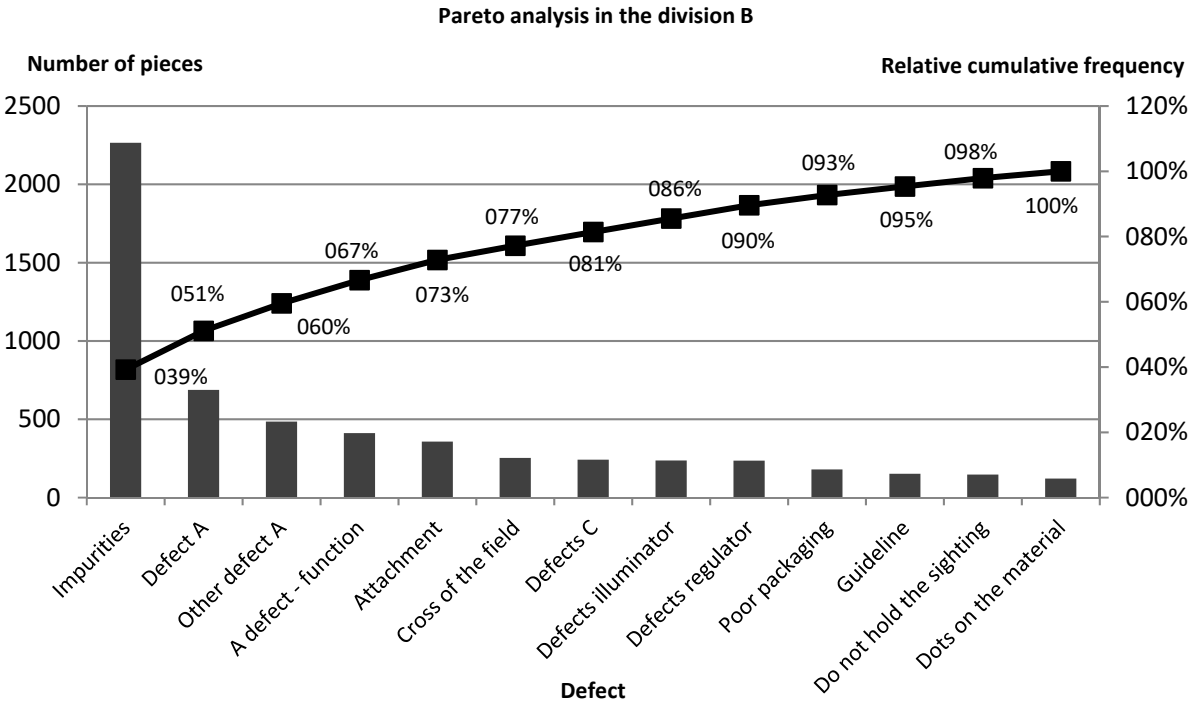
Source: Author

4.3. Analysis of the total costs of quality

The management of the company does not deal with the processes of the cost of quality. The PAF model deal with the costs of failure, appraisal and prevention. The category of appraisal and prevention are considered efficient use of resources. The category of failure costs is then classified as a loss for the company. (Nenadál, 2002). For this purpose, it could therefore be concluded regarding the overall total cost of quality that it is necessary to verify the following hypotheses that focus only on costs that are spent effectively: appraisal costs and the costs of prevention.

4.3.1 Costs of prevention

This category can be determined to verify the following hypothesis:

H1 = Between the years which the company has the same level of costs in the category of prevention.

This hypothesis was tested through the Friedman test and the program R. The results are shown in the following figure.

Fig. 3: The results of verify H1

```
Asymptotic General Symmetry Test

data:  Naklady by Rok (2010, 2011, 2012, 2013, 2014)
             stratified by Naklad
maxT = 1.5492, p-value = 0.5303
alternative hypothesis: two.sided
```

The results show that there is not enough evidence to reject the hypothesis of compliance costs in individual years. Further statistical analysis can not be performed because the cost structure is the same in all years (2010-2014). The category of prevention can still help us examine the relationship between the cost of prevention and cost of failure. In the regression analysis the costs of prevention and the costs of failure are compared. Horizontal axis x shows the costs of prevention and the costs of failure is examined on the vertical axis y. We verify whether the dependent variable (explained) is depended on the x – the costs of prevention. If the cost of quality in a company is managed correctly then it adds value to the cost by preventing a decline in the cost of failure. To verify the relationship between these two categories we used regression analysis processed in the program XL Statistics.

Fig. 4: Regression analysis in the program XL Statistics

$CF = -79779374144 + 19008,8147 \; CP - 0,0015 \; CP \;^{\wedge}2$
$R^2 = 0,98623$
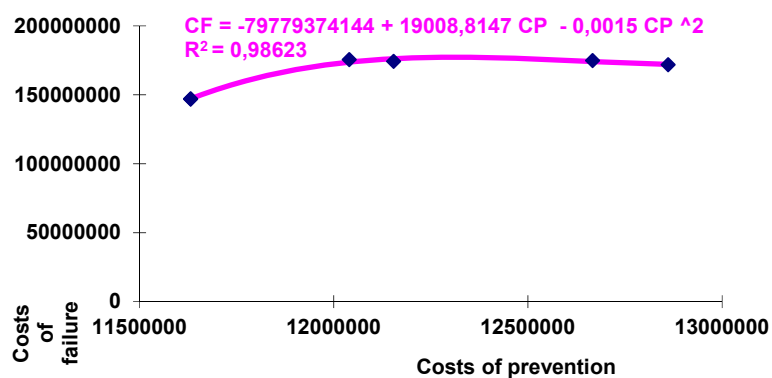
The above illustration represents a regression trend between the cost of prevention and cost of failure. Based on the results, we can say that the costs of prevention and the costs of failure to show strong and statistically significant negative relationship at the 95% confidence level.

4.3.2. *Costs of appraisal*
With this category can be determined to verify this hypothesis:

H2 = Between the years 2010 – 2014 the company has the same level of costs in the cost category for evaluation.

To verify the above hypotheses were also used Friedman test carried out in the statistical program R.

Fig. 5: Verify H2 in the program R

```
$Friedman.Test

        Asymptotic General Symmetry Test

data:  Naklady by Rok (2010, 2011, 2012, 2013, 2014)
         stratified by Naklad
maxT = 4.2485, p-value = 0.0001821
alternative hypothesis: two.sided


$PostHoc.Test

2011 - 2010 0.852647216
2012 - 2010 0.852647216
2013 - 2010 0.209624926
2014 - 2010 0.000214794
2012 - 2011 1.000000000
2013 - 2011 0.797107937
2014 - 2011 0.010510003
2013 - 2012 0.797107937
2014 - 2012 0.010510003
2014 - 2013 0.209624926
```

Source: Author

On the results of Friedman test, we can claim that we reject the hypothesis about the same level of costs between the years, and may perform post hoc test. This post hoc test showed that the rejection of this hypothesis was most apparent in difference in cost for the years 2010 - 2014, 2011 - 2014 and 2012 - 2014. It is therefore declared that the year 2014 for the company in terms of cost was the most important year as concerns changes in the cost structure.

Conclusion

In the company was applicated management system of quality costs. This tool is applied to improve the economic results in the company and is considered also as a tool that identifies key areas where the company should direct investment into quality improvement programs. In the company was implemented the PAF model which demonstrated real progress and regarding the cost of quality for the period from 2010 to 2014. The greatest potential for improvement was in the category of internal failure, which was also analyzed further. Based on these analyses against the sales of the process was assed and recommendations to streamline were presented. The company was advised to first start dealing with this category and gradually try to eliminate all the causes of problems and not just in Division B but gradually throughout the company. The next step would be legal and management costs in this category. During the next period the company should then start to drive additional categories of quality costs and according to recommendations (Nenadál, 2004) so that the cost of prevention increases an effect which will show further gradual reduction in the annual cost of failure. The cost of the evaluation should then report annually about the same or slightly rising trend. The main objective of this paper was to demonstrate that attention only to monitoring costs (without proper evaluation of the relative quality in a complex context) is not sufficient thereby it also demonstrates the importace of managing the costs of quality. Not only this case study but also studies by other authors (Ahmed Al-Dujaili, 2013; Schiffauerova, 2006) demonstrate that the findings suggest that this impelelementation improves firm performance as such more companies should look at the implementanion of cost of quality as a visible alternative to improve their bottom lines of quality. This results show that the implementation of cost of quality management plays an important role in the company.

Annex Article

Tab. 1: Costs of internal failure

	2010	**2011**	**2012**	**2013**	**2014**
Loss of irreparable defects	35,250%	32,324%	35,114%	35,135%	32,645%
Costs of labor to repair correctable defects	42,977%	39,874%	39,349%	37,674%	39,872%
Costs of removing defects in the results of design and development	5,323%	5,168%	4,375%	5,100%	5,841%
Costs for special tools and equipment nedded to repair defective products	0,011%	0,009%	0,009%	0,010%	0,009%
Losses incurred depreciation of materials and inventory at their rough handing	0,012%	0,010%	0,009%	0,010%	0,009%
Losses on customer property	0,011%	0,010%	0,009%	0,009%	0,009%
Losses due to nonconformance with the planned launch of new production processes	0,010%	0,009%	0,008%	0,010%	0,009%
Damages and shortages	0,028%	0,014%	0,022%	0,028%	0,024%
Losses caused by lower performance of processes	16,379%	22,582%	21,104%	22,024%	21,582%

Source: Author

Tab. 2: Costs of external failure

	2010	**2011**	**2012**	**2013**	**2014**
Costs of complaints	95,749%	96,367%	95,917%	96,236%	96,006%
Cost for seeking alternative buyers	4,251%	3,633%	4,083%	3,764%	3,994%

Source: Author

Tab. 3: Costs of appraisal

	2010	**2011**	**2012**	**2013**	**2014**
Costs of market research and defining requirements for production	2,829%	2,818%	2,758%	2,798%	3,052%
Costs of providing assistance to suppliers	1,078%	1,227%	1,005%	1,246%	1,094%
Costs of working quality department	2,097%	2,438%	2,732%	2,023%	1,902%

	2010	**2011**	**2012**	**2013**	**2014**
Costs of buying and maintaining external documentation	1,462%	1,498%	1,147%	1,238%	1,348%
Costs of management of internal documentation and records	10,639%	10,011%	8,717%	7,585%	8,996%
Costs of preventive action	12,622%	12,037%	11,376%	9,936%	12,400%
Costs of remedial measures	2,306%	2,270%	2,121%	2,512%	2,169%
Costs focused on continuous improvement	9,375%	9,028%	7,438%	9,466%	9,506%
Training costs, employee education and development costs	3,377%	4,055%	3,286%	3,790%	2,814%
Costs focused on impelementation of incentive programs	47,275%	48,105%	52,899%	52,535%	49,777%
Costs of membership in professional organizations and societies	9,501%	9,120%	9,078%	9,440%	9,775%
Costs for management review of quality by leadership	0,268%	0,211%	0,201%	0,230%	0,217%

Source: Author

Tab. 4: Costs of prevention

	2010	**2011**	**2012**	**2013**	**2014**
Costs of processes of control	40,259%	40,474%	40,603%	40,839%	40,766%
Costs for review of documentation	1,643%	1,652%	1,657%	1,667%	1,664%
Costs of operation tests	6,845%	6,882%	6,904%	6,944%	6,931%
Costs of buying services from external laboratories	0,121%	0,106%	0,096%	0,086%	0,102%
Costs of product conformation	0,102%	0,117%	0,103%	0,088%	0,081%
Costs associated with the obtaining Czech conformity mark	0,094%	0,079%	0,072%	0,070%	0,078%
Costs for purchase of measuring equipment	5,093%	4,627%	4,842%	4,216%	4,542%
Costs of calibration	2,464%	2,477%	2,485%	2,500%	2,495%

	2010	2011	2012	2013	2014
Maintenance costs	12,093%	12,158%	12,197%	12,268%	12,246%
Costs for development and production of special equipment	24,643%	24,775%	24,854%	24,998%	24,953%
Costs of marketing tests	3,190%	3,198%	2,739%	2,862%	2,697%
Costs of production samples	2,464%	2,477%	2,485%	2,500%	2,495%
Costs of continuous processes of inventory control	0,010%	0,010%	0,009%	0,010%	0,009%
Costs of creating self test conditions at the workplace	0,095%	0,091%	0,086%	0,084%	0,080%
Audit costs	0,874%	0,870%	0,862%	0,861%	0,853%
Costs of assessing capacity of machines and processes	0,009%	0,008%	0,007%	0,007%	0,008%

Source: Author

Tab. 5: Total costs of quality

	2010	2011	2012	2013	2014
Costs of prevention	4,077%	3,763%	3,870%	3,917%	3,611%
Costs of appraisal	44,419%	41,371%	42,715%	43,757%	44,626%
Costs of failure	51,505 %	54,866 %	53,415 %	52,326 %	51,763 %

Source: Author

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PUBLIC ADMINISTRATION PROJECT SELECTION USING CASE-BASED REASONING

Meaza Haile, Jiri Krupka

Abstract: *European Union (EU) member countries design and implement different projects under programs designed by the union to improve standards of member countries. One of these programs is regional policy program. Thousands of projects have been funded under this program. Some of these projects are developed in collaboration between countries and some by a single country. The issues addressed by different projects are sometimes similar, for instance, improving quality of life for the elderly people. Q-Ageing and design led-innovation for active aging are two projects that focus on this issue. Even though these projects were designed independently and used different methods the main goal of both projects is to improve the quality of life for the elderly people. In this paper, case-based reasoning method is proposed for EU member countries to selects projects that has already been designed to address similar issues. Text parser and Chouquet fuzzy integral are used in the method for comparing cases in order to choose best matching cases. Application example was also performed to demonstrate.*

Introduction

The lack of general European Commission legislation applicable in the domains of public administration and administrative law poses a problem for European Union candidate countries. Candidate countries are required to have administrative systems and public administration institutions capable of transposing, implementing and enforcing the acquis communautaire, EU legislation, according to the principle of 'obligatory results' (obligation de résultat). Candidate countries have to meet the criteria required for EU Membership as adopted by the European Council in Copenhagen, Madrid and Luxembourg. In addition, candidate countries' progress will be measured against those criteria, i.e. in the wording of the European Commission's Regular Reports, in terms of their 'administrative and judicial capacity to apply the acquis', which signifies implicitly that their progress will be assessed against European administrative standards (Sigma, 2014). Therefore, it is essential for the EU member states to use strategic planning to achieve the expected progress.

Strategic planning… is based on the premise that leaders and managers of public and non-profit organizations must be effective strategists if their organizations are to fulfil their missions, meet their mandates, and satisfy constituents in the years ahead (Bryson, 1995).

The framework, used by many authors in developing strategic plan is data collection, surveys, researches and thematic analyses – SWOT (strength, weakness, opportunity and threat) analysis (analytical part); vision – goals, aims, (strategic part);

actions and activities (action part) and a part of implementation, management, measurement and evaluation (Šilhánková, 2007). As long as measurement and evaluation is involved a strategic planning process is on-going where organizations evaluate their improvement, identify their weakness propose a solution to overcome their weakness implement it and back to evaluating improvement.

1 Statement of a problem

Even though EU member cities have their differences in many ways, most cities suffer from the same problem at one point or another. 'Our cities possess unique cultural and architectural qualities, strong forces of social inclusion and exceptional possibilities for economic development. They are centres of knowledge and sources of growth and innovation. At the same time, however, they suffer from demographic problems, social inequality, social exclusion of specific population groups, a lack of affordable and suitable housing, and environmental problems' (Bundesministerium, 2007). For instance based on studies conducted independently for the city of Vienna and Prague although presented in different categories and different words both countries face the following weaknesses:

- Poor coordination between public and private sector

- Low interaction between companies, authorities and education

- Relatively low outcome in research and development

Over the years may frameworks and tools have been developed where EU member countries exchange experience and refer guidelines in order to improve their strategic plan and to create similar situation through the member countries. Among those are RFSC and Quality of Public Administration: A Toolbox for Practitioners.

RFSC is a web tool designed to help cities and urban territories promote and improve their integrated urban development actions (RFSC, 2012, 2016b). Where 'respect' means the RFSC values the diversity of European cities, respecting differences in local priorities and institutions. There is no one-size-fits-all solution for integrated urban development, no universal recipe for success. It is the shared vision that matters, the time frames, targets and themes should be decided locally. RFSC enables cities to move at their own pace and choose the scope of their involvement. It offers a set of tools for evaluating and monitoring public policies, and an online space for cities to share their experiences. The RFSC rethinks the basis for sustainable development of cities by proposing a grid of 25 common questions formulated based on the following four dimensions: enhance the economic efficiency of territories, foster social cohesion in conurbations, improve the environmental quality of cities, and develop integrated governance practices. It means that RFSC analyses four areas simultaneously: economy, social, environment and governance. The RFSC is a vibrant community of cities that learn from each other, share experience and discuss common challenges. By joining the RFSC community, cities get access to different forms of exchange and support, including dedicated training sessions, peer learning and coaching from urban governance experts. Finally, for 'cooperation', not competition, which is at the heart of the RFSC. Developed for cities and with cities, RFSC is a meeting place that aims to bring together various actors within one city, hundreds of cities and local authorities from across Europe and finally all those at the national and European level who believe that sustainable cities are the future (RFSC, 2016a,

2016b). The RFSC is used in countries such as Czech Republic, France, Italy, Netherlands, Poland, Portugal, Spain and Sweden (RFSC, 2016b).

Quality of Public Administration: A Toolbox for Practitioners was conceived as a helpful and practical guide for civil and judicial administrations to the challenges of good governance in a constantly changing environment. It examines the key elements of good governance and highlights positive real-world responses in Member States to dilemmas in administration, signposting the way that others may also wish to follow. The Toolbox concentrates solely on the administration of public policy and services, including both civil and judicial systems. It is about governance as a process. It does not cover the specifics of individual policies or services - for example regarding education, taxation, health, customs, competition, training, etc. (EU Commission, 2015). The figure below (Fig. 1) shows the toolbox.

Fig. 1: Toolbox overview by theme and topic
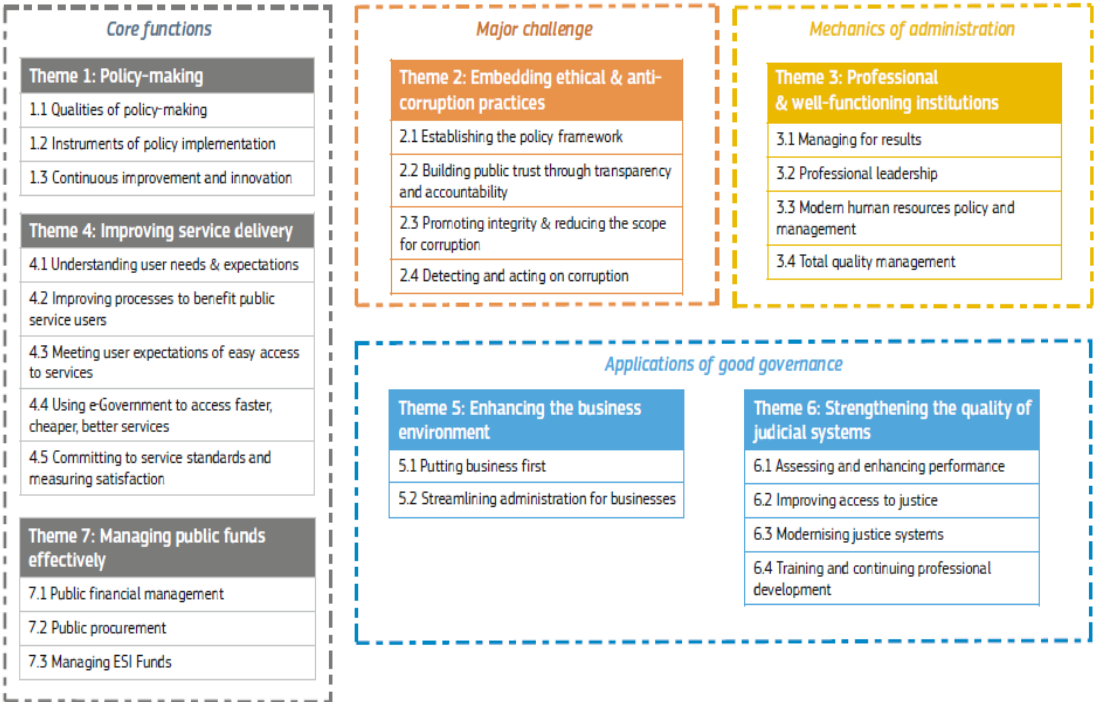
Many projects are also funded by the EU, under different programs, to improve public administration policies and other governance issues. One of these programs is regional policy. This program has funded different projects on the issues like sustainable development, technology, and quality of life for the elderly people. In this paper two projects under the regional program, focused on the issue of improving quality of life for the elderly people are discussed briefly. Most of these projects are designed in a way to be implementable by all EU member countries.

What is proposed in this paper is a reasoning system that could be used by EU member countries to solve specific city problems or make decision based on the experiences of others. By solving problems in the same or similar way, quality of public administration of cities could get closer to achieving unanimity. What makes the proposed method different from the RFSC discussed in the above section is the way data is stored and retrieved. City council or experts provide the system with desired criteria and the system returns top solutions based on those criteria. The

system focuses on cities since cities play a key role in the social and economic development of all European territories and provides home for the majority of population (EU Commission, 2011). A hypothetical case study was also performed to clarify the application of the method for project selection in solving a specific issue.

2   Case based reasoning

The idea behind CBR terminology is to solve a problem by using previous experience. A problem that has already been solved is referred to solve a new problem at hand. Otherwise, a solution with more similar criteria will be modified to suit current problem and the new solution will be stored in the case library for future reference. In CBR terminology, a case usually denotes a problem situation previously experienced which has been captured and learned in a way that could be reused in the solving of future problems. In general, a case is composed of problem description, problem solution, and outcome (Amodt, Plaza, 1994; Kolonder, 1993). The problem description essentially contains as much data about the problem and its context as necessary for an efficient and accurate case retrieval. Problem solution or outcome states the derived solution to that problem. CBR has the two main processes: storing and organizing cases in the case library and retrieving the solution that best suits current problem (Kolonder, 1992).

In order to solve problems using previously solved cases, there has to be an initial case memory with successful cases stored in an indexed and organized way. CBR scholars have proposed several guidelines on indexing; Indexes should be: predictive of the case relevance, recognizable in the sense that it should be understandable why they are used, abstract enough to allow for widening the future use of the case base and discrete enough to facilitate efficient and accurate retrieval. Methodologies for choosing indexing could be manual and automated methods. when cases are complex and the knowledge needed to understand cases well enough to choose indexes accurately is not concretely available, hand indexing is needed otherwise automated indexing could be used. Another important factor is case organization; the case base should be organized into a manageable structure that supports efficient and accurate search and retrieval methods. Accurate retrieval guarantees the retrieval of best matching case, and efficient retrieval guarantees fast retrieval of cases for acceptable system response times (Kolonder, 1992).

The retrieve solution task starts with a (partial) problem description, and ends when best matching previous case has been found. The subtasks of retrieve process are referred as identify features, initially match, search, and select, executed in that order. The identification task comes up with a set of relevant problem descriptors. The goal of the matching task is to return a set of cases that are sufficiently similar to the new case given a similarity threshold of some kind. The selection task works on these set of cases and chooses the best match (or at least a first case to try out) (Amodt, Plaza, 1994). In this step, a new case is entered into the system by the user; the system recalls cases that have relatively high similarity values, i.e., previous cases with similar indexes are retrieved. This process is called interpretation. When problem situations are interpreted, they are compared and contrasted to old problem situations. Different methods can be used to search cases (Kolonder, 1992). CBR has been applied by researchers since the 90's for different fields recent applications include business

failure prediction (Hui, Jie, 2011), eco-innovation product design (Cheng, Jahau, 2014), medical domains (Cindy et al, 2014; Isabelle et al, 2010).

In this paper instead of the traditional retrieving methods, such as inductive retrieval, Choquet Fuzzy Integral was applied, that is to use specific characteristics to compare cases and to find the best solution that satisfy the cities' requirement. Once a similar case is retrieved the next step is to adopt the solution to meet the demands of the new case and to store the new solution to the case base for future reference.

3 Discussion

As mentioned in the introduction strategic planning is on-going process and needs a constant monitoring and fix to improve success. What is proposed here is CBR system that records all the problems or weaknesses faced by EU member cities and their solutions so these solutions could be adopted by other cities in the future. This will create relation among cities in sharing experience, avoids redundancy and saves costs.

3.1 Theoretical application of the proposed method

While solving any problem cities consider solutions that are implementable on their capacity and structure. Capacity includes fund, human resource, time limit, the city the problem was solved in, and so on, which are considered as case attributes. Therefore, in case representation each case contains these attributes, problem statement, and solution. The advantages of the proposed method over existing tools include:

- Providing a way to adapt solution for a specific problem instead of strategic plan, based on the criteria set by city council or experts;

- The method is also cost and time effective by avoiding the process of proposing alternate solutions;

- Solving these specific problems improve the overall success of a strategic plan;

- The system provides cities with options and freedom to choose a detailed solution for a specific problem based on their capacity without going through strategic plans of other cities.

Generally, the method provides a bottom up approach where cities can solve their weakness and improve the success of their strategic plan.

In this paper, a two-step retrieval method is proposed. The first step is to use text parser to find cases with similar problem statement. Once these cases with similar problem statement are found Choquet fuzzy integral method will be used to choose the best-suited case for the current problem based on the comparison of case attributes.

In the first step of the case retrieval process, the problem statement of the new case will be compared with cases and the cases that match the new case will be chosen. This will limit the number of candidate cases. To further reduce candidate cases Choquet fuzzy integral method will be used to find the best matching solution based on criteria set by city council. For instance, cities with smaller population would prefer solutions generated in cities with similar population size, similar culture, and growth rate based on the type of problem the city is facing. Furthermore, the solution has to be implementable with resources affordable by the city. These criteria could be

implemented using multiple criteria decision-making methods such as analytic hierarchy process. For this paper, Choquet fuzzy integral method is chosen to avoid dependency issues among characteristics (Choquet, 1953). The following figure (Fig. 2) shows the two step case retrieval process.

Fig. 2: Case retrieval process
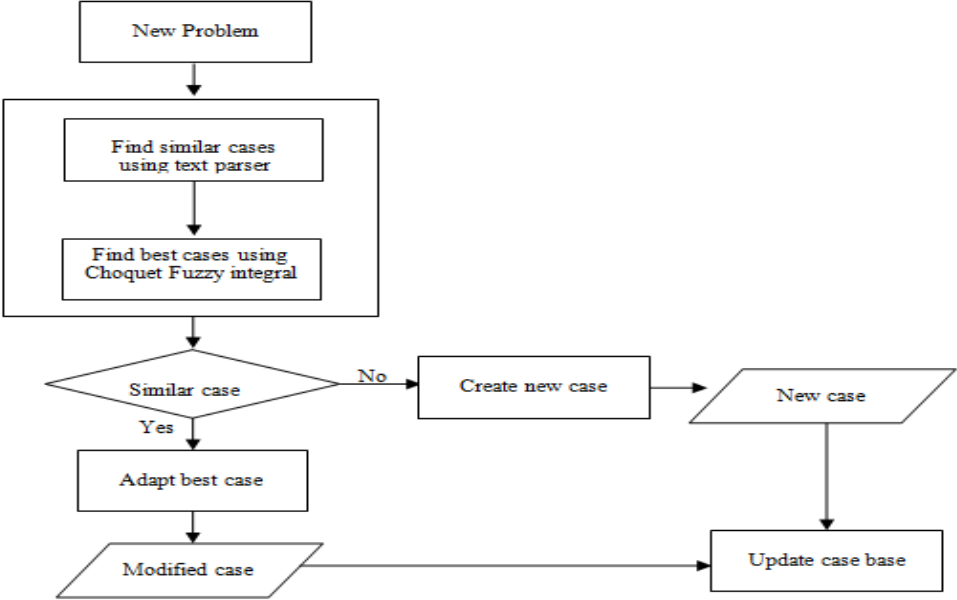
If a case that satisfies the given criteria is found then the solution will be adapted and implemented by the city. The adaption process highly depends on knowledge and experience of experts. After the adaption and implementation process the new solution will be stored in the case library for future reference. If there is no such case that satisfies the given criteria a solution for the new case will be created, implemented by the city and stored in the case library (Haile, Krupka, 2016). The following figure (Fig. 3) shows the process flow while accessing a solution from a case base using the proposed method.

Fig. 3: Process flow for the proposed model CBR
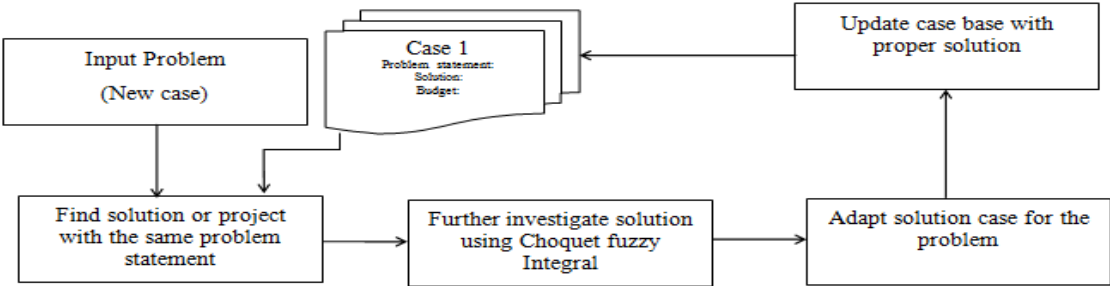
For instance in section 1, the common weaknesses of the cities of Prague and Vienna was discussed. If one of these cities were to solve those problems, using the proposed method, the city specifies the problem, and the characteristics the expected solution has to fulfill. Since it is unlikely to find a case that fulfill all required characteristics the characteristics has to be assigned priorities. Then the case library will be searched for proper solution, if a solution is found it will be adopted, implemented, and the new solution will be properly indexed and uploaded to the case

library. If the problem has not been solved by another city in the past, a solution will be created, implemented, and uploaded to the case library. (EU Commission, 2014).

3.2 Application demonstration

There have been different projects on improving the standard of living for the elderly people, in the EU. Some of those projects are implemented in collaboration between cities for example Q-Ageing and design led-innovation for active aging.

European Regional Development-funded Q-Ageing united partners from Germany, Hungary, Italy, Poland and Slovenia. Together they demonstrated the significant contribution older people can make to society through a final set of pilot projects tested in each country.

A key feature of Q-Ageing is its toolbox, which is a culmination of the work carried out under the project. It paves the way for the development of senior-friendly public spaces and improvement of mobility through senior recreation parks, open air space, as well as urban transportation facilities. The toolbox is intended for use by all EU-Member States. A Transnational Ageing Resource Centre was also established under Q-Ageing and serves as an online community space for the elderly. 30 temporary jobs were created as a result of the project (EU Commission, 2014).

Main attributes of the project include problem statement, budget, duration, and solution, the following table (Tab. 1) shows these attributes and their values.

Tab. 1: Attributes of Q-Ageing

Attributes	Values
Problem statement	Making aging better for elderly people
Budget	2 218 871 Euro
EU investment	1 768 345 Euro
Duration	12/2008-03/2012

Source: (EU Commission, 2014)

The findings under Q-Ageing support the idea that demographic ageing could be better tackled by ensuring elderly people stay longer in the labor market and remain healthy, active, and autonomous well into retirement. Q-Ageing partners have demonstrated the significance of actual and potential contribution that older people can make to the society through a final set of 18 pilot projects tested in various central European countries and regions. These include the online 'SkypeCare' for the elderly in Hungary and a day care center in Slovenia (EU Commission, 2014).

Design led-innovation for active aging is a project conducted by eight cities, RÉG. Bruxelles-Cap./Brussels Hfdst, GEW, Belgium, Antwerpen , Belgium, Yugozapaden, Bulgaria, Helsinki-Uusimaa, Finland, Etelä-Suomi, Finland, Berlin, Germany, Norge, Norway, Mazowieckie, Poland, Cataluña, Spain and Stockholm, Sweden. Each of these eight cities focused on a specific aspect of elderly care services, called 'scenarios'. The project aimed at an integrated approach, including stakeholders and users (EU Commission, 2016). The aim of the project was:

- Rethink and redefine senior care by using innovative processes and design methods

- Find feasible and sustainable solutions that keep senior citizens physically and socially active and that provide them with the care they need

- Improve the effectiveness of local policies by learning from best practices elsewhere and assessing their transferability

- Use design to build the innovation capacity of cities, to enhance their service development, and to improve their policy making

- Adopt a 360-degree approach by searching for systemic solutions in different areas and by involving all kinds of stakeholders

- Make it easier for public authorities to find strategic and service design competencies to support their policy making

- Increase awareness of the complex issues that arise from demographic ageing and the many challenges that senior care poses

- Jointly develop action plans, design briefs, best practice descriptions, field visits, thematic workshops, and guidelines for policy makers and public organizations (EU commission, 2016).

The following table (Tab. 2) shows the main attributes of Design led-innovation for active aging project

Tab. 2: Attributes of Design led-innovation for active aging

Attributes	Values
Problem statement	Making aging better for elderly people
Budget	2 022 700 Euro
EU investment	1 366 133 Euro
Duration	01/2012-06/2014

Source: (EU Commission, 2016).

For demonstration purpose, a hypothetical case where one of the weaknesses of a city is low quality of life for elderly people is considered. The city desires to implement a project for improving life standard for elderly people. For the sake of simple demonstration the two projects, discussed above are the only cases in the case library that were performed on improving life standard for elderly people. Also, let the three attributes: budget, duration and EU investment be the only important variables. EU investment is assumed as an important variable believing the EU will grant the same amount of money for the same project implementation. The two cases discussed here are only used to show the possibility of implementing the proposed method and the information used here is general.

The first step is to find a project whose objective is similar with the hypothetical problem, using text parser and key words like elderly people and aging. Once the two cases are found, the next step is to compare them based on the attributes of the hypothetical case. The city needs a project with lower budget. EU investment is very important for the city since the city needs to spend as minimum amount of budget as possible. Time duration is not a big issue for the city. The following table (Tab. 3) shows cases, their attributes, and the weight of the attributes.

Tab. 3: Case attributes and their values

Attributes	Case 1	Case 2	Weight
Budget	2 218 871 Euro	2 022 700 Euro	0.5
EU investment	1 768 345 Euro	1 366 133 Euro	0.7
Duration	12/2008-03/2012	01/2012-06/2014	0.2

Source: (EU Commission, 2014, 2016)

First, the measurement of the attributes will be changed to similar unit. In this case sequencing method was used. Since there are only two cases and two sequences the interval from 1 to 2 is used. The table below (Tab. 4) shows the value of case attributes on the scale of 1 to 2.

Tab. 4: Case values on the scale of 1 to 2

Attributes	Case 1	Case 2	Weight
Budget	1	2	0.5
EU investment	2	1	0.7
Duration	2	1	0.2

Source: Authors

Definition: Let $\lambda \epsilon(-1, \infty)$ and let $X = \{x_1, x_2, \ldots, x_n\}$ be a finite set. If $(X, P(X))$ is a measurable space and if set function $g_\lambda: P(X) \to [0,1]$ satisfies the following conditions, then g_λ is denoted by a Sugeno λ measure and $g_\lambda(\varnothing)=0$, $g_\lambda(X)=1$; $A \cap B=\varnothing$, $A \cup B \neq X$ $g_\lambda(A \cap B)=g_\lambda(A)+g_\lambda(B)+ \lambda g_\lambda(A)g_\lambda(B)$ that

$$\lambda + 1 = \prod_{i=1}^{n}(1 + \lambda g_\lambda(x_i)), \ \lambda > -1 \tag{1}$$

where $g_\lambda(x_i)$ is fuzzy measure.

Definition: Let set function $g: P(X) \to [0,1]$ be a fuzzy measure on measurable space $(X, P(X))$, and $h: X \to [0,1]$ be a measurable function on X. If $h(x_1) \leq h(x_2) \leq \ldots \leq h(x_n)$, $A_i = \{x_i, x_{i+1}, \ldots, x_n\}$ then (Choquet, 1953; Grabisch, 2000; Sugeno, 1974).

$$E^{def} = \int h dg^{def} = h(x_1)g(A_1) + \sum_{i=2}^{n}(h(x_i)-h(x_{i-1}))g(A_i) \tag{2}$$

Where E^{def} denotes the overall function $h(x_i)$ is viewed as the performance of sub characteristic x_i of the organization at a specific time $g(A_i)$, express the grade of importance for the subset A_i. The fuzzy integral of $h(x_i)$ with respect to g denotes the overall evaluation.

The first step is to Calculate lambda based on the equation (Eq. 1).

$$\lambda + 1 = \prod_{i=1}^{3}(1 + \lambda g_\lambda(x_i)) = (1 + 0.5\lambda)*(1 + 0.7\lambda)*(1 + 0.2\lambda), \ \lambda > -1$$

After calculating the roots of the polynomial resulted from the above equation, the following results were obtained: $\lambda=0$, $\lambda=-0.744$ and $\lambda=-7.69$. $\lambda=-0.744$ was chosen since it is the value that satisfies fuzzy measure criteria. Then the combined aggregate for the attributes was computed: $g_\lambda(12)=g_\lambda(1)+g_\lambda(2)+ \lambda g_\lambda(1)g_\lambda(2)$, where, $g_\lambda(1)$ is the weight for the first attribute (budget), $g_\lambda(2)$ is weight for EU investment and $g_\lambda(3)$ is

weight for duration of project. By substituting the values $g_\lambda(12)=$ 0.9396, $g_\lambda(13)=$ 0.6256, $g_\lambda(23)=$ 0.79584 and $g_\lambda(123)=1$ was calculated

The next step is to calculate the aggregate evaluation of each case to determine the better choice, based on Equation (Eq. 2)

Tab. 5: Fuzzy aggregate evaluation of attributes

Case 1 E^{def}	Case 2 E^{def}
1.78	1.5

Source: Authors

Based on the result from the above table (Tab. 5) case 1 is the better choice for the hypothetical city but since the results of both cases is close the best solution will be for the city to consider both cases and design a new solution based on the two cases. The budget for the project will be significantly less since by using this method some steps of project development cycles will be avoided.

Conclusion

Over the years, different frameworks and tools have been available by EU to assists member countries to have administrative systems and public administration institutions capable of transposing, implementing, and enforcing the acquis according to the principle of 'obligatory results'. The method discussed in this paper is application of CBR for solving cities' problems based on others experience. Project developed by a city as any project follows the steps of project conception, design, implementation, evaluation, and, once the project tasks are completed and evaluated, closing of the project. When the proposed system is used the tasks and costs of project conception and design will significantly decrease.

The advantage of the proposed method over existing tools include: the proposed method provides a way to adapt solution for a specific problem instead of a strategic plan. Solving these specific problems improve the overall success of strategic plan. The method also provides cities with options and freedom to choose a detailed solution for a specific problem based on their capacity without going through strategies of other cities. This is a bottom up approach where cities solve weakness and improve the success of strategic plan. Practical implementation of the system will be presented in the future.

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IT UTILIZATION RATE WHEN DETERMINING CORPORATE STRATEGIC GOALS

Romana Hajkrová

Abstract: *This article assesses current level of the information support tools for a specific area of the corporate process. Under this area we understand strategic planning and determination of corporate strategic goals. The mentioned area is perceived quite differently by the plant owner than for instance employee of the same company. But the fact is that this area is the major axis that passes through the entire corporate structure and, if set correctly, it is the very key to success and especially to long-term development and stability of the company. From the historical point of view, creation of corporate strategic objectives was a certain foretelling from the crystal ball for a number of managers, depending on the corporate life cycle phase, or stereotypical raising the goals. Based on this way created corporate strategic goals, it is not surprising that fulfilment of these objectives reflects the reality rather by accident in many cases. Creating truly realistic strategic goals of the company with respect to its life cycle is a much more complex process and therefore one wonders at the low level of responsibility applied by certain managers to it.*

Keywords: *Information technologies, strategic goals, strategic plans, company / plant, software, analysis*

JEL Classification: *M15, M21*

Introduction

Nowadays a relatively large number of information support tools is available in the market for the majority of processes used by the plant depending on its focus, i.e. the manufacturing, trading or services-oriented plant. These tools have been created and developed gradually in conformity with development of the information technologies intended for corporate support. These tools were at first specialized in a specific process, e.g. production support, sales records, warehouse management, economics, etc. In the course of time the tools for management of the company as a complex whole or large parts of it have arisen. The tools of e.g. CRM, ERP, SCHM, MIS type have thus appeared. But the development has not stopped there, and today we are experiencing the stage of implementation of the tools such as BI, integration platforms and other integrated tools. If we consider this area creating the very top level of the IT pyramid of each individual company, we can establish that the whole mosaic of the information support tools misses one specific part, intended only and exclusively for formulation of strategic goals and objectives. This tool should become an indispensable part of information support for the managers at all levels of the organizational structure of the company. If you want to commence the research focused on determination of the potential of utilization of the information support tools for identification of the corporate strategic goals, it is at first necessary to define what are the strategic goals of the company. While searching for the professional literature sources, I have discovered a number of papers devoted to the issue of corporate

strategic goal planning. This topic is mentioned in this area in connection with all sorts of processes, cycles, and other possible links with the company. But when seeking for the information support tools applicable for determining the corporate strategic goals, I am unable to find any relevant outputs. It was one of the reasons for elaboration of this article dedicated to this issue.

1 Problem formulation

1.1 Strategic goals of the company

Each company was established with a certain vision of its owners, and realization of this vision should be its mission. Keřkovský (2015) believes that not only determination of the goals and the ways to achieve them, but also the correct definition of the starting position is important for successful conduct of the organization. The same is also applicable to assessment and consideration of the current position and direction of the competitors, including objectives of their clients and suppliers. Knowledge of the latest state and development of the environment is an inevitable feature for effective internal setting of the organization. According to Dedouchová (2001) strategic goals are the future state to be achieved. They are formulated at the top level of the organization. What is the vision? Why do the companies exist, what do they want to achieve? A number of examples of why the companies do exist can be quoted. And it is certainly not just making profit and making money. On the contrary, profit making is conditioned by the quality of products and services as well as by satisfaction and loyalty of customers and employees, market position, ability to develop itself and respond to changing market conditions and by many other factors. Practical use of strategic goals in the organization is crucial to clarify their vision which is specified more precisely. Strategic goals of the organization are usually defined by its owner or the top management, which is also responsible for achieving them. The strategic goals specify the vision more precisely and assist the managers in managing and motivating the employees organization-wide (Leon-Soriano, Munoz-Torres, Chalmette-Rosalen, 2010).

Strategic goals and their formulation are the very basis for:

- Corporate organization, structure, measurement and assessment of corporate process performance,
- Management of corporate information and information systems,
- Human resources management, determination of responsibilities and competencies, performance management (Kourdi, 2011).

According to Cimbálníková (2012), strategic goals are understood the future desired state, which the companies try to reach through their own activities and existence. These strategic goals are determined by the top organizational and strategic unit of the company. Determination is based on the strategic analytics and on formulation of strategic plans. The goal achieving degree is the most important parameter for assessing success or failure of the company. Correct setting of strategic goals is very important, as stated Cimbálníková (2012) in her book, mainly for the following reasons:

- Goals are important for assessment of corporate activities,

- Goals create the environment for defining competence and responsibility of individuals

- Goals enable to create the right conditions for cooperation of competent decision makers generating and defining the conditions for achieving the raised goals,

- Goals determine position of the organization with respect to the environment and assist in integrating into it.

According to Souček (2003), strategic goals are focused on four groups:

- Regional (corporate social responsibility),

- Personnel (professional growth and improvement of qualification, indicators for assessing performance),

- Client (development and growth, effectiveness focused on maintaining quality and reliability advantageous conditions of funding),

- Owner or founder (economic and performance indicators, profitability and cash flow stability).

Identifying strategic objectives is essential for the ability to plan effective and long-term sustainability of the organization with respect to uncertainty of the market and the environment. According to Fotr (2012), achieving the goals is conditioned by the necessary coordination and synergy of various professional structures of the company and their specialized activities.

1.1.1 *Intentions*

Business objectives define the intentions, which shall be achieved within the project. It happens sometimes that intention of the project is confused with the product, but product is the outcome project activities. Such confusion leads to poor understanding of the whole project and the latter can thus become unsuccessful. So, when defining the project, it is important to specify very carefully the intentions that lead to execution of the project, namely both the primary and the secondary ones; the secondary intentions are not decisive for project definition and will be met through fulfilment of the primary objectives. These intentions should be in compliance with general conceptions of development and with capabilities of corporate particular personnel structures up to the management, since this leads to common orientation of the whole team on achievement of the primary goal. This conception requires, in the phase of intentions preparation, very good and clear mutual communication of the particular structures - including the feedback to the management. (Muller, Jugdev, 2012).

1.1.2 *Critical success factors*

To achieve the goals, it is necessary to determine the main areas that are very important for their fulfilment. These areas are usually considered as early as when determining the goals, but their explicit designation will lead to common understanding of their importance by all stakeholders who are involved in the project team. All particular areas must also be defined with respect to the existing own human resources, capacities, and processes and authorities setting of the system. Each of the above mentioned items, when underestimated or poorly set, means high risks both for

the particular area and for the goal itself. From the facts above it follows that increased attention has to be paid to this project area and its failure can seriously affect the overall outcome of the project. (Muller, Jugdev, 2012).

1.2 Creation of corporate strategic goals

It is a systematic method of defining and implementing the specific steps that will lead and contribute to fulfilment of the main corporate goal. The strategic planning process is always divided into specific phases and steps that are grouped by their priorities, resources and mutual links. Everything is spread on a timeline and delegated to relevant managers and teams. Selection of the strategy and specific strategic corporate planning is a critical point for the companies that want to preserve a firm position in the market. Good phasing of individual parts and adequate selection of the strategic planning tools is therefore advisable. Every high-quality plan starts with a precise analysis of the needs of the organization. It is necessary to pay attention to the maximum clear and unambiguous formulation of the corporate goals as well as to analysis of external influences that can significantly affect normal business of the company. The second phase includes formulation of the strategy, i.e. breakdown and identification of long-term goals, appropriate selection of strategic procedures and tactics themselves. One level below includes breakdown of the strategy into the operating plan, containing individual sub procedures and delegation of responsibility in order to implement specific tasks. In this case it is advisable to consider well automation of corporate processes and digitization of documents, taking in view efficiency of operation. The last phase comprises monitoring and assessment of the raised goals. Thanks to the data analysis and the applied Business Intelligence software it is possible to monitor states in real time. This allows to respond to the present state immediately and to predict the future state, which is necessary to meet the set strategic goal. The procedure, management and organization of preparation of the strategic plan are affected materially by the chosen method for its preparation. Combination of the following two methods is used most frequently, and principles of one of them usually prevail. (Boyer, Frank, Green, 2010)

Expert method – characterized by a high level of involvement of the external professional processor and by a low level of participation of the local actors. The method has a standardized procedure of processing and emphasizes professional, methodological and high-quality work. Independence on the local environment (not subject to the local influences) is understood positive aspect of this method, but only shallow knowledge of the local development (specific) context, ignorance of relationships between individual actors in the territory in question and, last but not least, a limited explanatory power of the statistical data and shallow depth od consideration are its disadvantages.

Community method - a summary name for repeated discussions with the users participating to a large extent in preparation of the strategic plan under the supervision of the supplier. The external expert plays the role of the discussion "moderator" here. The method offers a general analysis of the key issues and focus on their specific solutions. The de facto public discussion of the strategic document and 'identification' of the users with the strategy (it will most probably be implemented by them) is a great advantage. On the other side, its disadvantage consists in a certain shallowness, i.e. not

yet identified problems in the addressed area do not need to be formulated in the discussion. (Avison, Fitzgerald, 2006)

2 Methods

Research in this area will be aimed at determining the degree of implementation of the information support tools in the selected top management group of the preset number of companies. The methodology is based on the literature review of the current state of the analyzed issue. The primary research utilizes interviews, observations, monitoring and expert estimate. The secondary research applies evaluation of the data from the information system database, documentation of the workshops / seminars. The secondary objective of the research is to determine availability and portfolio of the information support tools for creation of corporate strategic goals. The research should answer two fundamental questions:

- To what an extent the managers utilize the IT tools when creating the strategy?

- Which IT tools are available to support strategic planning?

The quantitative research was mapping for orientation in the issue, confrontation with the theory, and the qualitative research was realized as a structured projective user-oriented interview. (Sekaran, Bougie, 2010)

3 Problem analysis

The next part of the research comprises analysis of the situation in the market of information technologies with respect to the information support tools contributing to create the strategic goals. This analysis is focused on basic classification of the information support tools by their intrinsic purpose, i.e. whether or not it is the tool designed and created as support for determination of the corporate strategic goals or whether this tool is the integral part of a larger complex intended primarily as support of other corporate processes. Potential and possibly quality of these tools in the given context is the very reason of this breakdown.

The aim of the research was to analyze the current state of the information support tools contributing to the corporate strategic goals as the process of the corporate information system, its position in the Czech companies and complexity of offered information systems functionalities, to determine what functionalities of the information support are commonly used for creation of the corporate strategic goals and how the information systems offered in the Czech market are adapted to the used functionalities as a standard.

Based on the research, in the information technology market I have identified the following information support tools, intended exclusively on support to creation of the corporate strategic goals.

3.1 Actual Research

45 below mentioned and defined IS users were contacted, 13 of them responded with filled-in questionnaires (i.e. returnability of 34.6%). The questioning took place in September and October 2016. The mentioned IS users belong, according to the European Commission, mainly to small enterprises. It means 58.7% of the enterprises according to the factor of turnover (up to 220 million CZK) and 48% of them

according to the factor of staff headcount (up to 50 employees). The medium-sized enterprises are on the second position and only part of them (according to both classification factors) is formed by large companies.

3.1.1   MACS Controlling Suite

It is the software controlling tool supporting operational and strategic planning and assessment. It includes cost and income management to achieve profitability. The MACS software tool has undergone many years of development that has started in 1998, and representatives of universities have also taken part in its development. The product is aimed on organizing the data from many non-structuralized sources and on setting complex interrelationships. In a unified system the process of planning is much more easier and business is managed successfully. This tool can be characterized simply as an integration platform between information systems of the company with the possibility to utilize the gathered data as the source for the creation of strategic goals. The information support tool of strategic goals for assessment draws the data from the ERP system (real state) and compares them to the planned values. It also plans and assesses (at the operational and strategic levels) costs and income -> EBITDA, EBIT (monitoring by individual accounts and centres), calculations and production. (Laudon, Laudon, 2006)

3.1.2   ADVANTA/KOMIX

It is a modern strategic management tool, able to unify change sub-projects efficiently with the corporate strategy. It encompasses a whole se set of events connected with the preparation, definition and implementation of the corporate strategic goals. Through a single tool it is possible to share the vision, motivate, plan, implement and measure a specific outcome. The information support tool of this vendor works on the principle of process analysis, proposing the optimum control indicators. It also enables to plot the corporate strategy in the optional way. The Balance Scorecard, expressed as the Norton / Kaplan scheme, can be selected for instance or there may be a registration under the theory of constraints. In any case, the strategy and its individual logical steps are always associated with specific projects within the system. Their procedure thus becomes the integral part of the scheme. It is therefore not necessary to assess specific activities to get an overview of how close we are to the preset goal - one view is quite enough. (Laudon, Laudon, 2006)

3.1.3   Statistica

This analytical software contains tools for data management, their analysis, visualization and development of user applications, including the information support tools for determination of the corporate strategic goals. It provides a wide range of basic and advanced techniques designed specially for BI, Big Data sectors, quality control, research and many others. Thanks to the analytical platform the organizations are able to manage the entire analytic lifecycle – starting by data grouping and preparation, visualization and ending by creation and implementation of the model supporting strategic goals. Manual stepwise regression – besides the manual (the user himself can choose in each step what predictors will be added or deleted) stepwise logistic regression even the classic linear and the Cox regression are available. The main advantage of the stepwise model construction is its ability to add the most

important predictors manually and to monitor their impact on the model. The "what-if" functionality allows to define the models conforming to corporate guidelines and policies. The data visualization module for advanced and interactive data visualization allows easy visualization of large and dynamically changing data (business data, power sector, industries, etc.).

Based on the research, in the information technology market I have also identified the following information support tools, suitable for creation of the corporate strategic goals, representing the integral part of the software complex primarily oriented on support to other activities (e.g. ERP). (Laudon, Laudon, 2006), (Croson, Drnevich, 2013)

In case of two software types their incorporation into this category may certainly become the very subject of discussion due to their partial overlapping or identical methodology for drawing the sources necessary for the information support tools aimed at creation of the corporate strategic goals. It is the MIS type software, one part of which is designed for creation of the corporate strategic goals, depending on its scope or priority of this part at the interface between the described two categories.

The BI type software is the other one; it is designed primarily to gather the data from different sources of different types (data mining); as the time goes, this principle is reflected in acquisition of various data sources in general, i.e. I can speak about gathering even the data representing the very basis for creating the corporate strategic goals.

3.1.4 Microsoft Dynamics AX

It is the business solution of the Microsoft company for large enterprises of the ERP type. It accelerates business, because it allows the people to adopt quickly smarter decisions, based on findings and analyses in real time, to transform business processes more quickly to achieve a faster return on investment and growth of business. On the basis of these modules we can also consider this tool as the information support tool for determination of strategic goals. Within a single package Microsoft Dynamics AX brings the services for ERP, BI, infrastructure, computing resources and databases, thanks to which the organizations are able to perform sectoral and general operational corporate processes upgradeable through specific solutions.

3.1.5 Pohoda BI

The mid-sized companies are able to implement quickly the cutting-edge solutions for budgets and planning thanks to the planning tools at advanced level with intuitive functionalities. Tens to hundreds of new data, documents and/or orders appear every day in the economic system. These reports are very difficult to process, and maintaining them updated every day without the necessary tools is more or less impossible. The BI tools help with presentation of these results. They offer deep, immediate and always accurate data analysis, as well as different perspectives and points of view to their users. Just a few clicks, and all values are displayed well arranged for example in Microsoft Excel or intranet portals. These underlying materials at the same time serve for creation of strategic objectives, both through the described reports and also through several tools for prediction. (Palacios, Juste, Redondo, 2016)

Fig. 1: Preparation of the data for creation of strategic goals through the BI sources
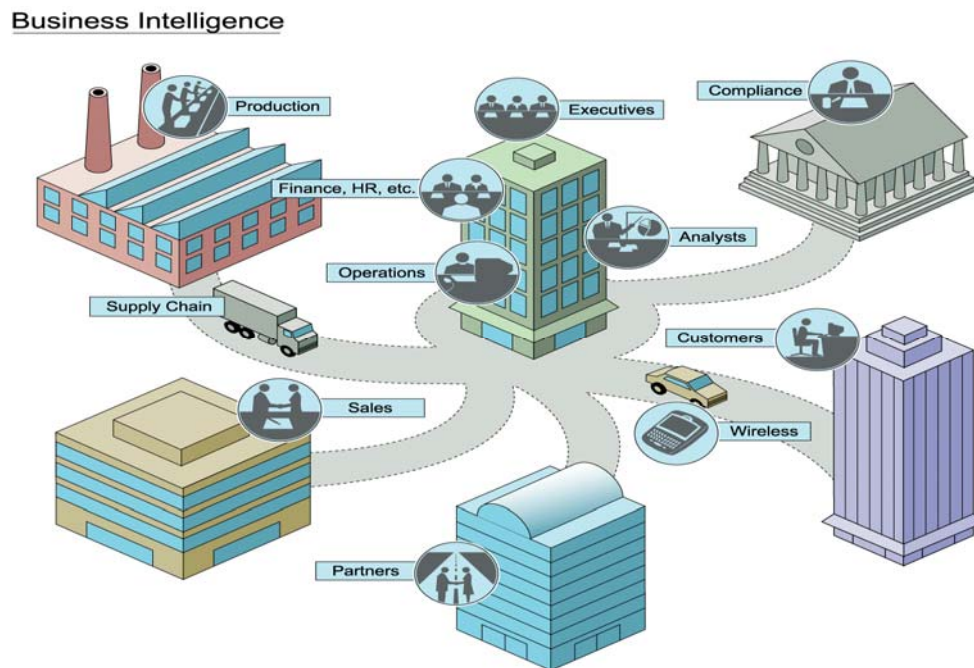
3.2. Research characteristics

<u>Area of the research</u>: Use of defined systems for the support of the corporate strategy creation
<u>Territory</u>: Czech Republic
<u>Respondents</u>: IS users with support for the corporate strategic goals definition
<u>Number of respondents</u>: 45

The aim of this research was to analyse the existing state of functionality systems for the creation of corporate strategy offer, and to characterize the level of standard adaptation of products on the Czech market for these used functionalities. Three basic areas of questioning were presented to the respondents within these goals, focused on support (functionality) level of given systems in the area of information support during creation of the corporate strategy. Then it was the possible range of information tool usage as a product for the area of reporting for the corporate strategic goals definition. The last part of questioning was focused on customization, proposal visualization and feedback of selected IS tools for the corporate strategic goals definition.

The questionnaire structure was aimed at percentage functionality fulfilment in particular areas – from the respondent's point of view.

4 Discussion

The paper has defined a relatively specific issue relating to the new trends of how to view of the data necessary and needed for managerial decisions in the company. The research was performed in the Czech Republic, where it was focused on the method of obtaining the information integrated into the method of obtaining the data

for managerial decisions. The research has brought a new consolidated view of the data and highlighted the information support tools provided for this purpose. It is necessary to take into account the fact that the quantitative data from the existing accounting files into process controling is very difficult to obtain. Regardless of the IT support platforms this fact considerably reduces the total effect of the method.

Individual parts of the economic process are understood in the companies at different levels of importance and the tools – being the standard integral part of functionalities of the information systems offered on the Czech market – are not utilized adequately at all levels of management, taking in view their informational support. The information provided by the information systems are primarily outcomes of software architects ideas and not a true reflection of practical requirements. It means that they are not designed according to the actual needs of the executives and the users responsible for handling the everyday corporate routine. Even less they are processed in the correspondence with managers and senior executives responsible for strategic planning and creation of strategic goals. For the sector of strategic planning no information support tools are available on the market, that can compile (above the chosen data) the requested corporate processes, interconnect the utilized systems into the functional units not defined in advance and derive the consolidated data from them for analytical processing afterwards. Support to the Business Intelligence allows to use the well-arranged synoptic reports from various sources as well as, for example, interactive graphic boards intended for the higher and middle management. These tools are of rather information character and in principle are not intended as the tool contributing to creation of the strategic goals.

On the basis of existing state in this issues the basic areas of the evaluation as for information tools support for the corporate strategy creation were chosen. These areas were subject to next part of the written questioning. Then it was necessary to define, according to the described products, the tools – according to the range and specification in tables 1 and 2.

The highest degree of support in the area of tools focused on creation of strategic plans is with the products MACS Controlling Suite on the level of 80%, the product Statistica has this level even by 5% higher, and the product ADVANTA/KOMIX with 70% has clear evaluation that the use of IS tools in this area is usable. Similar evaluation – betweeen 80 and 90% - is in reporting area. The last area – creation of the own visualization and customization of IS tools is on the other hand on very low level with all products. It is 50 to 70 % only.

In the area of information support tools as a part of software packages (Tab. 2) the research results are to some extent the same or similar like the IS tools specialized on the strategic goals creation, but they do not reach such support level nor in other areas. It is quite evident from these results that the degree of support and output creation and their use in the strategic goals creation is good. The area for the creation and customization is on much lower level. The results also show lower level of IS tools usage for the strategic goals creation when using bigger SW packages, which is rather strange fact, considering better options with supposed larger data volumes.

Tab. 1: Information support tools focused on creation of strategic plans

Trade name	Degree of support	Reporting	Creation
MACS Controlling Suite	80 %	90%	50%
ADVANTA/KOMIX	70%	80%	70%
Statistica	85%	85%	60%

Source: [own]

Tab. 2: Information support tools intended for creation of strategic plans as a module within the scope of the software package

Trade name	Degree of support	Reporting	Creation
Microsoft Dynamics AX	70%	80%	40%
Pohoda BI	60%	70%	30%

Source: [own]

The main objectives of the research of the degree of utilization of the information support tools for creation of corporate strategic goals were as follows:

- interconnection of individual systems of the company, including the possibility of further extension,

- enabling effective support to the decision making process at higher and top levels of the information pyramid,

- support to the major corporate processes through high-quality reporting,

- enabling monitoring and management of the running integration processes without the necessity to apply another separate system,

- support to easy scalability at all integration levels,

- support to an easily applicable visual design of corporate processes and transformations,

- support to import and processing the data acquired outside the core systems.

Conclusion

More and more companies face the issue of acquisition of the adequate information support solution for economic assessment of results and outcomes of the company, allowing them to display and work with the information relevant for adopting immediate and accurate decisions. As follows from the research in this area, there is no comprehensive system available that can be considered the information support tools for the economic assessment of the company. The companies purchase and deploy specialized tools, such as Business Intelligence, or specific tools for certain departments, which do not reflect the strategy in terms of outcomes within the whole organization. As the time went on, this approach has become a barrier to use the information. The main complication is that the users have to learn how to use a specialized software, though it is accessible for certain departments only (financial or analytical department as a rule). Such approach is accompanied by considerable costs for maintenance of separate systems and especially by low efficiency of utilization of

the obtained information. The tools, supporting creation of the corporate strategic goals, assist in solving the problems of the information and transaction systems, thus creating the space for improving management of the company. They represent a certain strategy of work with the information, are based on delivery of the information into the right hands, at the right time, in the requested format and in the undistorted form. High-quality information from the information support tools for economic assessment of the company is necessary for proper decision-making at all levels of corporate management. The task of such a system is to combine the data from different sources, monitor selected indicators, analyze influencing factors, determine prognoses and present everything in the graphic form. The system must allow revealing contexts and planning trends without any significant performance demands on other corporate information systems. And now I get to the fundamental question, which I am trying to find the answer to in conformity with the objective of this paper. Will a comprehensive information support system for creation of corporate strategic goals really appear in the information technology market?

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DLOUHODOBÁ PÉČE VE VYBRANÝCH ZEMÍCH OECD V KONTEXTU DEMOGRAFICKÝCH ZMĚN

LONG-TERM CARE IN SELECTED OECD COUNTRIES IN THE CONTEXT OF DEMOGRAPHIC CHANGES

Renáta Halásková, Martina Halásková

Abstract: *With respect to demographic changes and population ageing, all OECD countries will be tackling issues of long-term care (LTC) associated with the need for professional services, collaboration between the formal and informal long-term care systems, and the adjustment of the mix of public and private resources playing part in long-term care financing. The paper aims to evaluate the potential of long-term care in selected OECD countries in connection with population ageing. The majority of the selected countries have seen a rise in the number of long-term care recipients along with total expenditures on long-term care. Nevertheless, these countries differ fundamentally in total expenditures allocated on long-term care per recipient. Results of evaluation using selected indicators of long-term care, by use of two-step cluster analysis, in years 2008 and 2013 also showed a variety of approaches in the provision of long-term care among the analysed countries (mainly in terms of LTC recipients aged 65+ as percentage of total LTC recipients) and in financing of long-term care (mainly in terms of LTC expenditures on institutions as percentage of total LTC expenditures).*

Keywords: *Long-term care, long-term care expenditure, recipients of care, demographic changes, population ageing, OECD countries*

JEL Classification: *H41, H51, H75, J11.*

Úvod

Řešení dlouhodobé péče je vzhledem k demografickým změnám důležitou podmínkou udržitelnosti zdravotnických služeb a zdravotně sociálních služeb (Gavurová, Šoltés, 2016, Rowles, Teaster, 2016). „S rostoucím počtem starších osob všechny země Organizace pro hospodářskou spolupráci a rozvoj (OECD) očekávají, že výrazněji budou narůstat náklady na formální a neformální dlouhodobou péči. S tím souvisí zvyšující se finanční břemeno, které vyžaduje již dnes co nejefektivnější využití disponibilních zdrojů, tj. snahu o co nejoptimálnější nastavení spektra služeb dlouhodobé péče pro jednotlivce a pro celé komunity tak, aby splňovaly tři základní atributy: byly geograficky dostupné, kvalitní a finančně únosné pro jednotlivce i pro společnost" (Repková et al, 2010: 17-18). Otázkám dlouhodobé péče v souvislosti s rozvojem a demografickými trendy již byla věnována pozornost např. v pracích (Österle, 2010, Colombo et al., 2011, Brennan et al., 2012, Deusdad, Pace, Anttonen, 2016). Snahou článku je navázat na studie a výzkumy věnované dlouhodobé péči (Kraus et al., 2010, Colombo et al., 2011, Repková et al., 2011, Bettio, Verashchagina, 2012) a poskytnout širší pohled na dlouhodobou péči v kontextu demografických změn v zemích OECD. Článek si klade za cíl, na základě teoreticko-empirického přístupu, zhodnotit ve vybraných zemích OECD možnosti poskytování a financování

dlouhodobé péče ve vazbě na stárnutí populace. V souvislosti s cílem je definován předmět zkoumání, kterým je zdravotní a dlouhodobá péče v užším pohledu. Kvantitativní výzkum předpokládá selekci vybraných nástrojů dlouhodobé péče. V souvislosti s poskytováním a financováním dlouhodobé péče a stárnutím populace se blíže zaměřujeme na vybrané ukazatele (příjemce a výdaje dlouhodobé péče) v letech 2008 a 2013. Ve vybraných zemích OECD ověřujeme dvě výzkumné otázky: 1) Jaký je vztah mezi příjemci a výdaji na dlouhodobou péči ve vazbě na stárnutí populace? 2) Existují mezi zeměmi OECD výraznější rozdíly v poskytování i financování dlouhodobé péče?

1 Teoretická východiska řešené problematiky

Dlouhodobá péče (LTC) představuje komplex služeb, které potřebují lidé s dlouhodobě omezenou soběstačností. Dlouhodobá péče zahrnuje škálu služeb pro osoby se sníženou soběstačností (sníženou funkční kapacitou) v důsledku dlouhodobě zhoršeného zdravotního stavu, postižení (disability) nebo nemoci. Dlouhodobou péčí se podle OECD označuje péče o osoby, které po delší časové období vyžadují podporu ve vykonávání základních aktivit denního života a další aktivity spojené s péčí o vlastní osobu. Služby dlouhodobé péče často zahrnují i pomoc s dalšími aktivitami nezbytnými pro zajištění soběstačnosti (OECD, 2005, Repková et al., 2011).

Podle Světové zdravotnické organizace (WHO) je dlouhodobá péče poskytování zdravotních, sociálních a osobních služeb na opakované nebo průběžné bázi osobám s chronickými, tělesnými nebo duševními poruchami. Tato péče může být poskytovaná v institucionálním prostředí nebo v domácnosti dané osoby (Repková et al., 2011). Dlouhodobá péče je nejčastěji poskytována v domácím prostředí nebo v pobytovém (ústavním, institucionálním) zařízení poskytujícím zdravotní nebo sociální služby. Domácí dlouhodobá péče je poskytována lidem s funkčními omezeními, kteří bydlí většinou ve vlastním bytě či domě. Institucionální dlouhodobá péče představuje ústavní ošetřovatelská zdravotnická zařízení (kromě nemocnic) a pobytová (residenční) zařízení sociálních služeb, která poskytují ubytování a současně dlouhodobou péči lidem s potřebou trvalé zdravotní a ošetřovatelské péče v důsledku chronické nemoci a snížené soběstačnosti v aktivitách denního života. Tato zařízení poskytují pobytové služby společně s ošetřováním a zdravotním dohledem nebo i dalšími typy péče (OECD, 2005, European Commission, 2009, Kraus et al., 2010, Colombo et al., 2011, Wija, 2012a).

OECD zdůrazňuje potřebu rozlišovat na jedné straně mezi zdravotní péčí a na druhé straně definovat dlouhodobou péči vůči ostatním službám (služby sociální). Definice zdravotní a sociální složky dlouhodobé péče se v zemích OECD liší. Rozdíly v definici dlouhodobé péče mohou ovlivnit mezinárodní srovnatelnost klíčového ukazatele, jakým je podíl výdajů na zdravotnictví na hrubém domácím produktu (HDP) země. Podle pojetí OECD by celkové výdaje na dlouhodobou péči měly zahrnovat, jak výdaje na zdravotní služby dlouhodobé péče, tak výdaje na sociální služby poskytované v rámci dlouhodobé péče (Colombo et al, 2011, Wija, 2012b). Definice dlouhodobé péče a metody stanovení výdajů na dlouhodobou péči jsou podrobněji rozebírány např. ve studii (OECD, 2007).

Služby dlouhodobé péče se podle systému klasifikace zdravotních účtů (SHA) skládají ze: 1) **Služeb dlouhodobé ošetřovatelské péče**, které lze považovat také za zdravotní komponentu dlouhodobé péče nebo za dlouhodobou zdravotní péči. Jedná se

o poskytování pomoci v tzv. základních aktivitách denního života (ADL) jako je jídlo, koupání, hygiena, základní mobilita. Tato péče je zpravidla poskytována společně s dalšími službami zdravotnického charakteru, které zahrnují „ošetřovatelskou péči" (předepisování a podávání léků, monitorování zdravotního stavu), prevenci, rehabilitaci nebo paliativní péči. 2) **Sociálních služeb dlouhodobé péče**, které představují poskytování sociálních služeb lidem s onemocněním či disabilitou (tj. invalidita – nesoběstačnost). Jedná se zejména o tzv. instrumentální aktivity denního života (IADL), které zahrnují péči o domácnost, užívání léků, nakupování nebo dopravu (OECD, 2005, Repková et al., 2010, Colombo et al., 2011).

2 Metody

Při zpracování byla využita databáze OECD (2015, 2016). Vzhledem k omezené dostupnosti dat pro konkrétní ukazatele dlouhodobé péče ve statistice OECD, byl zvolen jako výchozí rok 2008 a rok 2013 (poslední dostupná data OECD v době zpracování). Objekt kvantitativní analýzy, výběrový soubor 13-ti zemí OECD představuje: AU-Austrálie, CZ-Česká republika, DK-Dánsko, EE-Estonsko, FI-Finsko, DE-Německo, HU-Maďarsko, KR-Korea, LU-Lucembursko NL-Nizozemí, NO–Norsko, SE-Švédsko, CH-Švýcarsko. Výběr zemí byl proveden na základě záměrného výběru s cílem zajistit jeho heterogenitu z pohledu sledovaných ukazatelů/proměnných, kde jsou zastoupeny země s rozdílnou úrovní poskytování a způsobem financování dlouhodobé péče. Kritériem pro výběr zemí byla i dostupnost srovnatelných dat z OECD databáze k problematice dlouhodobé péče v letech 2008 a 2013. Na základě studia odborné literatury využíváme obsahovou analýzu při tvorbě teoretického rámce řešené problematiky, v empirické části práce jsou využity analytické metody, principiální komponentní a dvoukroková shluková analýza, metoda komparace a při vyvozování závěrů metoda syntézy a částečné indukce.

Principiální komponentní analýza (PCA) byla zvolena vzhledem k odhalení závislostí sledovaných proměnných dlouhodobé péče v letech 2008 a 2013 za využití korelační analýzy při $p<0,05$. (Tab. 1).

Tab. 1: Matice interkorelací proměnných dlouhodobé péče ve vybraných zemích OECD pro rok 2008 a 2013

	I.	II.	III.	IV.	V.	VI.
Proměnné/ukazatele dlouhodobé péče						
I.	1					
II.	0,476[*a]	1				
III.	-0,714[**]	-0,314	1			
IV.	-0,254	0,172	0,253	1		
V.	0,039	0,309	-0,096	0,493[*]	1	
VI.	0,745[**]	-0,107	-0,442[*]	-0,509[**]	-0,331	1

Poznámka 1: I) celkové výdaje na dlouhodobou péče jako % z HDP, II) výdaje dlouhodobé péče (PLI, USD) na jednoho příjemce dlouhodobé péče, III) výdaje na dlouhodobou péči v institucích jako % z celkových výdajů dlouhodobé péče, IV) počet příjemců dlouhodobé péče ve věku 65+ jako % z celkových příjemců dlouhodobé péče, V) příjemci dlouhodobé péče v institucích jako % z celkových příjemců, VI) celkový počet příjemců dlouhodobé péče jako % z populace.

Poznámka 2: *p<0.05, **p<0.01

Pro extrakci principiálních komponent bylo zvoleno Kaiserovo pravidlo, které doporučuje ponechat pouze ty komponenty dosahující vlastní hodnoty vyšší než 1. Zdrojem pro určení principiálních komponent byla korelační matice. Jako nejlepší se ukázal výstup se čtyřmi proměnnými (celková variabilita dosáhla 82,2 %), mezi které patřily: 1) celkové výdaje na dlouhodobou péče jako procent z HDP, 2) výdaje na dlouhodobou péči v institucích jako procento z celkových výdajů dlouhodobé péče, 3) počet příjemců dlouhodobé péče ve věku 65+ jako procento z celkových příjemců dlouhodobé péče, 4) příjemci dlouhodobé péče v institucích jako procento z celkových příjemců. Vysledek principiální komponentní analýzy pak sloužil jako nástroj pro další analýzu za využití shlukové analýzy. Pro lepší názornost výsledků byly pro shlukovou analýzu využity originální hodnoty výše uvedených proměnných v PCA.

Pro následné hodnocení podobností a rozdílů zemí OECD, dle vybraných ukazatelů dlouhodobé péče, byla použita dvoukroková shluková analýza. Jedná se o metodu hledání podobností a rozdílů, sdružování dat do smysluplných celků (shluků), kdy případy patřící do stejného shluku jsou si maximálně podobné, ale jsou minimálně podobné případům patřících do jiného shluku (Košťál, 2013). Dvoukroková shluková analýza je kombinací nehierarchické a hierarchické shlukové analýzy. V prvním kroku se vytvoří nehierarchické shluky a rozsáhlý výběrový soubor se tak zredukuje na menší sadu shluků. Ve druhém kroku pracuje metodou hierarchické analýzy, kdy tento postup byl využit i v tomto případě vzhledem k počtu třinácti zemí s panelovými daty za dva časové řezy, tj. celkem 26 případů. Shapiro-Wilkův test pak prokázal, že proměnné vstupující do shlukové analýzy splňují podmínky normality (p<0,05), až na proměnnou počet příjemců dlouhodobé péče ve věku 65+ jako procento z celkových příjemců dlouhodobé péče, u které odchylka od normálu není výrazná, jelikož jak u minimálních, tak maximálních pozorovaných hodnot dosahují absolutní maximální odchylky s hodnotou 0,70. Kvalita shluků podle dvoustupňové shlukové analýzy se měří tzv. obrysovým koeficientem (Košťál, 2013). Obrysový koeficient je stanoven jako průměrná hodnota z hodnot ψi , tj.

$$\psi = \frac{\sum_{i=1}^{n} \psi_i}{n} \tag{1}$$

Může nabýt hodnoty od -1 do 1. Pokud průměrná vzdálenost i-tého objektu od ostatních objektů nacházejících se ve stejném shluku je menší než průměrná vzdálenost s objekty z libovolného jiného shluku, pak obrysový koeficient nabývá kladných hodnot. Čím vyšší je jeho hodnota, tím jsou shluky kompaktnější. Pro hodnoty nižší než 0,2 je rozdělení objektů do shluků označováno jako chabé (poor), pro hodnoty od 0,2 do 0,5 jako uspokojivé (fair) a pro hodnoty vyšší než 0,5 jako dobré (good). Nejvyšší hodnota obrysového koeficientu ze zadaného intervalu může sloužit také pro určení optimálního počtu shluků (Řezanková, Löster, 2013:141-142).

3 Výsledky a diskuse

Ve vybraných zemích OECD se zaměřujeme v letech 2008 a 2013 na hodnocení příjemců dlouhodobé péče a celkových výdajů na dlouhodobou péči ve vazbě na demografický vývoj a stárnutí populace. Ve druhé části je provedeno hodnocení podobností a rozdílů zemí OECD dle vybraných ukazatelů dlouhodobé péče s využitím dvoukrokové shlukové analýzy.

3.1 Demografický vývoj a růst poptávky po dlouhodobé péči ve vybraných zemích OECD

Poptávka po dlouhodobé péči je úzce spojena s věkem, přesto senioři nejsou jedinou cílovou skupinou dlouhodobé péče. Ve věkové skupině osob mladších 65 let tvoří příjemci dlouhodobé péče méně než 1 % populace, avšak po dosažení věku 65 let se pravděpodobnost užívání dlouhodobé péče rychle zvyšuje (Colombo et al., 2011). V důsledku stárnutí se bude v zemích OECD podíl osob ve věku 65+ a 80+ v populaci poměrně rychle zvyšovat (Tab. 2).

Tab. 2: Projekce vývoje podílu populace ve věku 65+ a 80+ ve vybraných zemích OECD

	Podíl osob ve věku 65 a více let (v %)					Podíl osob ve věku 80 a více let (v %)				
	2013	2030	2050	Změny v % 2013-2030	Změny v % 2013-2050	2013	2030	2050	Změny v % 2013-2030	Změny v % 2013-2050
AU	14,4	18,6	20,9	4,2	6,5	3,8	5,4	7,4	1,6	3,6
CZ	17,1	24,1	32,3	7,0	15,2	3,9	7,5	11,0	3,6	6,1
DE	20,8	27,8	31,8	7,0	11,0	5,4	7,8	13,6	2,4	8,2
DK	18,0	22,2	23,6	4,2	5,6	4,2	6,9	9,2	2,7	5,0
EE	18,0	24,2	28,6	6,2	10,6	4,7	7,1	10,3	2,4	5,6
FI	19,0	25,5	26,9	6,5	7,9	5,0	8,5	11,2	3,5	6,2
HU	17,3	21,9	28,2	4,6	10,9	4,1	5,7	8,0	1,6	3,9
CH	18,5	24,7	28,3	6,2	9,8	4,9	8,2	12,3	3,3	7,3
KR	12,2	24,3	37,4	12,1	25,2	2,4	7,4	14,3	5,0	11,9
LU	15,1	20,0	22,1	4,9	7,0	3,9	5,2	8,4	1,3	4,5
NL	17,1	24,3	26,9	7,2	9,8	4,2	7,2	11,3	3,0	7,1
NO	15,8	20,6	23,2	4,8	7,4	4,4	6,0	8,6	1,6	4,2
SE	19,9	22,1	24,1	2,2	4,2	5,5	7,5	9,2	2,0	3,7

Zdroj: OECD (2016a) + vlastní výpočty

Z Tab. 2 vyplývá, že do roku 2050 by měl podíl osob ve věku 65+ a 80+ v populaci dosáhnout nejvyšších hodnot v Jižní Koreji (37,4% osob ve věku 65+ a 14,3 % osob ve věku 80+). Pokud se zaměříme na dynamiku a tempo stárnutí v zemích OECD, situace je velmi odlišná. Konkrétně v Německu by se měl podíl osob ve věku 80+ zvýšit na zhruba 13,6 % a podíl osob ve věku 65+ na cca 32 %. V případě České republiky by měl podíl osob starších 80 let dosáhnout 11 % (oproti 3,9 % v roce 2013) a podíl osob ve věku 65+ 32,3 % (oproti 17,1 % v roce 2013). V některých zemích OECD bude ale nárůst podílu osob ve věku 80+ pozvolnější. Jedná se o Austrálii, Lucembursko, Norsko, Švédsko nebo Maďarsko, ve kterých by se podíl nejstarších osob (80+) měl mezi roky 2013 a 2050 zvýšit o méně než 5 % a měl by dosáhnout hodnoty méně než 9,5 %.

3.2 Hodnocení výdajů a příjemců dlouhodobé péče ve vybraných zemích OECD v kontextu stárnutí populace

V souvislosti s demografickým vývojem a stárnutím populace je v zemích OECD vyvíjen tlak na poskytování služeb dlouhodobé péče pro starší osoby a očekává se, že v budoucnu vzroste i poměr výdajů na dlouhodobou péči k HDP.

3.2.1 Celkové výdaje na zdravotní a dlouhodobou péči ve vybraných zemích OECD v letech 2008 a 2013

Podíl celkových výdajů na zdravotní a dlouhodobou péči ve vybraných zemích OECD v letech 2008 a 2013 zachycuje Obr. 1. V letech 2008 a 2013 země Nizozemí, Švýcarsko (zdravotní péče hrazena z veřejného povinného zdravotního pojištění) a Švédsko, Dánsko (zdravotní péče hrazena z daní) dosahovaly nejvyšší objem celkových výdajů na zdravotní péči. Tyto země vynakládaly i vyšší objem celkových výdajů na dlouhodobou péči. Naopak země s nižšími celkovými výdaji na zdravotní péči, vynakládaly i nižší objem celkových výdajů na dlouhodobou péči (Korea, Estonsko, Česká republika nebo Maďarsko).Výjimkou je zejména Austrálie (zdravotní péče hrazena z daní - Beveridgův model Národní zdravotní služby), která dosahovala nadprůměrný objem celkových výdajů na zdravotní péči (cca 9% z HDP), ale minimální výdaje na služby dlouhodobé péče. Také Německo, kde zdravotnický systém je založen na veřejném (povinném) zdravotním pojištění, se řadí mezi země s nejvyššími celkovými výdaji na zdravotní péči (cca 10,8 % z HDP), ale průměrnými celkovými výdaji na služby dlouhodobé péče (cca 1,5 % z HDP).

Obr. 1 : Srovnání celkových výdajů na zdravotní a dlouhodobou péči ve vybraných zemích OECD v letech 2008 a 2013
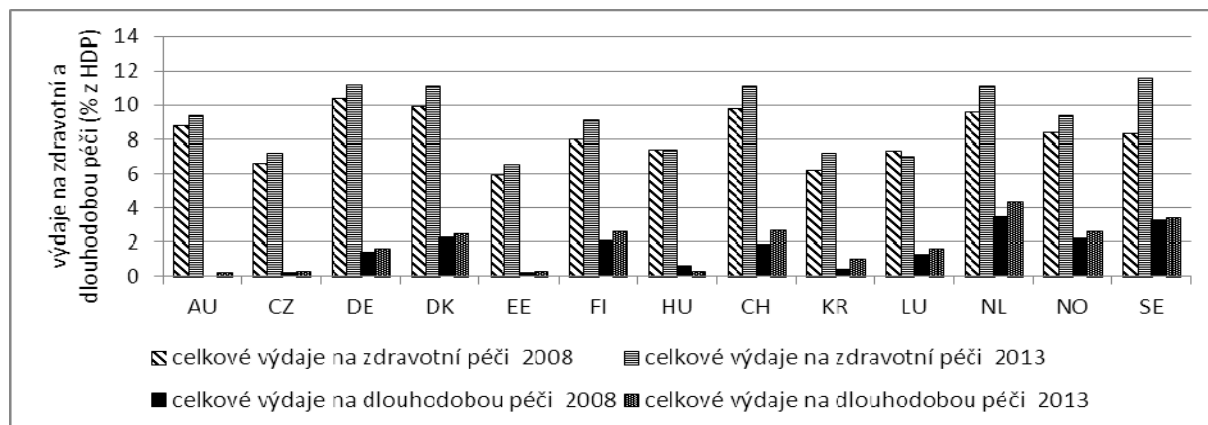
Zdroj: autorky s využitím OECD (2015)

Z objemu vynakládaných výdajů na zdravotní a dlouhodobou péči je možné konstatovat, že země OECD přistupují k financování dlouhodobé péče s rozdílnými prioritami. Jak uvádí Colombo et al. (2011) nebo Wija (2012b) potřeby dlouhodobé péče jsou v některých zemích uspokojovány téměř výhradně prostřednictvím neformální péče, zejména rodinných pečujících a s rozvojem profesionálních služeb lze tedy v budoucnu předpokládat významný nárůst veřejných výdajů. Formální sektor dlouhodobé péče (jako podíl na HDP) v zemích OECD podle Colombo et al. (2011: 214) „je stále relativně malý, ve srovnání s výdaji na zdravotní péči nebo výdaji na penzijní systémy a to i přesto, že veřejné výdaje na dlouhodobou péči vykazují rychlejší vzestupnou tendenci než výdaje na zdravotní péči". Veřejné výdaje na zdravotní a dlouhodobou péči podle Appleby (2013), De La Maisonneuve, Oliveira

Martins (2013) by se měly v zemích OECD zvýšit ze zhruba 6% HDP na téměř 9% HDP v roce 2030.

3.2.2 Příjemci a výdaje na dlouhodobou péči ve vybraných zemích OECD

Ke zvýšené poptávce po službách dlouhodobé péče (z pozice příjemců péče) bude docházet v zemích s rychlejším tempem stárnutí populace. Zároveň dojde i k růstu veřejných výdajů na profesionální služby dlouhodobé péče. Obr. 2 zachycuje podíl příjemců dlouhodobé péče z populace a podíl celkových výdajů na dlouhodobou péči z HDP v zemích OECD v letech 2008 a 2013.

Obr. 2: Příjemci a celkové výdaje na dlouhodobou péči ve vybraných zemích OECD v letech 2008 a 2013
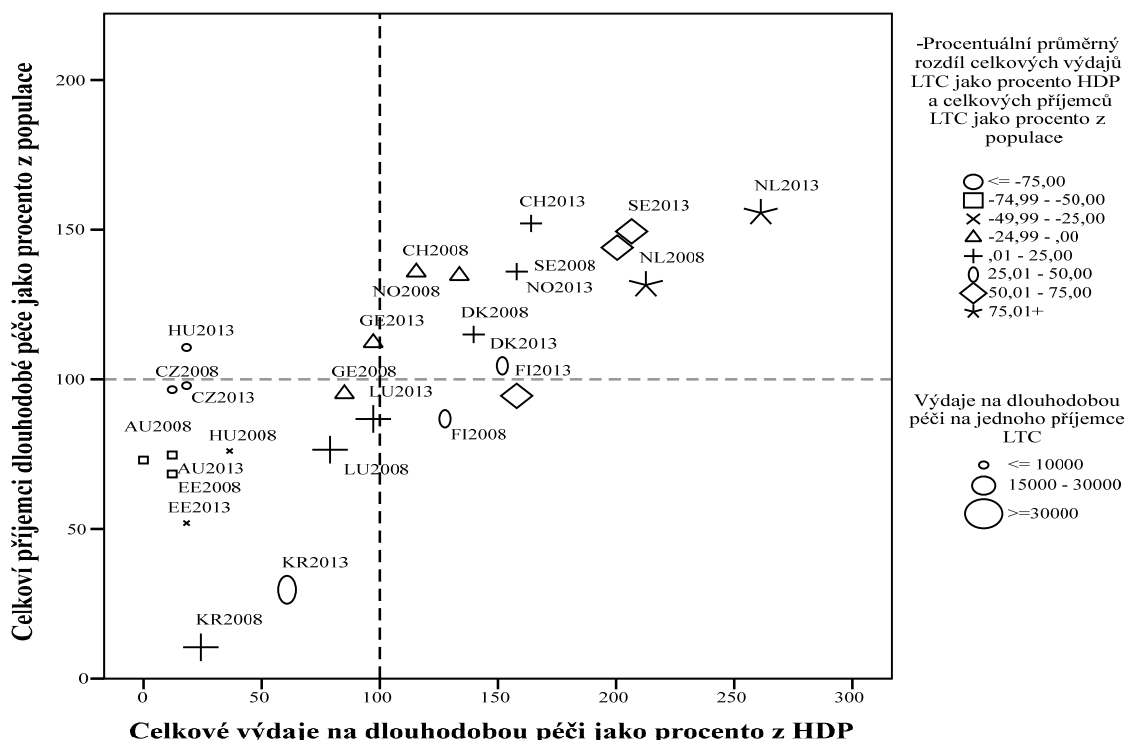
Poznámka: země jsou rozděleny do čtyř kvadrantů: Kvadrant I = HH tj. nadprůměrné obě hodnoty x a y; kvadrant II = LH (hodnota x- nízká, y- vysoká)); kvadrant III = LL tj. obě hodnoty x a y podrůměrné; kvadrant IV = HL (hodnota x- vysoká, y- nízká).
Výdaje na LTC na jednoho příjemce LTC (výdaje při zohlednění parity kupní síly a cenové diferenciace z pohledu měnových kurzů)

Zdroj: autorky s využitím OECD (2015), OECD (2016b)

Ve většině zkoumaných zemí OECD v letech 2008 a 2013 je mezi celkovými výdaji na dlouhodobou péči jako % z HDP (na ose x) a příjemci dlouhodobé péče jako % z populace (na ose y) patrný pozitivní vztah, kdy s rostoucím podílem příjemců na dlouhodobou péči se zvyšuje i podíl celkových výdajů na dlouhodobou péči. V I. kvadrantu jsou zastoupeny země (Jižní Korea, Estonsko nebo Austrálie) s relativně malým podílem příjemců dlouhodobé péče a zároveň i s nejnižším podílem celkových výdajů na dlouhodobou péči. Naopak ve III. kvadrantu jsou země (Nizozemí, Švédsko, Švýcarsko), které se v letech 2008 a 2013 vyznačovaly nejvyšším podílem příjemců i nejvyšším podílem celkových výdajů na dlouhodobou péči.

Z porovnání zkoumaných zemí OECD, dle objemu celkových výdajů na dlouhodobou péči na jednoho příjemce LTC v letech 2008 a 2013, pak vyplývá, že nejvíce nákladné služby na dlouhodobou péči má Lucembursko, Nizozemí a Jižní Korea (Obr. 2). Naopak v Austrálii, České republice, Maďarsku a Estonsku jsou

služby na dlouhodobou péči nejméně nákladné (dle celkových výdajů na jednoho příjemce LTC). To je dáno i podílem příjemců, kteří využívají služby formální dlouhodobé péče. Autoři Colombo et al. (2011) nebo Wija (2012a, 2012b) konstatují, že podíl příjemců institucionální a domácí dlouhodobé péče v populaci ve věku 65+ a 80+ se v zemích OECD výrazněji liší. Většina výdajů na dlouhodobou péči pak směřuje do sektoru ústavní péče, i přesto že uživatelé obecně preferují péči v domácím prostředí. V posledních letech ale řada zemí potvrzuje, že u nich došlo ke změnám postojů (Yeandle, Kroger, Cass, 2012, Anttonen, Karsio, 2016, Broese van Groenou, De Boer, 2016, Kubalčíková, Havlíková, 2016) a byly vytvořeny programy podpory péče v domácnosti nebo programy komunitních a terénních služeb.

3.3 Hodnocení podobností a rozdílů zemí OECD dle ukazatelů dlouhodobé péče s využitím dvoukrokové shlukové analýzy

S využitím dvoukrokové shlukové analýzy jsou ve výběrovém souboru zemí OECD následně hodnoceny v letech 2008 a 2013 čtyři ukazatele dlouhodobé péče: 1) celkové výdaje na dlouhodobou péči jako procento z HDP, 2) výdaje na dlouhodobou péči v institucích jako procento z celkových výdajů dlouhodobé péče, 3) příjemci dlouhodobé péče v institucích jako procento z celkového počtu příjemců, 4) počet příjemců dlouhodobé péče ve věku 65let jako procento z celkových příjemců dlouhodobé péče. Hodnocení kvality modelu pomocí obrysového koeficientu, pro 3 shluky se 4 proměnnými/ukazateli dlouhodobé péče, dosahuje hodnotu 0.6. Shluky získané pomocí dvoukrokové shlukové analýzy dokumentuje Obr. 3.

Obr. 3 : Krabicový diagram shluků vybraných zemí OECD podle ukazatelů dlouhodobé péče pro rok 2008 a 2013[a]
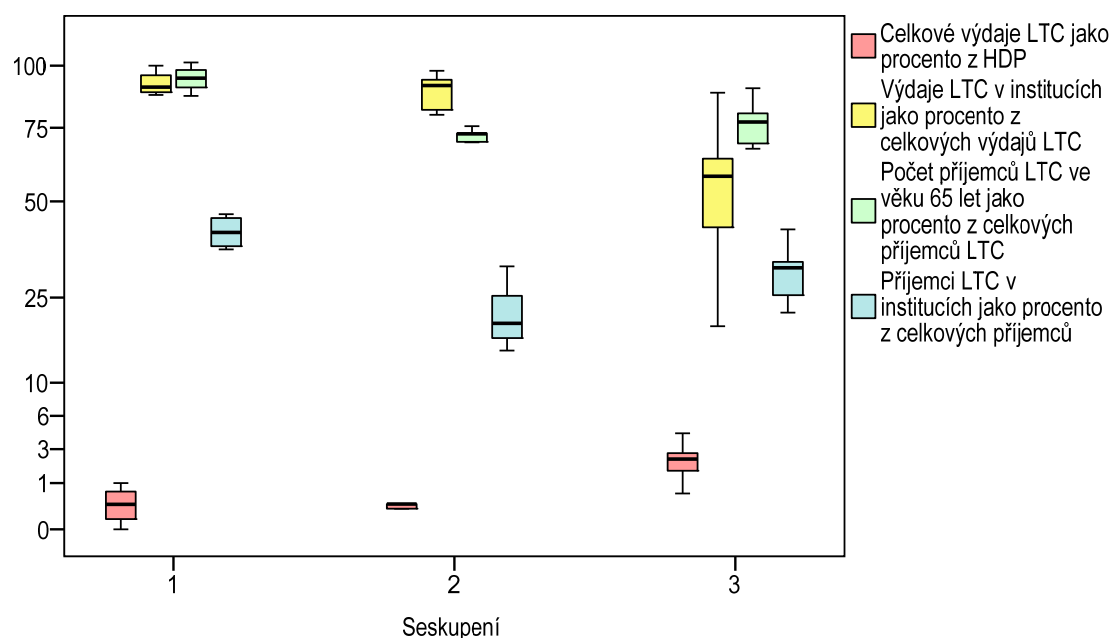
Poznámka: V krabicovém diagramu měřítko s exponentem 0,5 na ose y bylo použito pro správnou viditelnost hodnoty proměnné celkové výdaje LTC jako procento z HDP.
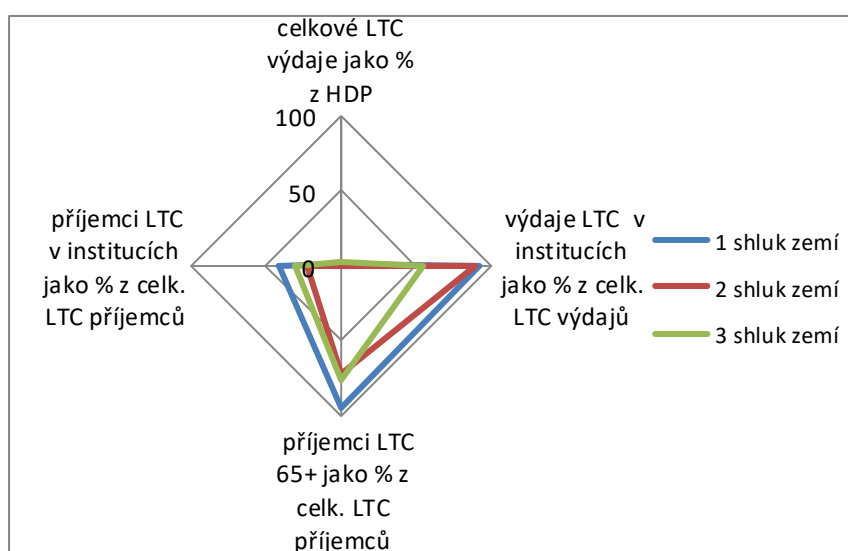
Zdroj: autorky s využitím OECD (2015), OECD (2016b)

Shluk 1 (AU 2008, AU 2013, KR 2008, KR 2013) je nejmenší v zastoupení zemí OECD dle hodnocených ukazatelů dlouhodobé péče. Vyznačuje se nejnižšími celkovými výdaji LTC jako procento z HDP (hodnota mediánu 0,4), ale nejvyššími výdaji LTC v institucích jako procento z celkových výdajů LTC (hodnota mediánu

92,4) i nejvyšším celkovým počtem příjemců LTC ve věku 65+ jako procento z celkových příjemců LTC (hodnota mediánu 94,5) a příjemci LTC v institucích jako procento z celkových příjemců (hodnota mediánu 41,2).

Shluk 2 (CZ 2008, CZ 2013, EE 2008, EE 2013, HU 2013) představují země, které se, obdobně jako země v prvním shluku, vyznačují nejnižšími celkovými výdaji LTC jako procento z HDP (s hodnotou mediánu 0,2) a vyššími výdaji LTC v institucích jako procento z celkových výdajů LTC (s hodnotou mediánu 89). Země druhého shluku, ve srovnání se zeměmi prvního shluku, se vyznačují nižšími hodnotami s větší rozptýleností zejména u příjemců LTC v institucích jako procento z celkových příjemců (hodnota mediánu 21,8 a rozptýlenost hodnot od 14,86 CZ 2008 do 32,18 EE 2013). Země druhého shluku dosahují i nejnižší hodnoty počtu příjemců LTC ve věku 65+ jako procento z celkových příjemců LTC než země prvního a třetího shluku.

Shluk 3 představuje největší seskupení zemí (DK 2008, DK 2013, FI 2008, FI 2013, DE 2008, DE 2013, HU 2008, CH 2008, CH 2013, LU 2008, LU 2013, NL 2008, NL 2013, NO 2008, NO 2013, SE 2008, SE 2013). Třetí shluk zemí se vyznačuje vyšším celkovým počtem příjemců LTC ve věku 65+ jako procento z celkových příjemců LTC (s hodnotou mediánu 76,8 a rozptýleností hodnot od 67,38 pro NO 2013 do 90,48 pro DK 2013) a nejvyššími celkovými výdaji LTC jako procento z HDP (s hodnotou mediánu 2,35 a rozptýleností hodnot od 0,60 HU2008 do 4,30 NL 2013). Ve srovnání se zeměmi prvního a druhého shluku se třetí shluk zemí vyznačuje největší rozptýleností hodnot u všech sledovaných ukazatelů. V případě výdajů LTC v institucích jako procento z celkových výdajů LTC (s hodnotou mediánu 54,3 a rozptýleností hodnot od 19,19 pro SE 2008 do 88,67 pro CH 2008) a celkovým počtem příjemců LTC ve věku 65+ jako procento z celkových příjemců LTC (s hodnotou mediánu 30,96 a rozptýleností hodnot od 21,84 pro NO 2013 do 41,84 pro FI 2013).

Obr. 4 : Srovnání vybraných ukazatelů dlouhodobé péče ve shlucích zemí OECD

Z celkového srovnání ukazatelů dlouhodobé péče (Obr.4) vyplývá, že největší podobnost vykazují země prvního a druhého shluku ve financování dlouhodobé péče (celkové výdaje na dlouhodobou péči jako procento z HDP, výdaje na dlouhodobou péči v institucích jako procento z celkových výdajů dlouhodobé péče) a země druhého

a třetího shluku v poskytování dlouhodobé péče dle příjemců (počet příjemců dlouhodobé péče ve věku 65+ jako procento z celkových příjemců dlouhodobé péče, příjemci dlouhodobé péče v institucích jako procento z celkového počtu příjemců). Naopak země prvního a druhého shluku vykazují největší rozdíly v poskytování dlouhodobé péče dle příjemců (počet příjemců LTC ve věku 65+ jako procento z celkových příjemců dlouhodobé péče, příjemci dlouhodobé péče v institucích jako procento z celkového počtu příjemců) a země prvního a třetího shluku největší rozdíly ve financování péče dle výdajů na dlouhodobou péči v institucích jako procento z celkových výdajů dlouhodobé péče.

Rozdíly v poskytování a financování dlouhodobé péče v zemích OECD je možné, podle Colombo et al. (2011), Fernandez, Gori, Wittenberg (2015), vysvětlit nejen odlišnými potřebami a využíváním formální dlouhodobé péče seniory, ale i rozdíly ve struktuře a komplexnosti formálního systému LTC, které jsou dány i rozvinutostí systémů dlouhodobé péče, jejich přístupností a kulturními odlišnostmi (role rodiny v poskytování péče). Rozdíly souvisí i s tím, že jednotlivé země OECD preferují odlišné přístupy pro financování systémů dlouhodobé péče tj. od podpory rodinné solidarity v péči o dlouhodobě nemocné až po poskytování veřejnoprávních služeb financovaných z veřejných rozpočtů. Jak uvádí De La Maisonneuve, Oliveira Martins (2013:25) „rozdíly ve výdajích na zdravotní a dlouhodobou péči mezi zeměmi OECD částečně odráží také odlišné demografické trendy (počet závislých lidí v populaci, vývoj průměrné délky života), jakož i počáteční úroveň příjmů, změny v poptávce po veřejně financovaných službách LTC a neformální dlouhodobé péči."

Závěr

V důsledku stárnutí populace roste význam dlouhodobé péče a snahou je nastavení co nejoptimálnějšího spektra služeb z hlediska kvality a finanční únosnosti. Cílem článku bylo zhodnotit ve 13-ti vybraných zemích OECD možnosti poskytování a financování dlouhodobé péče ve vazbě na stárnutí populace. Ve většině zkoumaných zemí OECD v letech 2008 a 2013 s rostoucím podílem příjemců dlouhodobé péče vzrostl i podíl celkových výdajů na dlouhodobou péči jako procento z HDP. Podle vynakládaných celkových výdajů na zdravotní péči a celkových výdajů dlouhodobé péče na jednoho příjemce se ale země OECD výrazněji liší. Z výsledků hodnocení, dle vybraných ukazatelů dlouhodobé péče v letech 2008 a 2013 s využitím dvoukrokové shlukové analýzy, se mezi zkoumanými zeměmi potvrdily podobné, ale i rozdílné přístupy v poskytování a financování dlouhodobé péče. Největší rozdíly v poskytování dlouhodobé péče dle příjemců (počet příjemců dlouhodobé péče ve věku 65+ jako procento z celkových příjemců dlouhodobé péče) byly zjištěny v Austrálii a Jižní Korei s největším podílem příjemců LTC a v České republice, Estonsku a Maďarsku s nejmenším podílem příjemců LTC. Největší rozdíly ve financování dlouhodobé péče (dle výdajů na LTC v institucích jako procento z celkových výdajů na dlouhodobou péči) byly prokázány v Austrálii a Jižní Korei (země s nejvyšším podílem výdajů na LTC v institucích) a Skandinávských zemích s nejnižším podílem výdajů na LTC v institucích.

S demografickými změnami a stárnutím populace budou všechny země OECD řešit otázky dlouhodobé péče spojené s potřebou profesionálních služeb, včetně služeb institucionálních, domácích a komunitních, spolupráci mezi formálním a neformálním systémem LTC a nastavení mixu veřejných a soukromých zdrojů při financování

dlouhodobé péče. Zvýšená pozornost řešení otázek dlouhodobé péče by měla být věnována především v zemích s rychlejším tempem stárnutí populace a s nižší úrovní rozvinutostí systémů LTC, což může být námět pro další výzkum.

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EXPORT BARRIERS IN LATIN AMERICA ACCORDING TO CZECH COMPANIES

Barbora Kaprálová

Abstract: *This article presents the results of research on export barriers encountered by Czech companies in Latin America. This research focuses on the praxis and shows where do some Czech companies see problems in exporting to this specific region but it also puts these findings in context by including a testimony of other actors participating in export as well as author´s own observation from private sector export consultancy, economic sections of embassies and the foreign office of export promoting agency CzechTrade. This research shows that cultural differences and lack of qualified staff is as significant of a barrier as protectionism and bureaucracy in the target country. Surprisingly barriers such as logistic complications, lack of capital etc. did not show to be crucial for interviewed exporters. Furthermore the results of this paper show that the perception of the importance of certain barriers as well as the ability of the firm to overcome them profitably is highly connected to the mental model of the export manager responsible. The main aim of this research was to contribute to the discussion about territorial export diversification and to find out the reasons behind the relative passivity of Czech exporters in the region of Latin America.*

Keywords: *Export, Export barriers, Czech exporters, Latin American markets, Export management*

JEL Classification: *F10, F14, R10.*

Introduction

Export is generally considered one of the least risky forms of international involvement of a company, mostly because it does not necessarily demand resources as significant as for example joint ventures or other types of overseas involvement. (Porto, 2005: 68) As an open economic, Czech Republic is historically focused on export of goods mainly with higher added value and traditionally in the field of engineering or luxury products. Even though in recent years there has been a development in the so needed product diversification, the territorial structure stays dangerously stagnant. Over 80 percent of Czech export of both goods and services goes to one of the 28 countries of the EU and from this amount over 30 percent to Germany.[1] South America, Central America and the Caribbean together absorb only around one percent of Czech export.[2] The focus of Czech companies on European Union is understandable, the absence of formal barriers, long history of mutual business and political relations and geographical proximity are factors that help reduce costs of entering foreign markets and maintaining business operations. (Korneliussen, Blasius, 2008: 217-218) On the other hand finding new markets outside the EU can be crucial for the company´s expansion, especially if the product is highly specific and therefore needs a bigger market. Another reason is that even in globalized world some economies are more sensitive to each other´s development and an economic or political crisis in one will presumably affect the other. The 2009 economic crisis, which affected Czech exporters via

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[1] Czech export to European Union was 83 percent and 82,2 respectively in 2015 and 2014 (January to August) and from this part 32,3 percent and 32,1 percent respectively again was to Germany. (Zahraniční obchod 1-8/2015, MPO)
[2] According to own analysis of data provided by Czech Statistical Office.

affecting their most valuable destinations, became a strong argument for creating new strategies ensuring that a potential future drop-out of one partner will not negatively influence the whole Czech economy. Latin America can be an important partner for Czech companies looking to expand to less traditional markets as well as for firms looking to secure their income via diversification. The reason for that might be that economic and political developments are not as interconnected between Latin America and Europe/Czech Republic as they are for example between Europe and the Middle East, which is often argued to be a good option for territorial diversification of Czech export. This paper aims to investigate the reasons behind the relative passivity of Czech exporters in Latin America by focusing on the barriers encountered by Czech companies exporting to Latin America as well as the perception of export barriers of individual managers via conducting in-depth interviews as well as taking into account the context of this perception via personal observation and observation of other actors in export activities.

1 Statement of a problem

There is a broad body of literature focusing on export barriers, among the most cited authors are Robert E. Morgan and Constantine S. Katsikeas (Katsikeas, Morgan 1994; Morgan, Katsikeas 1998; Morgan 1997), Leonidas C. Leonidou (Leonidou 1995a; 1995b) or Peter Yannopoulos (Yannopoulos 2010). Those studies usually focus on the topic from a quantitative point of view, with the sample of hundreds of companies. This approach makes these studies appropriate for further use and easier generalization. However, the wide sample of companies without territorial or field specification and the strict focuson quantifiable variables, however understandable, can also be limiting to deeper and specific understanding of the problem.

Majority of existing research focuses on developed countries, predominantly on Europe and North America therefore it is important to take into account also authors focusing on topics such as the connection between poverty and export barriers (Porto 2005) or the export in developing countries (for example da Silva, da Rocha 2001; Tesfom, Lutz 2006; Ahmed, Julian, Mahajar 2008; Özkanli, Benek, Akdeve 2006). When it comes to overcoming export barriers, an extensive body of literature focuses on the efficiency and role of governmental export promotion and assistance (for example Czinkota 1982; Seringhaus 1986; Seringhaus 1987; Seringhaus, Rosson 1990) with one of the most complex empirical study completed by Volpe Martincus, Estevadeordal, Gallo et al. (2010).

1.1 Concept of export barriers

The literature views barriers to export as "all those attitudinal, structural, operational, and other constrains that hinder the firm´s ability to initiate, develop, or sustain international operations". (Leonidou, 1995a: 31)

Part of authors divides export barriers as external and internal. Internal export problems stem from inside the company and are connected to limited resources - financial or organizational. Generally they are associated with the company or product characteristics. (Köksal, Kettaneh, 2011: 109) These problems tend to be important for both exporters and non-exporters (companies not currently exporting to a target country but with a potential and/or plan to do so). (Gashti, Rad, Fard et al., 2013: 1873) For example difficulties in obtaining information about export market could be a crucial barrier for both exporters and non-exporters. (Vila López, 2013: 265, 270-271; da Silva, da Rocha, 2001) External barriers on the other hand stem from outside the company, from its environment. Another typology

used widely in literature is the domestic/foreign one. Domestic barriers in this case are affecting the exporter from his base country, whilst foreign problems can be found in the target destination. A more synoptic approach is to combine those two typologies and use four categories – i.e. internal-domestic (problems, which stems from within the company and are relevant for the base country environment), external-domestic (barriers arising from the base country environment, beyond the control of the firm), internal-foreign (internal limits of the company complicating overcoming the problems in target country) and external-foreign (barriers in the target country, beyond control of the exporter). (Leonidou, 1995b: 18-19)

It is important to stress that none of these barriers inhibit the firm from export activities by themselves and the perception of their importance depends on other factors, the essential one being the quality and attitude of management, but also the size of the company or its previous export experience. (Leonidou, 1995a: 32; Volpe Martincus, Estevadeordal, Gallo et al., 2010: 139) The ability of management to obtain relevant information and to pay attention to marketing research activities correlates with higher export activity according to Morgan and Katsikeas. (Morgan, Katsikeas, 1998: 163-164) These two authors are stressing the role of good quality management in export strategy of the company by for example stating, that by the lack of educated, well informed, experienced and proactive management companies are putting themselves in danger of insufficient inputs to create a marketing strategy. For such strategy the ability to create a stable communication with potential partners, obtain information about foreign market and have experienced staff, educated about the distribution channels and other relevant factors is of course crucial. (Morgan, 1997: 164)

2   Methods

This qualitative research was conducted in a form of an in-depth semi-structured interviews with companies exporting (or in few cases intending to export) to Latin America, these interviews were linked with direct observation of author when working as an intern for the economic section of the Czech embassy in Lima, foreign office of CzechTrade in Santiago de Chile and completing a Latin American export project for a Czech company (2014-2015). The list of companies to address with the entreaty to participate in the research was put together by means of references from the employees of embassies, as well as searching for companies mentioned in press in context of export to Latin America. After reducing the list to the most relevant firms, total of 110 companies were sent an email with a description of the research and an entreaty for a personal interview. Eventually 27 interviews were conducted. This gives a response rate of 24,5 percent which is roughly analogous to response rates of similar studies in literature, the rate would be higher if companies who do not participate in export activities in Latin America anymore or export through other company (agent or a group member) were excluded, which did not happen in this case. One company was later excluded from the results due to the fact that it was the only company exporting services, for a better coherence only the 26 goods exporting companies formed the results of this research.

In the sense of the size of the companies 10 companies were large, 9 middle sized and 7 small. All of the interviewed firms had some export experiences but the level and depth varied. Also the fields of their activity varied from Food industry, Defence and Arms industry, Engineering, Bio-chemical products to Glass industry or Medical instruments etc. In this sense it is necessary to acknowledge in some cases that the perception of some

barriers or export activities in general is field-sensitive as state for example Smith, Gregoire and Lu in their work. (Sousa, Bradley, 2006: 54-55) In-depth semi-structured interviews allow better understanding of specific approach of a company and helps understanding that some barriers are more or less pronounced for specific industries. The same applies to different countries in Latin America that companies are exporting to. Except of two cases, all interviews were conducted with only one representative of the company. In general this might lead to a misrepresentation, since one person´s testimony might be incomplete or distorted in other way. However, in the Czech case, even bigger companies do not commonly have a Latin American section larger than one or two employees. In many cases the export manager also focuses on other regions as well. Therefore all the interviews used in this research were conducted with the most relevant person in the company, usually in a position of export/business development manager or similar, where in only one company was the Latin American section not only separate, but also split in the Spanish- and Portuguese-speaking sub-sections, with two leading managers (both participated in the interview).

3   Problem solving and discussion

After an analysis of all the interviews a complete list of 19 barriers was made. Only barriers actually mentioned by the respondents themselves (without suggesting them by author) were taken into an account, therefore not all generally suggested barriers were included (for example disadvantageous exchange rates, etc.). Found barriers were categorized by the Internal/External and Domestic/Foreign typology. Table 1 shows the four categories with individual barriers.

Tab. 1: List of perceived barriers

Internal-domestic		External-domestic	
	Qualification/adequacy of staff		Bureaucracy in the base country
	Production capacity		Unqualified/inadequate staff at embassies/governmental agencies
	Lack of managerial time		Not optimal governmental support with financing/insurance of export
	Lack of capital		Limited info about foreign markets
Internal-foreign	Technical limits of product (standards, certificates	**External-foreign**	Different foreign consumer habits/attitudes
	Difficult/slow collection of payments from abroad		Protectionism (tariff/non-tariff barriers)
	Difficult to obtain local distributors/partners		Keen competition
	Logistics (problematic transport, shipping costs)		Socio-economic or political instability
	Cultural differences		Corruption
			Bureaucracy at the target country

Source: Own

3.1 Internal-domestic barriers

As is evident from Table 2 and Figure 1, which presents the results of the research, the least problematic for the exporters seem to be the barriers categorized as internal-domestic. The lack of capital being a factor that only one company (small, relatively new company) perceived as a serious barrier. This might be slightly surprising considering that almost two thirds of the companies participating were small or middle sized, without extensive financial resources, which according to other researchers puts them in a bigger danger of encountering more export barriers. (Katsikeas, Morgan, 1994: 27) The reason might be that interviewed exporters do not perceive this as something specific when operating in Latin America and even though most of the managers mentioned the necessity to invest more

resources when entering Latin American market than for example an European one, in comparison to other non-European markets, this is not perceived as profoundly different.

Fig. 1: Categories of barriers, percentage
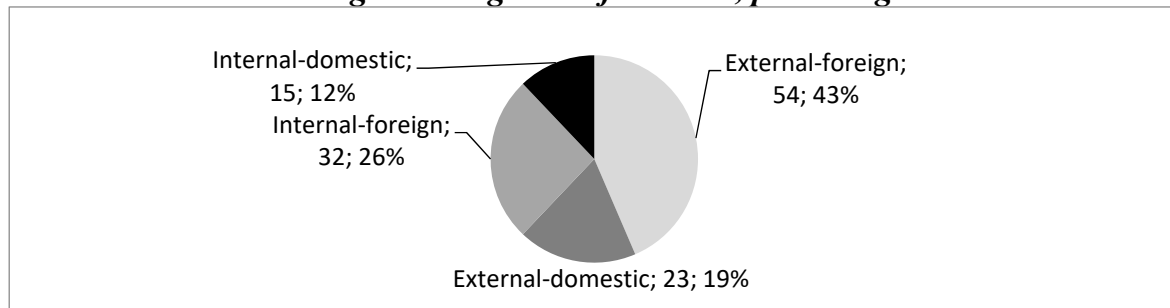
Production capacity was indicated as a barrier in two cases, both of them were firms with highly specific products for expert use and in both cases it was given more as an explanation for the actual relative passivity of the exporter in Latin American region, i.e. the active approach to export activities in this region will return when the company expands.

Lack of managerial time was indicated three times, but in context of author´s experience, confirmed by interviews with economic diplomats and CzechTrade employees, this factor is indeed a barrier very often without the company realizing its impact. As was mentioned above even in large companies the Latin American section usually shares staff with other export regions, very often more traditional and creating more revenue for the company. These other regions then understandably have more managerial attention, which subsequently leads to less resources and time spent on Latin America. Insufficient activity on Latin American market is then directly connected to less revenue from this region, which gives the company the rational reason to focus less on it - a go by book vicious circle.

Almost an exact third of respondents sees a problem in the lack of qualified staff. In this sense two factors were noticeable in this research. For several active and economically successful companies (meaning export success in Latin America) it seemed complicated to find more qualified managers or other staff members to expand their activities. The operations of Czech companies in Latin America are small in the sense of personnel, therefore a qualified employee must not only meet language requirements, ideally have a regional experience, personal and sales abilities corresponding with the environment but in many cases also professional knowledge of the specific field.

The other factor is that in several companies which did not mention lack of qualified staff as a problem a deeper interview uncovered that for example a lack of knowledge of very basic information about the region and/or a language incompetency caused that the concerns of the company were misplaced. For example several companies without a Spanish/Portuguese speaking manager informed about the region, believed their lack of success in Latin America was caused by cultural differences (i.e. culturally determined unreliable personality of business partners), a deeper interview uncovered, that this Beverage industry company is talking about their activities in Venezuela and that the manager does not have a basic knowledge of the current economic and political situation in the country and decided to try to enter this market nevertheless.

3.2 External-domestic barriers

Bureaucracy on the side of exporter´s country can be a problem, even in a country oriented on export (Morgan, 1997: 164) as the Czech Republic surely is. It is a barrier that is field-sensitive. In most cases European certificates and permits are sufficient for Latin American importers, therefore no additional certification is needed on the side of exporter in order to export to Latin America. In some cases in Food industry and Medicinal/Pharmaceutical products additional certification on the Czech side was needed, mostly for exports to Venezuela and Brazil. This was perceived as a barrier because in some cases it was problematic to obtain certificates in Spanish and in several cases the products of the company were innovated very often which created the need to obtain new certification. This barrier was not perceived as more complicated than in cases of other non-European regions.

The most frequently mentioned problem in this category was that the employees of the embassies and government agency CzechTrade did not have an adequate qualification. Seven respondents had a negative opinion about the qualification and/or adequate capacity of diplomats and other staff. In most cases this was seen as a problem in two ways, first often mentioned opinion was that diplomats at the economic sections of embassies lack a business experience from a private sector, therefore their assistance is limited in its efficiency, and second was that the employees of CzechTrade have their services subject to a charge. Results about the perception of governmental assistance to exporters is corresponding with the results of Volpe Martincus, Estevadeordal, Gallo et al., who concluded that this tool is more likely to promote export of goods with less severe intensity in the specific skills required to understand the product. (Moini, 1997: 110)

Another confusion seems to be prevalent when it comes to official information about foreign markets. Server BusinessInfo.cz, which provides general and in some cases detailed information provided by the embassies, CzechTrade and relevant ministries and offices was unknown to a large portion of interviewed exporters and in some cases the information on the website itself was outdated and misleading. Several exporters stated that they would be more interested in a field-specific information and for some managers (mostly younger companies) the information sources were too fragmented and they did not have a clear idea whether to follow the website of Ministry of Industry and Trade, Ministry of Foreign Affairs, International Chamber of Commerce or BusinessInfo.cz.

Five exporters mentioned problems with the governmental support with financing/insurance of export not being optional. These companies stated that in cases that they are not able to reach the government support in insuring their export activities, this creates a significant increase in risk volume.

3.3 Internal-foreign

Several barriers generally perceived as serious in literature were not mentioned by many interviewed exporters. For example getting payments from abroad was a problem for only four companies in contrast to this being a more important issue in other studies (Morgan, Katsiekas, 1998: 79). Technical problems were mentioned by only two companies, both with electrical appliances, where adaptation to a different standard was needed for some Latin American countries, but both companies have experience with non-European regions and are used to adapt their products, therefore it was not perceived as a serious issue.

Obtaining a local distributor or partner is a problem for five companies, both experienced exporters and non-exporters.

Logistics interestingly is not perceived as a barrier by vast majority of companies, only six firms stated it as a problem. This might be surprising because of a large distance and in many cases insufficient infrastructure in the target country. Yet majority of the interviewed firms sees this obvious disadvantage as something that is easily overcome with profitability and in many cases this is again connected to the company having experience with other geographically distant regions.

The most mentioned barrier hindering export to Latin America for Czech companies were Cultural differences and Bureaucracy at the target country, with both factors being indicated by the same number of respondents i.e. 15 companies, which is 57,7% of respondents. In connection to Latin America (and to other non-European regions, for that matter) it is important to include the barrier of cultural differences which is focused on the target country but ability or inability to overcome it stems from inside the company, and it includes a wide group of factors (for example language, lifestyle, cultural standards, consumer preferences or purchase power). (Morgan, Katsikeas, 1998: 78) The concept of cultural distance, or "the degree to which cultural values in one country are different from those in another country" (Tesfom, Lutz, 2006: 52) is widely used to explain a variety of situations in export activities of a company, from the market entry mode, control over export channels, firms performance abroad etc.

When this barrier was indicated exporters were asked how they perceive the importance of this barrier and the specific attitude towards it varied highly. In this case more in-depth interview was conducted. The most mentioned aspects of cultural differences were the necessity to speak a foreign language (Spanish or/and Portuguese), the need to create a long-term personal relations with the partners/clients and the differences in business communication Total of 10 managers of this group speak Spanish and two more speak Portuguese as well. In addition in 6 of these 10 companies, the manager had a knowledge and previous deeper experience with the region - in four cases the manager lived in Latin America longer than 6 months and in two cases they were born and/or raised in the region. In all the cases in which managers speak Spanish (and Portuguese), the interview revealed that cultural differences are a factor that a company needs to take into an account, but it is not a completely limiting factor. The fact that big part of these companies has a management qualified in sense of language and regional knowledge can explain why after a more profound interview 11 of these 15 companies stated that cultural differences are more of a challenge than a barrier, this including one company that does not have a Spanish/Portuguese speaker nor a manager with Latin American experience.

Figure 2 shows a summary of how many companies does or does not have a management with certain qualification and how many of both groups perceive cultural differences as a barrier. More managers without the knowledge of the region and without the ability to speak both Portuguese and Spanish perceive cultural differences as a barrier. Spanish speaking managers on the other hand do not seem to be a factor eliminating the cultural differences as a barrier.

Fig. 2: Cultural differences and managers´ qualification - summary
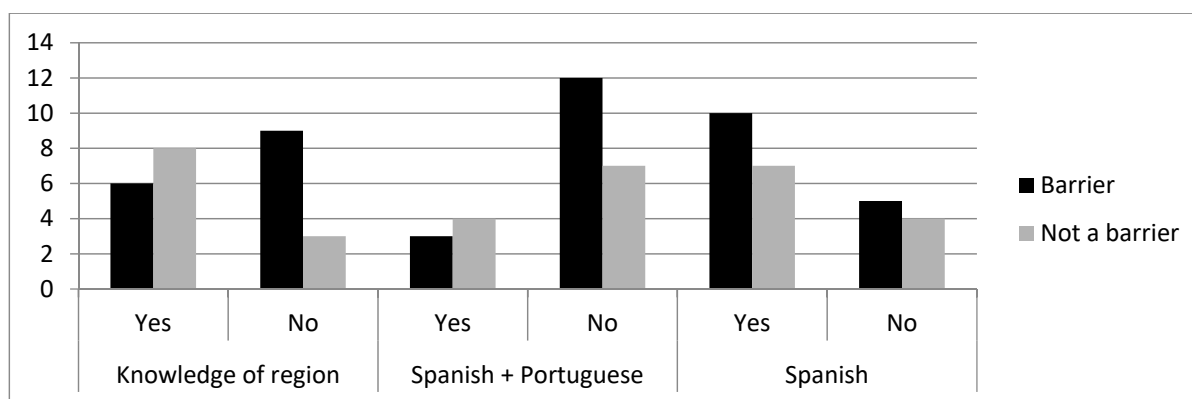
It can be interesting to have a look at the group of exporters that do not consider cultural differences to be a problem for export to Latin America. Again most of them have a manager speaking at least Spanish (7 out of 11 firms) and in four cases even Portuguese as well. All seven Spanish speaking managers plus one non-speaker also have a personal Latin American experience, mostly again a long-term stay in the region, or a life-partner/family member from Latin America. (See Figure 2) Also five of these companies had historical bounds to the region in business. For example their predecessor or previous management before 1989 had active partners in Latin America, or they substitute a brand that was perceived as traditional in Latin America. From the three cases that do not have a manager speaking the language, nor being experienced in the region two are substantially interesting, one because it seems to be a very typical negative case as seen by author´s experience as well as the experience of interviewed diplomats and CzechTrade employees.

The first example is a small company without large resources, with a specific product of a consumer goods kind which highly relies on the help of governmental assistance. This company does not have any bigger/international partner nor any historic bounds in the region and is highly exposed to a domestic, international and even Czech competition. Yet the manager does not believe knowledge of the language is necessary nor that they would have to make any special changes in their approach to Latin American customers and partners.

If this first case can be seen as typical the other is completely deviant. It is a rather new and fast growing company, with highly specific product intended for an expert client with a very limited competition due to both the expertise of the product and their pricing. This company does not see cultural differences as a barrier since they communicate with professionals all over the world in English, because in this part of bio-chemical industry majority of terms does not have equivalents in other languages and also even the end costumer is an expert customer. Also the demand in this case is larger than the supply, therefore at this moment the company does not need to seek customers and even Latin American clients contact the company by themselves. This experience indicates that in highly specific fields with limited number of producers and informed customers the marketing strategy can be more passive and still create a substantial revenue for the company.

3.4 External-foreign barriers

The last group of barriers is the most rigid one when it comes to the ability of the firm to deal with them by adapting its internal organization. Different foreign consumer habits/attitudes is usually a crucial barrier in the initial phase of export. The exporter may manage to overcome this problem by for example adapting the product or creating a marketing strategy which changes the perception of their product to suit the needs of target group of customers. In some cases of course this will not be possible or profitably possible, which will naturally lead to the conclusion of export activities in the region. In the two cases of the companies in this research who mentioned this problem in context of Latin America, the products were not traditional for this region, but in the opinion of the manager it was possible to address this barrier through an adequate marketing strategy.

Socio-economic or political instability in the target country can be a barrier for the exporter, especially in the sense that the company needs to follow developments in the country/region, which is very often not entirely connected to the development of other regions but also because in some countries of Latin America the changes in political or economic situation might be more radical than in Europe in recent years. The relative instability compare to Europe can be a barrier especially for some companies in Arms and Defence industry, since different kinds of restrictions might apply to them depending on the political situation in the country; or even in Food industry, where for example in Venezuela in recent years the lack of foreign exchange caused by the recent economic turmoil caused the conclusion of long-lasting business relations.

Corruption is a problem that is not of course unique for Latin America but it is a general perception that this factor might be highly problematic for exporters in this region. The fact that only six managers perceive corruption as a barrier that is more serious in Latin America than in other non-European regions is a positive sign for Czech firms intending to export and fearing to encounter this problem.

Protectionism and bureaucracy at the target country on the other hand were mentioned often. Protectionism in 13 and Bureaucracy in 15 cases. These two barriers are very country-sensitive, both of them were almost exclusively mentioned in the case of Brazil and (to a lesser extend) Argentina. Brazil in this context is an interesting example. The extend of its bureaucracy and protectionism can be preventing new companies to enter the market, and is complicated to understand, but several exporters stated, than if the company manages to establish their position the same barriers are protecting them from new competition. "Customs and tariffs are a problem but it is same for everyone so it is not really such a problem because after you get through it limits other companies to catch up." (Respondent 3) Other examples of protectionism than the obvious tariffs and quotas can be anti-dumping laws or domestic content legislation. (Korneliussen, Blasius, 2008: 219)

Keen competition is another barrier that appears more serious for Czech exporters, with over 46 percent mentioning it as a problem. Most of the competition is from large international companies or companies with larger governmental support but for example one smaller company of Food industry is competing mostly with other larger Czech companies exporting analogous product.

Conclusion

The concluded research shows that many of the barriers in reality encountered by Czech exporters are not the ones that first come in mind. Logistics, technical barriers or lack of

capital do not seem to be critical factors in export strategy of Czech exporters for Latin America, but of course a previous export experience plays a significant role in perception of these problems, as the literature states (Volpe Martincus, Estevadeordal, Gallo et al., 2010: 139).

It can be surprising how many exporters perceive cultural differences as a barrier and it would be very interesting to focus further on what really are these cultural differences and how to reduce their negative impact on business. The most problematic for Czech exporters seems to be the category of external-foreign barriers, which is understandable since these problems cannot be overcome by the company´s internal organization. On the other hand keen competition is a problem that most of Czech companies will encounter on most markets and protectionism and bureaucracy at the target country are the most country-sensitive barriers from the list and therefore a new exporter can choose a country from the Latin American region which might be more suitable for his export purposes.

Overall this research showed that on the side of the private sector the qualification or the mental model of the export manager plays a critical role, his or her activity and education about the region practically determines how successful will the company be in this region and in many companies this is very undervalued. The goal of this research was to show that problems of Czech export are not black and white and to avoid one-sided criticism, therefore it is necessary to mention that the limits are not only on the side of exporters, but of course on the side of governmental assistance which is a very wide topic. In this research the assistance appears to be confusing for the exporters and not perfectly suitable for smaller companies.

Acknowledgement

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Appendix

Tab. 2: Perception of barriers to export to Latin America by Czech exporters

Internal

	Internal	Firms*	Frequency rate**	Rank***
Domestic	Qualification/adequacy of staff	9	34,6%	5
	Production capacity	2	7,7%	16
	Lack of managerial time	3	11,5%	15
	Lack of capital	1	3,8%	19
Foreign	Technical limits of product (standards, specifications)	2	7,7%	16
	Difficult/slow collection of payments from abroad	4	15,4%	14
	Difficult to obtain local distributors/partners	5	19,2%	11
	Logistics (problematic transport, high shipping costs)	6	23,1%	7
	Cultural differences	15	57,7%	1

External

External	Firms*	Frequency rate**	Rank***
Bureaucracy in the base country	6	23,1%	7
Unqualified/inadequate staff at embassies/gov. agencies	7	26,9%	6
Not optimal governmental support with financing/insurance of export	5	19,2%	11
Limited info about foreign markets	5	19,2%	11
Different foreign consumer habits/attitudes	2	7,7%	16
Protectionism (tariff/non-tariff barriers)	13	50,0%	3
Keen competition	12	46,2%	4
Socio-economic or political instability	6	23,1%	7
Corruption	6	23,1%	7
Bureaucracy at the target country	15	57,7%	1

CORPORATE LIFE CYCLE IDENTIFICATION: A MODEL BASED ON RELATIONSHIP BETWEEN RETURN ON EQUITY AND COST OF EQUITY

Zdeněk Konečný, Marek Zinecker

Abstract: *The theory of shareholder value maximisation implies that the ultimate aim of each entrepreneur is to increase the market value of the company, i.e. to maximise the wealth of shareholders. This concept assumes that the returns to shareholders should outperform the cost of capital. The higher the spread is, the better the position of shareholders. The capital assets pricing model has been very often used for calculation the cost of equity as implicit costs, where the risk-free rate, the expected return of the market and the premium to operational and financial risks in the form of beta coefficient is considered. Moreover, the return on equity is significantly dependent on the corporate life cycle. The purpose of this paper is to develop an innovative model identifying stages of the corporate life cycle while using two variables: the rate of economic profit and the share of operational and financial risk within the total entrepreneurial risk. The model is verified by using data of a selected company. Identifying stages of the corporate life cycle should simplify the risk management and subsequently raise the capital access.*

Keywords: *cost of equity, financial risks, operational risks, rate of economic profit, return on equity.*

JEL Classification: *D24, G32.*

Introduction

The theory of shareholder value maximisation implies that the ultimate aim of each entrepreneur is to increase the market value of the company, i.e. to maximise the wealth of shareholders. Therefore, generating just an accounting profit is insufficient. Reaching a higher profitability compared to alternative investments projects is expressed by the concept of the economic profit considering opportunity costs. This theory of business income was developed by Edwards and Bell, as reported by Mohiuddin (2014). The concept of economic value added (EVA) developed in the company Stern & Stewart is just one example of measurements based on the idea of the economic profit (Stewart, 2013).

Companies differ in many aspects; thus, any comparison of economic success has to be based rather on relative than absolute metrics. The spread between return on equity and cost of equity might be an example. The risk of a company is incorporated in cost of equity (e.g. the parameter beta used in the capital asset pricing model – CAPM). In sum, the entrepreneurial success should be measured not just by its profitability, but also by the relationship between the profitability and the risk. Moreover, the entrepreneurial success is linked to the corporate life cycle; the identification of the particular stage is another issue, which has been investigated in the academic financial literature.

The purpose of this paper is to develop an innovative model identifying stages of the corporate life cycle while using two variables: the rate of economic profit and the

share of operational and financial risk within the total entrepreneurial risk. This model is intended to be used by financial managers while optimising the risk management and subsequently raising the capital access. The rest of this paper proceeds as follows. First we review the literature on economic profit and corporate life cycle identification. Section 2 provides an overview of the data used and methodological approach. Section 3 presents detailed findings and the last sections discuss and summarise main conclusions.

1 Statement of a problem

Mankiw (2015) defines the economic profit as total revenues minus total cost, including both explicit and implicit costs. Because enterprises differ significantly in size and other aspects, it is a necessity to develop indicators enabling to compare economic profit based on relative metrics. Thus, the relative economic profit is the spread between return on equity and cost of equity, as mentioned by Neumaierová and Neumaier (2005).

The return on equity is a ratio between the accounting profit and the value of equity. There are two basic concepts of the accounting profit (Belkaoui, 2004). According to the transactional approach the total profit is the difference between available cash resources at the moment of ending entrepreneurial activity and available cash resources at the beginning of the investment. Another concept is derived from the idea, that the accounting profit is an effect of changes in assets and liabilities.

The cost of equity can be defined as implicit cost and it is equal to the profitability of an alternative investment, according e.g. to Hořejší *et al.* (2010). If the effectiveness of financial management in a company should be assessed, then the cost of capital will be one of the main parameters as reported by Michalak (2016). The theory of corporate finance developed many concepts how to estimate the cost of equity. The essential approach is the Gordon growth model, mentioned by e.g. Lee *et al.* (2008), which supposes that dividends are paid to shareholders. Therefore, this model is very often unsuitable, because the cost of equity is perceived as explicit cost, which is contrary to the economic profit approach. The cost of equity can be also defined as a surcharge on cost of debt, because shareholders usually bear a higher level of risk than creditors, as recorded by Brigham and Ehrhardt (2008). However, this fact might not be valid during the stages of introduction and decline, as mentioned by Reiners (2004). The most frequently cited model for calculating the cost of equity is the capital asset pricing model (CAPM). This model uses the following formula describing the relationship between risk and expected return (Damodaran, 2006):

$$r_e = r_f + \beta * \left(r_m - r_f \right)$$

Explanatory notes:
r_e = cost of equity

r_f = risk-free rate

β = beta coefficient

r_m = expected market return on equity

The CAPM model requires three inputs to compute expected returns – a risk free rate, a beta for an asset and an expected risk premium for the market portfolio. The

beta for an asset can be estimated by regressing the returns on any asset against returns on an index representing the market portfolio, over a reasonable time period. In practice, we face many problems while beta estimating. E. g., there are no indices that measure the market portfolio (Damodaran, 2006). Despite interconnections among economies and capital markets are increasing, as reported by Balcerzak & Pietrzak (2016), Zinecker *et al.* (2016), Fałdziński *et al.* (2016), Pohulak-Żołędowska (2016), and Pietrzak *et al.* (2017), in many emerging markets the indices used tend to be even narrower and include only a few dozen large companies (Damodaran, 2006).

The arbitrage pricing theory, Fama-French three factor model and the Black-Scholes model represent another approaches how to calculate the cost of equity (Brigham and Ehrhardt, 2008; 10.Kislingerová, 2001; Mohiuddin, 2014).

There are several models of the corporate life cycle. As mentioned e. g. by Shirokova (2009), each model uses different number of stages as well as different variables for identifying them. The main issue, which complicates the identification of the stage of the corporate cycle, consists in the fact, that some variables are qualitative, and thus difficult to measure. Some models are based on using just quantitative variables. E. g. Slavíčková and Myšková (2016) developed an approach based on a set of criteria for accurate life cycle stage determination, which are quantitative, detectable and suitable for multi criteria evaluation. The model by Dickinson (2011) identifies the phases according to the combination of positive or negative values of cash flow from the operational, investing and financial activity. This model, however, does not respect the fact that cash flows from investing and financial activities can reach zero value. Reiners (2004) suggests using a growth indicator, which consists in average year-on-year change of assets, sales and cash flows. Intervals of values for the identification of individual phases of the corporate life cycle are set. The limitation of this model is the impossibility to identify the phase of introduction. In the model developed by Konečný and Zinecker (2015) the Boston Matrix is applied. In this model the phases of the corporate life cycle are identified according to relative sales growth, where the corporate sales growth is compared to market sales growth, and relative market share, where the market share of the company is compared to share of disposable assets of the company. The Boston Matrix, however, was developed for determination the product life cycle. Therefore, the expectation has to be met that the corporate life cycle is identical to the life cycle of all corporate products in this model.

The profitability measured by return on equity as well as the risk measured by the cost of equity is significantly affected by the corporate life cycle. Kislingerová *et al*. (2010) report that the maximal operational profit is reached during the phase of stabilisation. This might not mean that the return on equity is the highest one just in this phase. The reason consists in the fact that not just the profit, but also the amount of equity can increase during stabilisation.

According to Reiners (2004) the cost of equity has roughly a decreasing trend during the whole corporate life cycle. During the stabilisation, the cost of equity can be slightly higher than during the next phase of decline, when the owners have lost almost all their capital and so they bear just a low risk. This finding is, however, valid only for limited liability companies and joint stock companies. On the contrary, Hasan *et al.* (2015), who identified the life cycle according to model by Dickinson (2011), proved the U-shape of the cost of equity, during the corporate life cycle. The trend of cost of

equity is, according to these authors, similarly the same as the trend of cost of debt and weighted average cost of capital, as mentioned by Reiners (2004).

There are many approaches to the categorisation of entrepreneurial risks influencing the cost of equity. E.g. Myšková and Doupalová (2015) focused on identifying risks that could significantly affect the performance of small enterprises and developed an approach to risk management in a particular company. In this paper we distinguish between the operational (or business) and financial risk as defined by Tiwari and Verma (2011). The operational risk is reflected in the volatility of the expected operating profitability of the company. The level of operational risk is caused by three kinds of factors, namely by macroeconomic factors (e. g. fluctuations in the foreign exchanges, inflation, imports or restrictive regulations), industrial factors (e. g. perspective in the market, sector sensitivity to the economic cycle or rivalry of competitors on the market) and company-specific factors (e. g. human resource management, liquidity, intellectual property management or organizational culture). Financial risk refers, according to these authors, to the variability of the residual income to the equity due to debt. Thus the financial risk depends on the rate of indebtedness.

The level of operational risk can be measured as operating leverage. Miculeac *et al.* (2014) define the operating leverage as the ratio of change in profit to change in sales. Therefore, the operational risk increases with growing operating leverage. The level of financial risk has been estimated by financial leverage - the ratio between debt and equity as reported by Damodaran (2006). Analogously to the operational risk, a higher financial leverage signalizes a higher rate of financial risk.

Li *et al.* (2015) investigated the relations between the business and financial risk. According to the authors, firms with high rate of indebtedness tend to have a higher volatility of future earnings or cash flows. The authors implemented their research on a sample of companies which differ in size, age as well as credit rating for corporate bonds.

Furthermore, Bender and Ward (2009) investigated the relationship between the corporate life cycle and the operational and financial risk. The operational risk decreases steadily, whilst the financial risk has an increasing trend depending on the corporate life cycle. During the phase of stabilisation, both kinds of risk are on the middle level. In sum, the low financial risk in the phase of introduction signalizes the fact, that the companies in this phase cover their activities mostly by using equity. Alternatively, the venture capital can be used in the case of start-ups and companies in the stage of expansion after a crisis as mentioned by Silvola (2008).

However, in a research implemented in Italy by Rocca *et al.* (2011) other findings have been reported. The most important source of financing in the phase of introduction is debt, even though the interest rate is high because of a high risk. The reason is that Italy as well as continental Europe in general is a bank based country where the market with private equity and initial public offerings is rather underdeveloped although the primary capital markets were growing significantly in recent years (Meluzín and Zinecker, 2016) as well as their interrelationships as reported e. g. by Pietrzak *et al.* (2017). During the phases of growth and stabilisation, the companies finance their activities by using internal sources such as profit, financial

reserves and depreciation. External equity has not been used. The lack of start-up equity causes a lower amount of innovative projects and slows down the switch from the phase of introduction to the phase of growth, which is emphasized by Hirsch and Walz (2011).

Faff *et al.* (2016), who also used the model by Dickinson (2011) for identification the corporate life cycle, report, that amount of investments and equity issuance decrease during the corporate life cycle. Simultaneously, debt issuances increase in the phases of introduction and growth and decrease during stabilisation and decline. Moreover, Pashley and Philippatos (1990) mention that companies in the stages of stabilisation and decline keep a higher rate of liquidity as a ratio between current assets and short-term payables.

The secondary research summarised in this theoretical framework proved that profitability as well as cost of equity significantly depend on the corporate life cycle. However, to our knowledge, the previous literature has not developed a model identifying stages of the corporate life cycle using the spread between return on equity and cost of equity, which represents a quantifiable input. We believe that our model helps to fill this gap.

The model is a tool supporting managers in optimising the risk structure and subsequently the rate of economic profit as well as in raising the capital access. We also expect that our findings will be beneficial for a wide range of investors while decision making.

2 Methods

The research approach was developed after an extensive review of profitability, risk structure and corporate life cycle-oriented academic literature. The construction of the innovative model intended to identify individual stages of the corporate life cycle is based on estimating economic profit rates and shares of operational and financial risk that are typical for individual stages.

The rate of economic profit is calculated analogously to model INFA as a difference between return on equity and cost of equity (Neumaierová and Neumaier, 2005). The return on equity is a ratio of earnings after taxes (EAT) to equity. The cost of equity is calculated using the capital asset pricing model (CAPM). The share of operational and financial risk is determined using the unlevered and levered beta, which are variables of capital asset pricing model.

The initial model for calculating cost of equity is modified to distinguish the premium for operational and financial risk. This approach enables us to determine the share of operational and financial risk within the total entrepreneurial risk. Finally, the various combinations of the rate of economic profit and shares of operational and financial risk will be linked to the findings on characteristics of the corporate life cycle to determine its individual stages.

Tab. 1 shows a set of variables having sufficient support in the relevant academic literature applied in our model. The model works with seven variables representing measurements of profitability, beta coefficients, cost of equity and risk. We modified the formula of unlevered beta calculation; the cash flow is divided by total assets, not

by equity as recorded in our previous study (Konečný and Zinecker, 2015). This modification eliminates the impact of different sources of corporate financing.

Tab. 1: Variables used for identification of the corporate life cycle

Variable	Calculation
Return on equity ($ROE_{accounting}$)	$$\dfrac{EAT}{E}$$
Unlevered beta ($\beta_{unlevered}$)	$$\dfrac{\dfrac{\sum\limits_{t=1}^{n}\left[\left(\left(\dfrac{CF}{A}\right)^{t}_{market}-\overline{\left(\dfrac{CF}{A}\right)}_{market}\right)*\left(\left(\dfrac{CF}{A}\right)^{t}_{company}-\overline{\left(\dfrac{CF}{A}\right)}_{company}\right)\right]}{n}}{\dfrac{\sum\limits_{t=1}^{n}\left[\left(\dfrac{CF}{A}\right)^{t}_{market}-\overline{\left(\dfrac{CF}{A}\right)}_{market}\right]^{2}}{n}}$$
Levered beta ($\beta_{levered}$)	$$\beta_{unlevered}*\left(1+(1-t)*\left(\dfrac{D}{E}\right)\right)$$
Share of operational risk	$$\dfrac{\beta_{unlevered}}{\beta_{levered}}$$
Share of financial risk	$$1-\dfrac{\beta_{unlevered}}{\beta_{levered}}$$
Cost of equity (r_e)	$$r_f+\beta_{levered}*(r_m-r_f)$$
Rate of economic profit ($ROE_{economic}$)	$$ROE_{accounting}-r_e$$

Source: (Damodaran, 2006; Konečný and Zinecker, 2015; Reiners, 2004; own processing)

Explanatory notes:
EAT = earnings after taxes
E = equity
CF = cash flow related to the company/market
A = total assets related to the company/market
t = effective tax rate
D = debt
r_m = expected market return on equity
n = number of surveyed periods

The model is verified in a case study. The corporate and market specific data were retrieved from www.justice.cz and www.mpo.cz, respectively. Recommendations related to managing risks are reported.

3 Problem solving

The model identifies the corporate life cycle while using two variables: the rate of economic profit and the share of operational and financial risk within the total entrepreneurial risk. The construction of this model is based on the idea that the

profitability, risk and thus the rate of economic profit as well as the share of risks differs significantly during the whole corporate life cycle.

As mentioned in the theoretical part, the rates of economic profit as well as the risk structure depend on the corporate life cycle. The secondary research proved that the cost of equity has roughly the U-shape across the corporate life cycle, whilst the return on equity is negative during foundation, positive during stabilisation and finally it decreases up to negative values in the stage of decline. From these findings there can be derived that the economic profit is reached during growth or stabilisation, whilst the stages of foundation and decline are connected with economic losses. Furthermore, the operational risk increases across the whole corporate life cycle, whilst the financial risk decreases steadily. These four individual stages of the corporate life cycle can be identified according to the characteristics shown in Tab. 2.

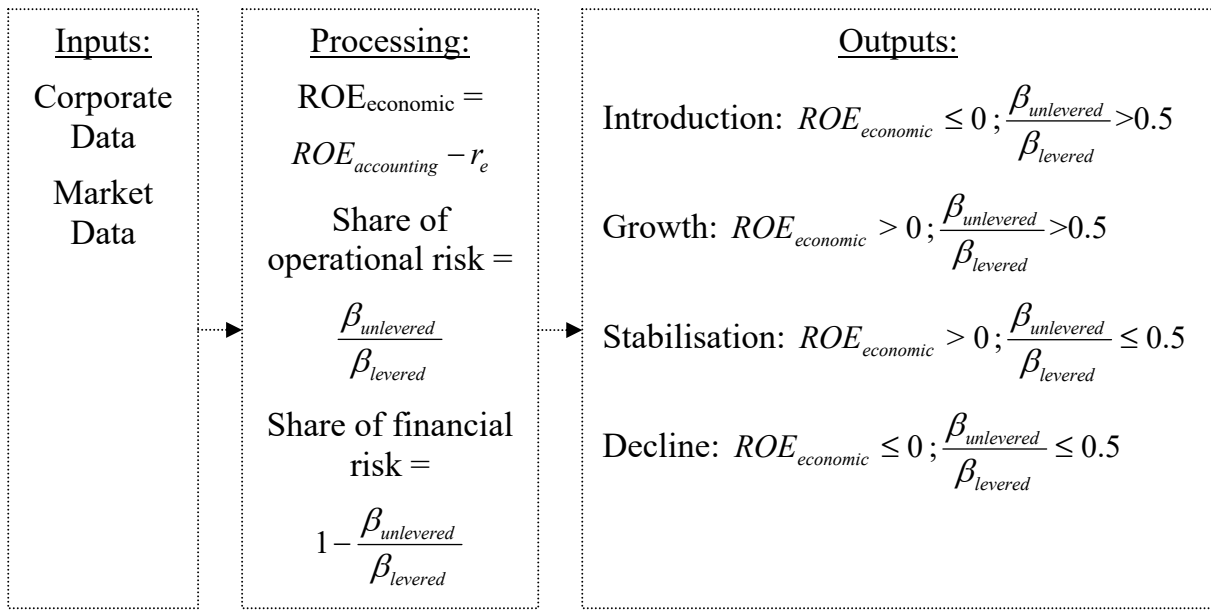*Tab. 2: Corporate life cycle identification based on economic profit and risk structure*

Phase	Rate of economic profit	Share of operational risk	Share of financial risk
Introduction or Re-Introduction	Negative	More than 50 %	Less than 50 %
Growth	Positive	More than 50 %	Less than 50 %
Stabilisation	Positive	Equal to 50 % or less than 50 %	Equal to 50 or more than 50 %
Decline	Negative	Less than 50 %	More than 50 %

Source: (Bender and Ward, 2009; Kislingerová et al., 2010; Reiners, 2004; own processing)

Fig. 1 shows our model proposal. The model works with corporate and market accounting data on assets, cash flow, equity, debt, earnings before taxes and earnings after taxes. The data processing has been performed by calculating the rate of economic profit and shares of operational and financial risk to determine the particular stage of the corporate life cycle.

Furthermore, the model enables financial managers identifying causes of a negative or positive rate of economic profit. If the main cause is a low or even negative return on equity, the most appropriate response should be focused on strengthening strategies in the areas of marketing, cost management and financing. If a high level of cost of equity signalizing a high entrepreneurial risk is identified, than there is more suitable to pay attention to reducing either operational or financial risk. The unlevered beta linked to the operational risk should be lower than +1; this means, that the corporate risk of relative cash flow volatility should be lower than the equivalent market risk. The levered beta linked to both operational and financial risk, can be also lower than +1. However, if the effective interest rate on bank loans and corporate bonds is lower than the return on assets (ROA), then using debt raises the return on equity. This effect is usually termed as financial leverage and in such a case using more debt is reasonable. If the low or negative rate of economic profit is affected by the risk, the managers should be focused on reducing either the relative cash flow volatility or the rate of indebtedness.

Inputs:	Processing:	Outputs:
Corporate Data Market Data	$ROE_{economic} =$ $ROE_{accounting} - r_e$ Share of operational risk = $\dfrac{\beta_{unlevered}}{\beta_{levered}}$ Share of financial risk = $1 - \dfrac{\beta_{unlevered}}{\beta_{levered}}$	Introduction: $ROE_{economic} \leq 0\,; \dfrac{\beta_{unlevered}}{\beta_{levered}} > 0.5$ Growth: $ROE_{economic} > 0\,; \dfrac{\beta_{unlevered}}{\beta_{levered}} > 0.5$ Stabilisation: $ROE_{economic} > 0\,; \dfrac{\beta_{unlevered}}{\beta_{levered}} \leq 0.5$ Decline: $ROE_{economic} \leq 0\,; \dfrac{\beta_{unlevered}}{\beta_{levered}} \leq 0.5$

Source: own research

Based on the model, there are two essential conditions to reach or raise the rate of economic profit:

$$ROE_{accounting} > r_m$$
$$\beta_{unlevered} < 1$$

3.1 Case study

The case study method was used to systematically verify the model of corporate life cycle identification. We selected a company from the sector of fertilizers and nitrogen compounds manufacturing. It is a joint-stock company with the amount of assets of CZK 300 M, sales CZK 500 M and 75 employees. Tab. 3 reports calculation results of individual variables linked to the risk structure and rate of economic profit. The unlevered beta considers cash flow volatility through the whole investigated period. Its value is fixed. The remaining variables are changing.

The company reached a positive accounting return on equity in all surveyed periods. However, a decreasing trend is obvious. Except to 2008, the levered beta is less than +1, thus investing in this company is less risky compared to the whole market. Furthermore, the levered beta tends to decline. Within the structure of entrepreneurial risks, the operational risk is dominant in all periods (its shares increase continuously). The cost of equity was relatively lower than return on equity, but there is recorded an increasing trend in cost of equity; in 2015 the cost of equity is even higher than return on equity. In the last period, a negative rate of economic profit compared to previous periods is recorded. Our interpretation of the research results is that the surveyed company switched from the stage of growth (between 2008 and 2014) into the stage of re-introduction (in 2015), i.e. company switched into a next corporate life cycle. This switch is caused by the decline of the economic profit to negative values combined with the dominant share of operational risk.

Tab. 3: Model Application

Quantity	Developments in individual years							
	2008	2009	2010	2011	2012	2013	2014	2015
ROE$_{accounting}$ (in %)	35.7	24.9	23.0	22.5	24.9	21.3	13.6	12.2
β$_{unlevered}$	0.619	0.619	0.619	0.619	0.619	0.619	0.619	0.619
β$_{levered}$	1.024	0.985	0.861	0.831	0.779	0.768	0.724	0.711
Share of operational risk (in %)	60	60	70	70	80	80	90	90
Share of financial risk (in %)	40	40	30	30	20	20	10	10
r$_e$ (in %)	4.5	-1.2	8.7	10.9	9.4	3.9	11.7	15.7
ROE$_{economic}$ (in %)	31.3	26.1	14.3	11.7	15.6	17.4	1.9	-3.5
Stage of the corporate life cycle	Gr.	Gr.	Gr.	Gr.	Gr.	Gr.	Gr.	Intr.

Source: own research

Explanatory notes:
Gr. = phase of growth
Intr. = phase of introduction or re-introduction

The risk considered in the levered beta was reduced and simultaneously the share of operational risk as a proportion of unlevered and levered beta increased. The effect of this development on the accounting return on equity was negative. Furthermore, the cost of equity increased because of a higher risk-free rate or market return on equity and this caused a decreasing trend in the rate of the economic profit reached by the surveyed company. The financial managers should focus on the strategy of financing - using a higher proportion of debt since the first period, even though the levered beta and thus the risk will be higher. There is evidence that a higher risk brings a higher profitability and vice versa.

4 Discussion and conclusions

The model proposed in this study is intended to be a tool supporting managers in identifying stages of the corporate life cycle, optimizing the risk structure and maximizing the rate of economic profit. It is based on recent research, in particular on models developed by Reiners (2004), Kislingerová (2010), Bender and Ward (2009), Damodaran (2006) and Slavíčková and Myšková (2016). The relation between cost of equity and the corporate life cycle was investigated by Reiners (2004). Analogously, Kislingerová (2010) paid attention to profitability during the corporate life cycle. Bender and Ward (2009) were focused on operational and financial risk in individual stages of the corporate life cycle. Damodaran (2006) calculated the unlevered and levered beta to determine the cost of equity. However, to our knowledge, the previous literature has not developed a model identifying stages of the corporate life cycle using the spread between return on equity and cost of equity as well as the share of operational and financial risk. Our contribution consists in developing an innovative model connecting recent knowledge on return on equity, cost of equity and risk structure during the corporate life cycle. Simultaneously, our model works with unlevered and levered betas to calculate the cost of equity as well as to distinguish premiums to operational and financial risk.

The model shows that some companies can reach a higher rate of economic profit in connection with a dominant share of operational risk; otherwise there are companies maximizing the rate of economic profit while the financial risk is dominant within the risk structure. Therefore, it is impossible to determine, which stage of the corporate life cycle is the most favourable from the shareholder value maximisation perspective. The general conclusion is that a positive rate of economic profit is typical either for the stage of growth, or for the stage of stabilisation.

Our outcomes provide valuable implications for companies and investors while formulating innovative financial strategies and incentives how to increase the attractiveness of firms in different stages of their life cycle. There are, however, also some limitations of the proposed model. Firstly, within the stage of introduction companies might finance their entrepreneurial activities by using bank loans or other kinds of debt if a difficult access to external equity such as venture capital or private equity exists (Rocca *et al.*, 2011). In such a case the dominant share of financial risk does not signalize the stages of stabilisation or decline. Next limitation consists in the fact that the calculation of unlevered beta requires historical data series. This means that the operational risk can be measured only within a fixed time interval, whilst the financial risk reflected in levered beta is changing in every moment. Some problems can also occur while matching the company with the correct industry, because activities of many enterprises can vary significantly. Furthermore, the life cycle determination should also reflect qualitative data as reported by Slavíčková and Myšková (2016). Therefore, in an upcoming research, we intend to focus on the issue how to incorporate qualitative data such as automatisation and digitisation into the model, i.e. how to reflect the impact of these developments on the rate of economic profit and its partial components such as the accounting profit, cost of equity and shares of the operational and financial risk.

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ECONOMETRIC ANALYSIS OF MACHINE-BUILDING ENTERPRISES' SUSTAINABILITY IN THE CONTEXT OF NEOSYSTEM PARADIGM

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Abstract: *Sustainability of business entities is one of the most actual unsolved problems in economics and management. Our research was devoted to its elaboration in the context of a new system-structural (neosystem) methodological paradigm, which implies a priori separation of all economic systems into four types depending on their spatial and temporal localization. Thus just a set of four different types of systems may be economic sustainable. The purpose of this work was to test the hypothesis that the economic sustainability of the enterprise caused by the level of balance of its four subsystems and can be determined on the basis of its measurement. It represents the results of the econometric analysis of 16 machine-building enterprises of Ukraine for the period of 2004-2015, conducted by the methods of Data Mining technology. We have determined the indexes of the enterprises' subsystems, estimated their mutual balance and on the basis of all estimates – the indexes of system balance of the enterprises. To test our hypothesis, we have compared the indexes of system balance with the results of traditional estimation of sustainability conducted on the basis of generally accepted financial ratios. This allowed to confirm the hypothesis and to identify the system-structural character of the imbalances of the subsystems inherent to the machine-building enterprises.*

Keywords: *balance of economic system, economic sustainability of enterprise, neosystem methodological paradigm, machine building.*

JEL Classification: *B49, C12, C23, L60*

Introduction

Machine-building has always played an important role in the industrial structure of Ukraine and usually it was an indicator and catalyst of national industrial development. But now, because of the almost complete economic disintegration with the Russian Federation which was the main trade partner of Ukraine in machine-building, the enterprises have lost their capabilities in production and selling traditional products. This, as well as the other consequences of the socio-economic crisis in our country, significantly violated sustainability of the enterprises. Fig. 1 shows the dynamics of the index of machine-building industrial production calculated using Laspeyres formula. But even in the periods of economic growth the development of machine-building enterprises was mainly destructive and had a low technological level. So all of these have led to an increased scientific interest in issues related to sustainability.

Fig. 1. The dynamics of the index of machine-building industrial production

- industry;   - machine-building
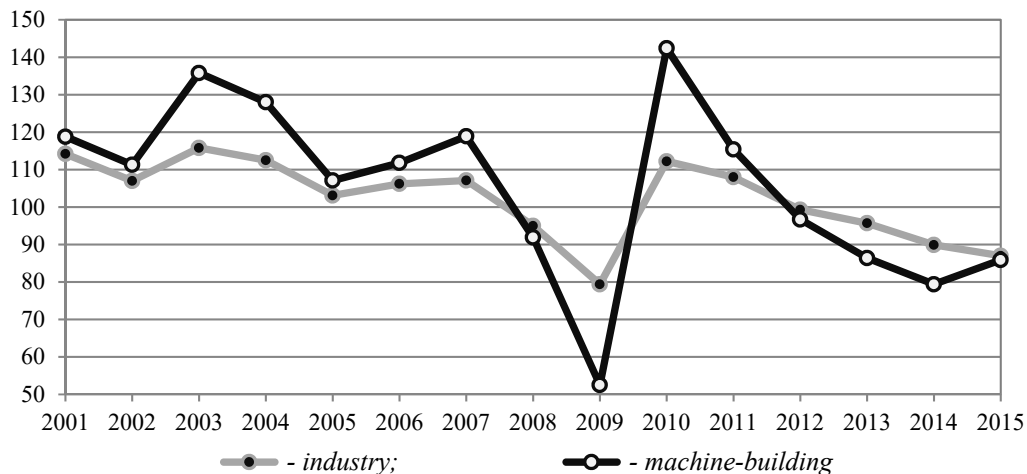
Source: compiled by author according to the statistic data (SSSU, 2016)

The epistemology of economic sustainability is extremely broad. There is not any generally accepted interpretation even in the range of general systems theory, which is the leading paradigm of research of complex objects nowadays. At the same time, regardless of interpretation, systems theory recognizes that spatiotemporal structure of the system plays the key role in ensuring its stability. As a result a new system-structural (or neosystem) theory and methodological paradigm of economic researches have been formed. Our work is devoted to study sustainability of the Ukraine machine-building enterprises based on them.

1 Statement of a problem

To date there is no methodology that allows to describe all economic systems on a unified basis and to derive universal "rule" of their stability in time and space. A neosystemic paradigm is an attempt to do this. Conceptual basis of it is based on a priori spatiotemporal typification of all economic systems. The paradigm mainly was developed in the works of researchers from the Central Economics and Mathematics Institute of the Russian Academy of Sciences (CEMI RAS) under the scientific direction of G. Kleiner (e. g. Kleiner, 2009, 2013, 2016; Rybachuk, 2016).

In the context of this paradigm, the structure of any economic system (including enterprises as a micro-level system) is viewed as a combination of elements with different degree of spatiotemporal limitation. Respectively they relate to one of the four types of subsystems: objects (have limited extension in space and unlimited duration in time), environments (have unlimited both extension in space and duration in time), processes (have unlimited extension in space and limited duration in time); projects (have limited both extension in space and duration in time) (Kleiner, 2009, 2013, 2016). None of the subsystems is self-sufficient and therefore sustainable. So they tend to the formation of donor-recipient pairs to exchange scarce resources and find appropriate empowerment. As a result, the interaction of the subsystems is circular and it leads to the creation of a tetrad – stable form, which can be considered as a result of the systems self-organizing.

If the subsystems is balanced, in interaction and cooperation they provide implementation of full cycles of the basic economic functions and sustainable

development processes, mutual provision of resources and properties and as result, as we suppose, – maintenance of economic sustainability of the enterprise.

The paradigm is interesting and credible, but new, so it does not have a proper methods, instrumental base and econometric treatment especially. Therefore, mentioned assumptions are not empirically confirmed or refuted until now and require a more rapid development. The purpose of our work is to verify the hypothesis that the level of economic sustainability of the enterprise depends on the mutual balance of its internal subsystems of four types (objects, environments, processes and projects) and therefore may be determined on the basis of this balance measurement. The hypothesis is being elaborated based on Ukrainian machine-building enterprises' data. We consider that the three tasks must be completed in order to test this hypothesis:

1. Selection of parameters that can be used to describe objects, environments, processes and projects subsystems of the enterprises and assessment of data concerning the values of parameters for the entire sample; selection of methods of data processing and their convoluting to obtain the index of each subsystem.

2. Forming of the methods and tools for conducting assessment of the index of system balance of the enterprise as a whole on the basis of indexes of subsystems values.

3. Determination of the statistical relationship between the index of system balance and "traditional" financial ratios that are generally used as the indicators of sustainable functioning of the enterprises.

2 Methods

The work is based on the above-mentioned neosystem methodological paradigm, which assumes a spatiotemporal structuring of economic systems, different from traditional approaches to structuring. It is assumed, that in order to be equally stable both in space and in time, the degree of expression of these subsystems of economic system should be the same, as symbolic shown in Fig. 2.

Fig. 2. The symbolic image of economic system consisting of the four subsystems with different spatiotemporal limitation
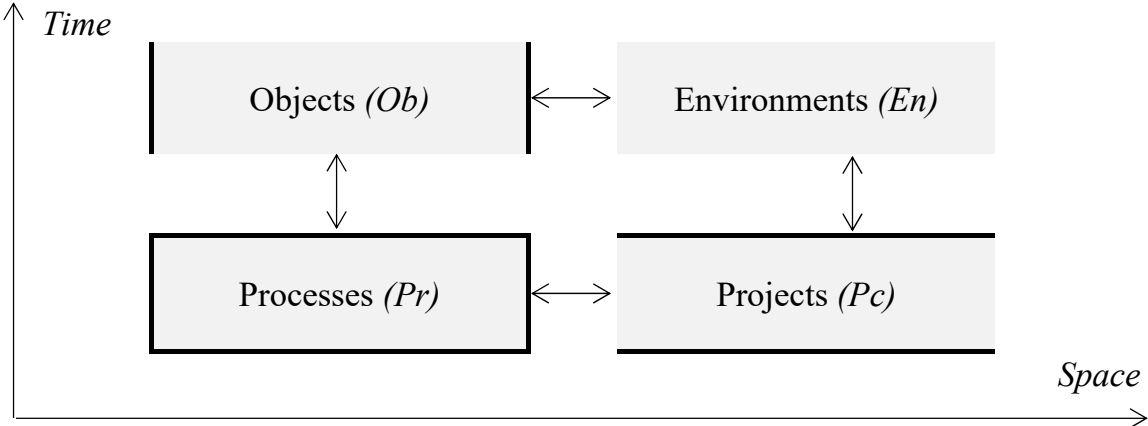
Source: (Kleiner, 2009)

Due to the lack of any econometric results obtained in the context of neosystem paradigm, the analysis requires the intelligent processing of large amounts of the panel data from different aspects. Data have been gathered from database of Stock Market Infrastructure Development Agency of Ukraine (SMIDA, 2016) and processed by the statistical program StatSoft Statistica 10.0. In various sources for such intellectual data processing, which is conducted with the involvement of a broad mathematical tools and information technologies, different terms are used: Data Mining, Knowledge Data Discovery, Data Science (e. g. Barseghyan, 2004; Cios, 2007; Ratner, 2011; Stanton, 2013; Witten, 2011). The most accepted by the experts is the term Data Mining. This technology is used to cover three areas of "extracting" the knowledge: classical mathematical statistics, which allows performing of data processing, aggregation and convolution; aggregate data visualization, which allows determination mathematically precise formula of dependencies and analysing trends; artificial intelligence methods, which allows improving of data processing in cases when mathematical statistics does not give adequate results (Ratner, 2011; Tuzovskiy, 2005; Witten, 2011). We have applied the technology in all of these areas to solve mentioned problems:

1. The methods of mathematical statistics, such as Principal Component Analysis (PCA) (e. g. Jolliffe, 2002), have been used to perform processing data concerning the values of parameters of four enterprises' subsystems and to conduct their convolution to obtain the indexes of subsystems. The normalization techniques have been used to bring different data to a single format. The arithmetic mean was used to obtain the generalized indexes.

2. The model of proportions of the subsystems visualization using quadrants, built in the Cartesian coordinate (Rybachuk, 2015), has been used to assess intensity of interaction of subsystems. The method of assessing the distance to the critical level by the formula of the Euclidean metric in the multidimensional space has been used in the calculation of the index of system balance.

3. The method of fuzzy logic (e. g. Chen, 2000; Dadios, 2012) have been used to conduct the financial ratios reduction to a single integral indicator of financial stability. This indicator has been used to determine the level of authenticity of obtained results and to verify the hypothesis – we have determined statistical relations between generalized index of system balance and integral indicator of financial stability for the group of analyzed enterprises.

3 Problem solving

3.1 Assessment of four enterprises' subsystems

In our research we have conducted the econometric analysis of 16 Ukrainian machine-building enterprises for the period of 2004-2015 (total sample consisted of 192 cases) to solve the target problem of their economic sustainability determination. At first, we have determined specific set of the subsystems' elements for an industrial enterprise is listed below:

- Objects subsystem *(Ob)* is represented by staff and departments of the enterprise and includes the totality of its employees, managers and stockholders.

- Environments subsystem *(En)* is represented by the social and cultural spheres

of enterprise and includes its internal standards, regulations, rules, institutions, communication, climate and culture.

- Processes subsystem *(Pc)* is represented by the sphere of industrial and economic processes of the enterprise and includes its technologies, information, management, logistics and business processes.

- Projects subsystem *(Pj)* includes the totality of the investment and innovative projects, programs, events, intentions of the enterprise.

The application of PCA has allowed us to perform processing data concerning the values of diverse parameters of four enterprises' subsystems and to conduct their convolution in order to obtain the index of each subsystem. Convolution of values of parameters was performed in a multidimensional space of principal components, taking into account the values of the eigenvalues of them. Thus, for estimation of objects subsystem index were selected 11 parameters, which were reduced to 6 components; for environments subsystem index – 13 parameters, which were reduced to 8 components; for processes subsystem index – 9 parameters, which were reduced to 5 components and for projects subsystem index – 16 parameters, which were reduced to 8 components.

To determine the index of subsystems based on the results of PCA the method of assessing the distance to the critical level has been used. For each subsystem "the worst sample" has been defined. It is multidimensional critical point, which reflects the worst set of values of all output components. Then the index of subsystem can be interpreted as a function of weighted distance to the critical point. For each subsystem it has been calculated by the formula:

$$I_{sys} = \frac{\sqrt{\sum_{a=1}^{A}\left[\lambda_a\left(t_{a_n} - \min_n t_{a_n}\right)\right]^2}}{\sum_{n=1}^{N}\lambda_a}, \qquad (1)$$

I_{sys} – index of subsystem; λ_a – ratio of eigenvalues for *a*-component of the subsystem, t_{a_n} – coordinate of the n-enterprise in the space of components; $\min_n t_{a_n}$ – minimum value for *a*-component of the subsystem; A – number of components allocated for the subsystem modeling by scree plot instrument, N – number of enterprises.

To integrate the results of modeling generalized indexes of each subsystem have been determined (objects – I_{Ob}, environments – I_{En}, processes – I_{Pc} and projects – I_{Pj}). They were calculated for the group of analyzed enterprises by the arithmetic mean formula. The results are shown in Fig. 3.

3.2 Evaluation of indexes of enterprises' system balance

The visualization of proportions of the subsystems by the ratios of their indexes using quadrants, built in the Cartesian coordinate system, as shown in Fig. 4, has allowed us to conduct assessment of intensity of interaction of subsystems. According to the (Kleiner, 2016) and (Rybachuk, 2016), this intensity may be characterized indirectly by measuring proportions of subsystems. We have adapted and, in our opinion, improved the outlined method.

## Fig. 3. The dynamics of generalized indexes of the subsystems for the group of analyzed enterprises

Fig. 3. The dynamics of generalized indexes of the subsystems for the group of analyzed enterprises
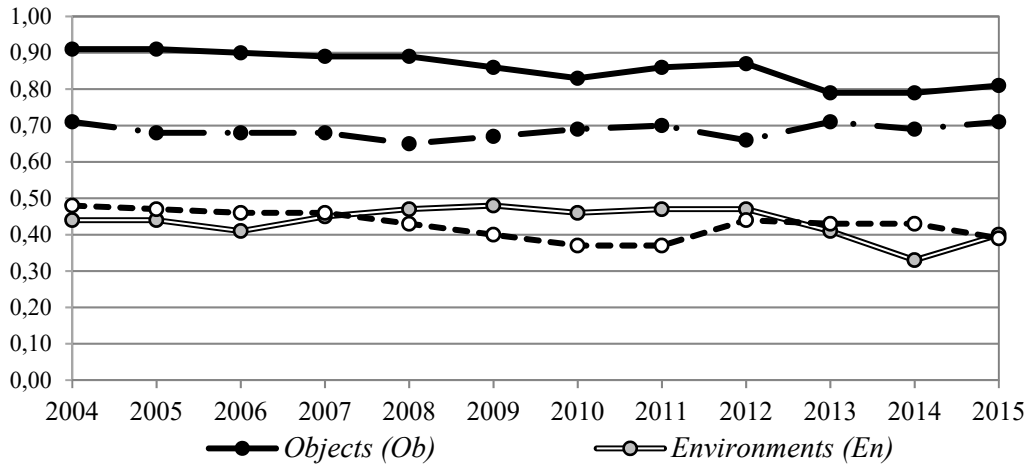
In Fig. 4 the coordinates of points *A, B, C, D* reflect the ratios of the indexes of interacting subsystems. In the proposed coordinates they are defined as $A\ (X_A;\ 1)$, $B\ (1;\ Y_B)$, $C\ (X_C;\ 0)$, $D\ (0;\ Y_D)$. The values of $X_A,\ Y_B,\ X_C,\ Y_D$ have been calculated by formulas:

$$X_A = \frac{I_{Ob}}{I_{En} + I_{Ob}}\ ;\ \ Y_B = \frac{I_{Pc}}{I_{En} + I_{Pc}}\ ;\ \ X_C = \frac{I_{Pj}}{I_{Pc} + I_{Pj}}\ ;\ \ Y_D = \frac{I_{Pj}}{I_{Pj} + I_{Ob}}\ . \qquad (2)$$

Fig. 4. The method of the proportions of the subsystems visualization (ideal balanced structure of tetrad is present)

Fig. 4. The method of the proportions of the subsystems visualization (ideal balanced structure of tetrad is present)
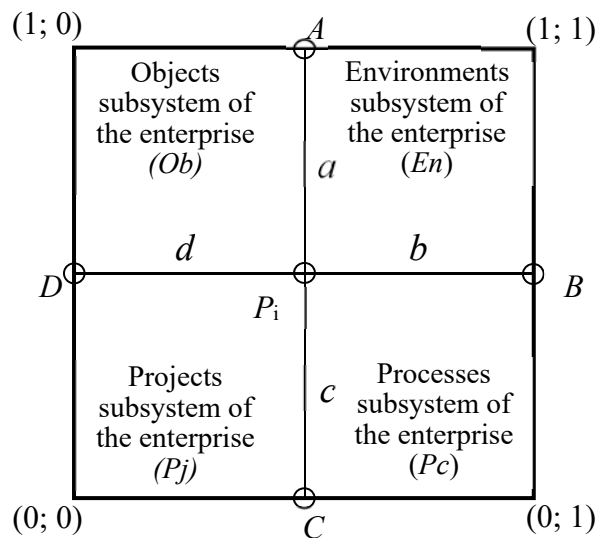
According to this method lengthsof *a, b, c* and *d* show the intensities of interaction between the corresponding subsystems: *a* – the intensity of interaction between objects and environments subsystems (*a = int (Ob-En)*); *b* – the intensity of interaction between environments and processes subsystems (*b = int (En-Pc)*); *c* – the intensity of interaction between processes and projects subsystems (*c = int (Pc-Pj)*); *d* – the intensity of interaction between projects and objects subsystems (*d = int (Pj-Ob)*). Their

normalized values may act as the indexes of intensity of interaction between these subsystems. The results of a generalized index of intensity of interaction between the subsystems determination are illustrated in Fig. 5.

Fig. 5. The dynamics of generalized indexes of intensity of interaction between the subsystems for the group of analyzed enterprises
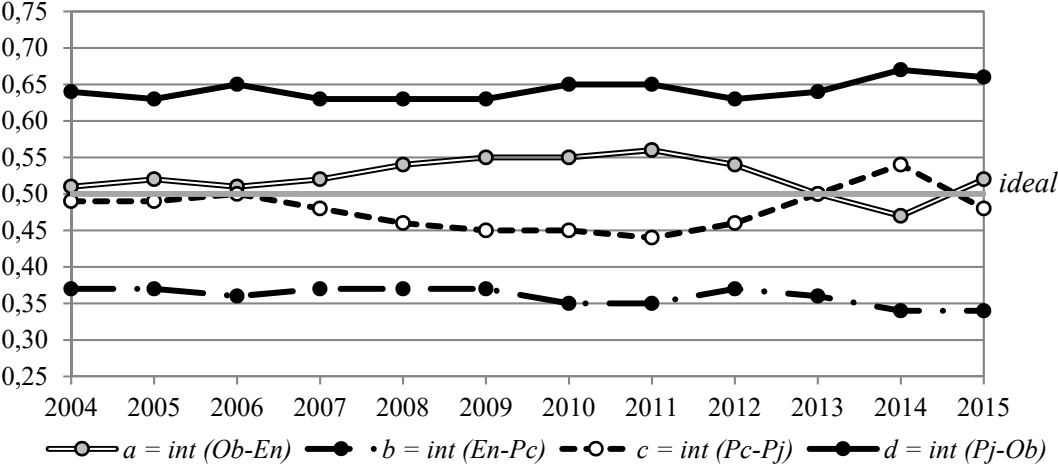
The indexes of intensity of the interaction between the subsystems became the basis for the evaluating of the index of system balance of the enterprises. So the value of a, b, c, d form a four-dimensional space, and the point S (a, b, c, d) in this space indicates the position of each enterprise in terms of its system balance. According to the specific of our methods, the system is balanced, when $a_0 = 0.5$, $b_0 = 0.5$, $c_0 = 0.5$, $d_0 = 0.5$. So the point S_0 (a_0, b_0, c_0, d_0) reflects the ideal position of completely sustainable enterprise.

Based on such considerations, normalized numerical value of Euclidean distance from the point S to the "ideal" point S_0, was evaluated. This value acts as index of system imbalance. The index of system balance, as the difference between the maximum possible value of the index of system imbalance and the one that had been calculated for each case, was determined. The results of the calculation are generalized in Fig. 6 (left scale).

Fig. 6. The dynamics of generalized index of system balance and integral indicator of financial stability for the group of analyzed enterprises
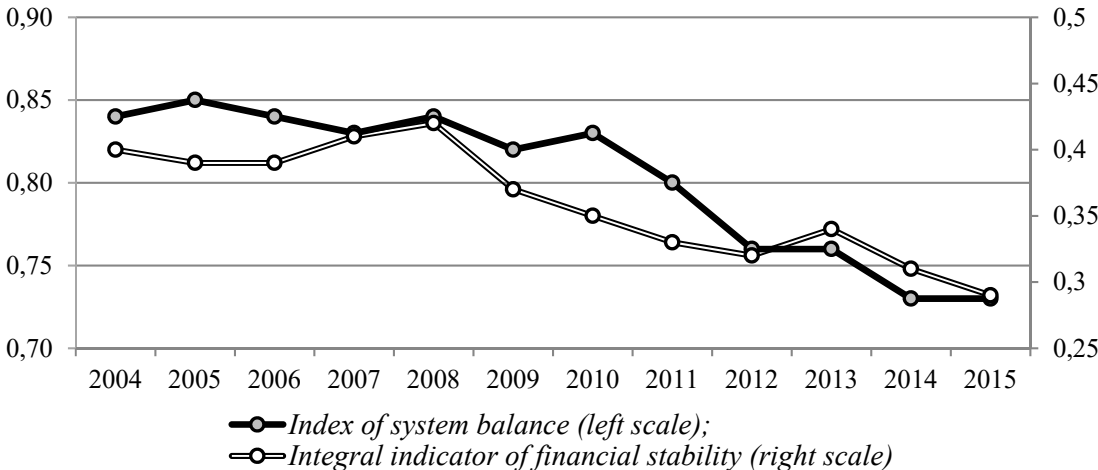
3.3 Determination of authenticity and the hypothesis verification

To determine the level of authenticity of obtained results and to verify the hypothesis we have conducted a correlation analysis of the statistical relations between the index of system balance and "traditional" financial ratios that are generally used as indicators of sustainable functioning of the enterprises (MFU, SPFU, 2001). For this purpose, it was necessary to conduct the financial ratios to a single integral indicator of financial stability. There are two possible approaches to do this: limiting the number of coefficients and performing correlation analysis of each of them or carrying out the convolution of a set of coefficients. We have selected the second through its relatively higher information value. The complexity of determining the range of acceptability of many ratios, which are interrelated and interdependent, caused difficulty of the indicator calculation. The range of acceptability and the dynamics of financial ratios are crucial, since the lack of financial stability could result in insolvency and the surplus might slow the development, burdening by the excess inventory and reserves – in either case, the economic sustainability of the enterprise is reduced. Therefore, for the convolution we have chosen the method of fuzzy logic.

The method was applied as follows. A clear set of financial ratios was limited to the fuzzy set of acceptable or unacceptable for the sustainability of the enterprise values. For this purpose each value of financial ratios was considered as linguistic variable defined in the entire range of possible fuzzy values with two terms – "acceptable value" and "unacceptable value". The fuzzy sets that meets these terms were defined based on existing regulations and expert recommendations. Membership functions of fuzzy sets were obtained using the Fuzzy Logic Toolbox for MatLAB R2012a. This is allowed us to obtain a single integrated indicator of financial stability. Its dynamics can be also seen on the Fig. 6 (right scale).

Our next task was to determine statistical relations between the generalized index of system balance and integral indicator of financial stability for the group of analyzed enterprises. Considering the fact that the values of both indexes belong to the interval type, their statistical correlation was assessed using Pearson coefficient. Pearson coefficient, calculated in terms of 2004-2015 is 0.901. Error correlation coefficient is 0.137. The value of t-criterion for the number of periods n = 12 (n – 2 = 10) is 6.562. It is corresponding to the probability of faultless prognosis p > 99.9%. This indicates that the correlation coefficient is statistically significant. Accordingly, we conclude that the statistical relationship between indicators is a linear, strong and reliable.

4 Discussion

The results obtained from the comprehensive application of Data Mining technology have allowed us to confirm the hypothesis that economic sustainability of the enterprise is caused by the level of balance of its four subsystems. If economic sustainability of the enterprise as the system is provided by the coherent implementation of functions by each of the four subsystems, then dis-functionality (deficit) or hyper-functionality (surplus) some of them, as well as their mutual imbalance, lead to the violation of the economic sustainability. And then causes of instability may be identified depending on the type of imbalance of enterprises' structure and relevant management techniques may be formed.

According to the analysis, fully balanced tetrad structure, which corresponds to

approximately equivalent severity each of the four subsystems at the enterprise and provides a high level of economic sustainability, has been observed in 19 of 192 cases – the frequency of its observation was 9.9%.

Unbalanced tetrad structure, when economic sustainability was lowered due to a significant deficit of processes subsystems, has been observed in 24 of 192 cases – the frequency of its observation was 12.5%. Unbalanced tetrad structure, when economic sustainability was lowered due to a significant deficit of environments subsystems, has been observed in 29 of 192 cases – the frequency of its observations was 15.1%. And unbalanced tetrad structure, when economic sustainability was lowered due to a significant surplus of objects subsystems, has been observed in 34 of 192 cases – the frequency of its observations was 17.7%.

Very unbalanced tetrad structure, when economic sustainability was significant lowered due to a simultaneous surplus of objects and projects subsystems and deficit of environments and processes subsystems, has been observed in 76 of 192 cases – the frequency of its observation was 39.6%. Very unbalanced structure, when economic sustainability was significant lowered due to a simultaneous surplus of objects and environments subsystems and deficit of projects and processes subsystems, has been observed in 6 of the 192 cases – the frequency of its observation was 3.1%.

The frequency of observation of other possible types of structures in the sample has been relatively low – not more than 1.0% each.

In general, across the sample deficit of processes subsystems has been observed in 51.0%, deficit of environments subsystems – in 43.8% of cases. Surplus of objects subsystems has been observed in 90.6% – these subsystems were more severe in most cases. The second more severe subsystems were the projects.

Based on the research, we have identified the general systems and structural types of imbalances, which are inherent to Ukrainian machine-building enterprises, and their signs. Surplus of objects subsystems is indicating the ineffectiveness of segmentation of enterprises' employees, their low workload, incoordination of departments, ineffectiveness of administrative and management activities and expenses and so on. Surplus of the projects subsystems primarily is indicating the ineffectiveness of innovation and investment activities at the enterprises, inefficient mechanism of selecting projects for implementation and their discrepancy to strategic priorities of the enterprises. Deficit of the environments subsystems is indicating the weakness of the organizational culture of the enterprises, high degree of uncertainty, unfavourable organizational climate. And deficit of processes subsystems is indicating the fragmentation, diminution of the main production activities of the enterprises and their low efficiency.

Surplus of objects subsystems simultaneously with deficit of environments and processes subsystems indicates that the situation which can be described as "surplus of labour under the deficit of qualification" is formed at the enterprises. This situation is not new, it has historically experienced by majority of countries, especially on the way of transition from one industrial technological structure to another (Gimpelson, 2007). But at the Ukrainian machine-building enterprises this situation has dragged on and become traditional.

Surplus of projects subsystems simultaneously with the deficit of processes

subsystems shows that despite the fact that the enterprises show a relatively high level of innovation and investment activity by their formal attributes, its impact and "benefit" for the main productive activity is very low. Because the innovations should meet the basic profile of the enterprises and their technological level or even raise it. But this is not happening.

Conclusion

We have confirmed the hypothesis, that economic sustainability of the enterprise is caused by the level of balance of its four subsystems with different spatiotemporal localization, by processing statistical data on 16 machine-building enterprises. Based on the author's techniques, the index of each subsystem was obtained, their mutual balance was evaluated and the balance index was derived. Then the received estimations were compared with an estimation of level of economic stability of the enterprise defined on the basis of financial ratios which are traditionally used as its indicators. The high level of correlation between these two assessments allowed us to conclude that such an approach is practically valuable and can be used to assess economic sustainability of other systems.

This research allowed us to identify the general system-structural patterns of the functioning of machine-building enterprises and explain many of the destructive processes that occur on them. The situation, which has been identified, as well as the neosystem methodology in general, requires further researches in two parallel directions. The first direction should be focused on the development of theoretical and methodological bases and techniques to managing economic systems, which are differentiated by the type of structure. The second direction should be focused on further elaboration of major theoretical and methodological principles of the paradigm and analysis of the sustainability of specific economic systems in its context. Both directions should be interconnected with each other.

Acknowledgement

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PUBLIC LIBRARIES´ SERVICES AND THEIR ECONOMIC EVALUATION

Veronika Linhartová, Jan Stejskal

Abstract: *The goal of public library is to meet the cultural, educational, and social demands and requests of local society by providing information services to their residents. Economic valuation of public libraries is being carried out more frequently in recent times. Since the mid-nineties researchers attempted to quantify the value of library services and asked users of these services for their opinions regarding the performance of public libraries. The economic value of public libraries for local residents in Czech Republic was measured in this paper. Data for the analysis were collected from 37 public libraries in the Czech Republic. The public libraries' benefit/cost ratio was calculated and it is 5,86 – 6,17 %. That means, for every $1.00 spent on analyzing Czech public libraries, provides on average $6.00 benefit value to taxpayers. The resulting value ($6.00) is quite comparable to results from similar studies conducted in other developed countries. It was also found that the library size does not affect the final value of the public libraries services, thus the efficiency of spent public funds is comparable in both large and small libraries.*
Keywords: *Contingent valuation, Public Services, Public Library, Return on Investment, Cost Benefit Analysis.*

JEL Classification: *E62, H41.*

Introduction

Effectiveness is currently increasingly becoming a discussed concept. In a market environment, the allocation of resources is consistent with the evaluation of economic performance and effectiveness of the activities of the business units. Penetration of market-based approaches into the public sector entails assessing the effectiveness of the activities of public sector organizations. Providers of public funds consider very carefully which organizations that should be allocated public resources for delivering public goods and services.

It is common ground that libraries are extremely valuable institutions providing broad mass of public services to their customers. The goal of a public library services is to meet the cultural, educational, and social demands and requests of local society by providing information services to residents (Ko et al., 2012).

Outcomes of public libraries are its benefits or services provided to its users (Vakkari, Serola, 2012). Their value is more complex in the public sector than in the private sector and can therefore be harder to measure (Bloch, Bugge, 2013). The public services provided by libraries are often referred to be a „hardly appraisable service". Generally, it is always difficult to quantify outcomes in the form of non-financial benefits, among which we can undoubtedly include also library services. In spite of this fact, the current state of international knowledge already provides methods for the quantification of these "hardly appraisable" services. Thereby methods for

evaluation of public performance, such as public library services are provided. Providers of public funds can gain valuable information for decisions making about the allocation of public funds. Common features of these existing approaches are that they were performed in limited number of developed countries.

The aim of this paper is to quantify the economic value of public libraries for local residents in the Czech Republic. The method of cost/benefit analysis (CBA) will be used, as it allows demonstrate the efficiency of public investments to public libraries.

1 Statement of a problem

Many international studies show that there are appropriate procedures that can define the output of public service and appreciate its usefulness for its users. The first approaches for evaluating library services appeared already in 1980 (Aabø, 2005; Holt, Elliot, Moore, 1999). All studies faced a problem of difficulty in measuring the output values of public service. It was found that the economic value is not a synonym to financial or business value. Trosby (2003) believes that it is a monetary expression of utilizable value of cultural goods or services which do not include non-market value.

Economic impact analyses usually use methods which are insufficient for evaluating the economic value of library services. Specific analytical methods must be used which result from analysis of utility coming from the provision of public service. Further, this utility has to be compared with costs that are spent on the realization. It is a kind of analysis similar to "return on investment" as the outcome is an approximate determination of a value which is created by spending one public monetary unit.

When determining the value of a public service, it is very difficult to express the monetary value of some provided services and express the utility of individual users and whole society. Presently, there are a number of approaches to determine the value of various impacts resulting from consumption of public services. Many of them are based on the availability of market valuation substitutes; another large group is based on the consumer's ability to determine the subjective value of consumed services.

Many economic studies on the value of public libraries use the contingent valuation method, which was developed in 1947 (Cummings, Taylor, 1999), to provide an estimate of the value of services when users receive those services for free. CV surveys ask users what they would be willing to pay for a service (WTP questions) and willing to get access elsewhere to the information resources they recently received from the library (WTA questions). This method allows researchers to calculate the average user-assessed value of access. The contingent valuation method is a widely used nonmarket valuation method especially in the areas of environmental cost (Venkatachalam, 2004), health care (Klose, 1999), public libraries (Stejskal, Hajek, 2015). CV principle is the basis of a method that is still used today in practice – contingent valuation method (CVM). The CVM is a survey-based technique generally accepted as a meaningful tool used to estimate the value of various nonmarket goods (Lee, Chung, 2012); it reflects altruistic motivation, a major component of non-use value in contingent valuation. This method gained popularity after the two major non-use values, namely, option and existence values have been recognized as important components of the total economic values (Venkatachalam, 2004). For methodology of

contingent valuation please see (Russell, Fox-Rushby, Arhin, 1995; Walsh, Greenshields, 1998).

1.1 Development of methods for assessing the value of public services

Methods of determining the economic value of public services can be further divided into two groups based on monitored services and library performance (Missingham, 2005).

The first group of used methods can be described as "study of efficiency" or study oriented on output. These studies determine value based on operational efficiency in the management of human and material resources. These types of evaluation analyze cost and demonstrate the outputs reached with used cost. By comparing those two variables, relative efficiency is shown.

Many providers of public services use benchmarking in this context. Thanks to the application of this method, management is able to compare results and improve processes continuously and thus realize cost-cuts Studies show that providers are able to effectively manage and use their financial resources. However, these studies do not provide managers or other interested parties information which directly demonstrates that they are offering and providing the right mix of services, or that they derived specific benefits from the existence of concrete public service.

The second group of the method brings a broader perspective on the value of public services. The methods used in these studies are trying (a) to determine the social value of providers and (b) to highlight the justification of the of public services provision existence, primarily for the owners (the political representation of the city, region, state and citizens - stakeholders). In this context, the balanced scorecard method is used. it provides concrete data that can be used to set targets and their subsequent evaluation.

The crucial shift can be seen in new analytical methods based on the use of contingent valuation method. These methods allow cost-benefit analysis (CBA) application or "return on public investment" (ROI) calculation (Carson, 2012; Marella, Raga, 2014). Both methods are now new. They are used to find the value of services by defining benefits and costs through consumer' perception of a good service.

1.2 The results of studies measuring the value of public libraries

Studies about the measurement of public economic value in the case of library services have been performed by the St. Louis Public Library, the State Library of Florida, Toronto (Martin Prosperity Institute, 2013) and the British Library (London Public Library, 2015). Diverse techniques for inducing value amounts have been used depending on the circumstances or research conditions for each library. Number of authors used auxiliary tools such as payment cards in their studies (Ko et al., 2012; Harless, Allen, 1999; Mcdermott 2002; Pyo, 2006). The British Library and other public libraries in the United States examined the amount of the WTP by asking open questions (Holt, Elliot, Moore, 1999; OECD, 1996). The split-sample method was used by (Aabø, 2005) with two value elicitation question formats to minimize sampling and to correct the elicitation method' effects. The following studies present the results of cost-benefit methods (B/C ratio or ROI) of public library services.

One of the newest researches from the area of public library services and their performance was carried out in Florida (Haas Center, 2013). It is also the largest research, because they started with the pilot project in 2004, continued in 2008 and the last one was in the year 2013. The total value of ROI was $6.54 dollars per $1 of libraries expenses in 2004, $8.32 per $1 in 2008 and $10.18 per $1 in year 2013. In other words, taxpayers in 2013 invested $496 million, but received an economic benefit of approximately $5.55 billion. It follows that during the eight years there has been an increase in ROI of 3.64 dollars, which is an increase of 55%.

One of the last researches was made in the U.K. in 2015 (London Public Library, 2015). The results of London' Public Library's economic impact study clearly demonstrate that London' Public Library delivers a strong Return on Investment. Through the delivery of library services that enhance London's competitiveness and prosperity to contribute to a better quality of life for all. For every dollar invested, Londoners received $6.68 in value.

Studies about the measurement of value for the users of public libraries, all around the world, are shown in table 1, as well as the methods which were used and the values of effectiveness for each library. Overall, the taxpayer's return is calculated to be $ 2,3-10.18 for every $1.00 invested during the period 2006 and 2015. Another study was made in 2015 but it was in University Library in Syracuse, where the economic and environmental value shows $ 4.49. Probably one of the newest studies made in 2016 in the Malaysian technical university library proved the libraries' value to be $ 1,28. But these academic libraries have different types of financing, so for this reason it was not included in the studies shown in Table 1.

Tab. 1: Review of studies dealing with the determination of the value of public libraries in the years 2006 – 2015

Year	Place/country of research	Methods	Result (in $)
2006	Pittsburgh	ROI	3,09
2008	Florida	ROI	8,32
2008	Illinois	ROI	4,38
2009	Colorado	ROI	4,99
2011	Victoria	B/C	3,56
2012	Queensland	B/C	2,3
2012	Lithuania	B/C	5,77
2012	Korea	ROI	3,66
2013	Florida	ROI	10,18
2013	Toronto	ROI	5,63
2015	London	ROI	6,68

Source: own processing according to Stejskal et al. (2013)

2 Methods

Cost-benefit analysis (CBA) is the most used means of characterizing the benefits that accrue to communities when they provide tax support to public libraries. The sense of CBA is to quantify and compare total benefits (of both library users and the whole society) and costs of public libraries on providing individual services. While

costs are easy to calculate, benefits are not. From the economic point of view, this CBA represents a standard method to measuring the net economic surplus from market goods or services (Aabø, 2005, 2009).

Input data - costs for providing evaluated portfolio of the public services - into the cost/benefit analysis were obtained from the accounting system of every library. Output data – utility are measured by CV method. It depends also on the number of customers, number of book loans etc., which were obtained from the KULT report (normalized statistical statement generated from every library in the Czech Republic). In CBA we are evaluating also the measurement of secondary economic impacts, the library's impact on the rest of the economy can be also calculated, e.g. its contribution towards employment, income, consumption expenditures, and state or local government revenue in the form of taxes. Economic impact studies are an established methodology in economics (Aabø, 2009).

CBA method has much strength for which it was chosen for the analysis. CBA allows defining all the benefits and costs of implemented actions. Secondly, CBA should show broad consequences (positive or negative) that impact on the whole group of consumers or even the whole society. The final reason for using CBA is due to the fact that it is as objective as possible. It does not permit the inclusion of some benefits or cost. It represents a "democratic element". To ensure objectivity, the whole process must be transparent and can be communicated with the whole public. Method solves so-called well-being and contributions of various projects to increase it.

3 Problem solving

Public libraries play an essential role throughout the communities in which they operate. Though traditionally considered havens for recreational readers, today's libraries have expanded their roles by providing information and community services. Public libraries have become centers of emerging technologies, offering vast array of Internet resources, access to technological equipment and hours of technological instruction for the public. In addition to material resources, public libraries offer guidance, expertise and support through the army of library staff that serve residents throughout the state.

An economic value measurement model that enables the estimation of diverse types of public library services was designed, using a contingent-valuation measurement method. Benefits were taken as the value of the main services provided by public libraries, such as accessibility to informational materials, facilities and programs. Costs included the total amount of expenses at libraries such as personnel expenses, materials purchasing expenses and other operational costs.

3.1 Data Collection and Pre-processing

With the survey of the project "*Methodology of measuring the value of library services*" in 2011, selected Czech libraries began to be evaluated from the point of view of their effectiveness.

The respondents were only readers of the Municipal Library in Prague (MLP). The total number of members of the panel questionnaire was the 1061 (answered only 374). Individual respondents were randomly selected from a panel of readers aged 15+. The question forms were sent out during October and November 2011 by the intranet of MLP.

During the year 2012 another empirical survey was realized. The qualitative and representative survey was conducted in July and August 2012 with the help of an on-line questionnaire (CAWI). 11,397 randomly selected readers of the MLP library were addressed. These readers were older than 15 years, said in their application an email and they used of library services in the last quarter before receiving the questionnaire. Return of the survey was 20 %, after cleaning the data file which consisted of a basic set of 2,227 respondents.

Evaluating the effectiveness of libraries within the project *"Lucky number for the library"*, followed the previously mentioned projects of MLP. The data obtained from the service users has been applied to calculate the CBA in 37 libraries in the Czech Republic in the period 2012 - 2014. It is probably the most comprehensive study looking at this issue in Central and Eastern Europe.

Ways of putting questions were similar to those from foreign studies, which used the mentioned methods WTA and WTP to determine respondents' opinions on the value of library's services. Part of the questions was conceived independently of the contributor (Stejskal et al., 2013). The questionnaire determining the perceived value of selected services provided by the library was first subjected to pilot testing so that individual questions were understandable for readers and the questions were able to be answered. At the same time, it was drawn up so that neither the way questions were phrased nor their order influenced the readers; this ensured a high degree of predicative ability and that the valuation obtained for the individual services would be realistic. The experiences published by (Venkatachalam, 2004) were used here.

WTP and WTA questions inquiring the value of public library services to the respondents were:

Question 1a): If you consider borrowing, information or other services you have received or used during your last visit, did library save your money?

Question 1b): How much money did the library save to you?

Question 2: If you had no access to the library, will it complicate your life somehow?

Question 3: How much would you have to pay in case you cannot use the library and have to use any other alternative. (Add please e.g. travel cost, price for access to materials etc. for the whole year.)

Also questions on tax assignation, which allows hypothetically decide how to use taxes paid by the respondent, were included into the questionnaire:

Question 4: If you could pay less tax by the annual contribution paid to the library, how much would you be willing to contribute to the library?

Question 5: If it would be possible, how much of 10,000 CZK paid on taxes would you give on the annual contribution to your library?

3.2 Cost-benefit analysis of Czech libraries

The CBA analyzes were categorized into the size of library. All libraries were divided into three groups depending on their number of registered users: large (70.38 % of total registered users), medium (19.74 %) and small (9.88 %) libraries. Data regarding the registered users as of December 31st, 2014 were obtained from the KULT report of each library. The results of estimating the CBA by library size are shown in Table 2. The B/C 2014 of large libraries was 6.17, the CBA 2014 of medium sized libraries was 5.86 and the B/C 2014 of small libraries was 6.07. The B/C value of medium-sized libraries was the highest. However, the analysis shows that there is no big difference in the B/C values due to the difference in library size.

As a result of measuring the total value of public libraries in the Czech Republic in the CVM, the final B/C ratio for the year 2014 was estimated as 6,03. This result is comparable to the values of studies all over the world (see Table 1).

***Tab. 2: Diversification the value of B/C 2014 by library size***

Library size	Total number of registered users	Avg B/C
Large (13)	199123 (70.38 %)	6,17
Medium (12)	55832 (19.74 %)	5,86
Small (12)	27958 (9.88 %)	6,07
Total (37)	282913 (100.00 %)	**6,03**

Source: own processing

For the graphical interpretation of the examined variables we used the so-called Bag plot created in Statistica program. Bag plot is a generalized two-dimensional graph, which serves the graphic interpretation of statistical data. Points in the graph represent a combination of dependent and independent variables of individual countries. Dark blue area (i.e. Bag) contains 50% of surveyed countries (between the first and third quartile) and dark blue square represents the median values of the examined countries. Light blue exterior bag contains other rated states that achieve different values than countries in the dark blue field, but are not outliers. Outside of this area there are outliers that are shown in the chart with small stars. Bag plot shows the relationship between the evaluated variables indicated by the orientation of the bag (positive slope of bag indicates a positive relationship between the evaluated variables and negative slope of bag suggests the negative relationship).

Figure 1 shows a bag plot of examined libraries. On the x-axis there are the numbers of registered users and on the y-axis there are the B/C values. Bag plot in Figure 1 shows that the size of the library, according to its registered users, does not affect the value of B/C value. The efficiency of the library is not affected by its size.

Fig 1: Bag plot chart with relation between the value of B/C 2014 and registered users
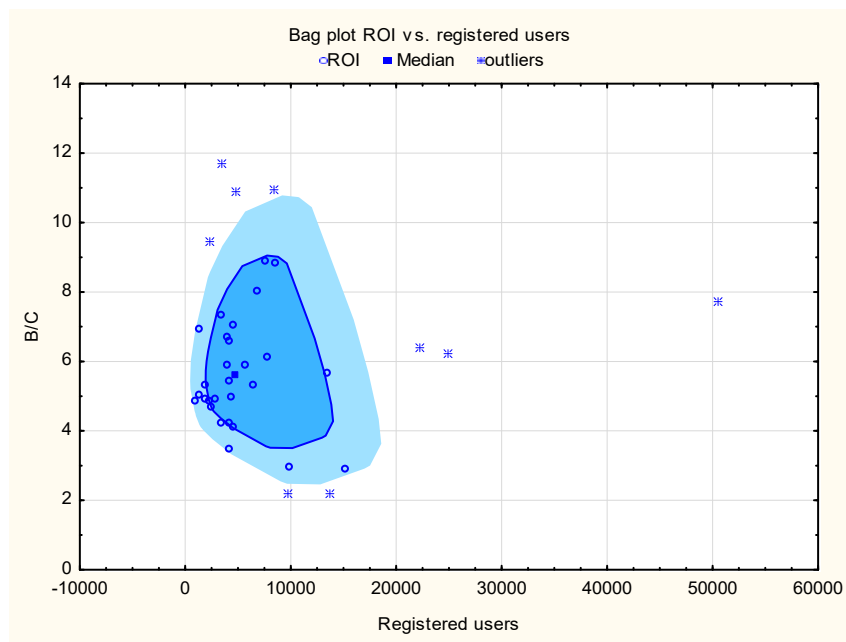
Source: own processing

Figure 2 shows the differences in the result values of analyzed 37 libraries in the years 2012, 2013 and 2014. The median in 2014 compared with previous years decreased; therefore there are smaller differences in reached B/C ratio of analyzed libraries.

Fig 2: Chart with median diferences between the years 2012 - 2014
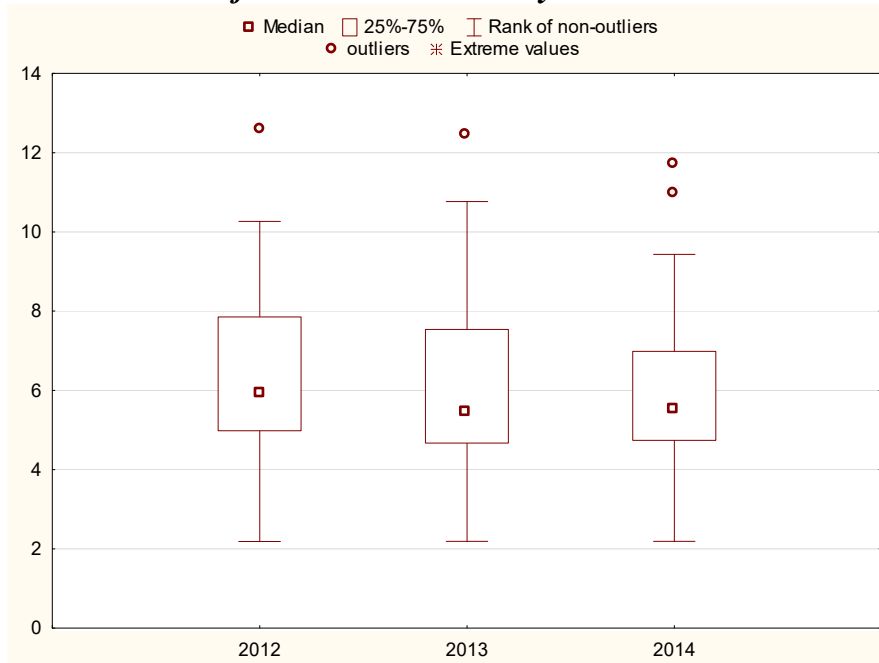
Source: own processing

Outliers in the graph represent libraries that received significantly higher ratings than others in the reporting year. From the graphical representation, it is clear that some Czech libraries reached B/C values even higher than 10 or 12.

This significantly higher value of B/C achieved libraries, regardless of their size. In these exceptionally evaluated libraries we can find small, medium and large libraries as well. Such a finding merely confirms that the resulting value of B/C does not depend on the size of the library and even a small library with a low number of users can produce the same value of public service as the big ones.

Discussion

The significance of the existence of public libraries and their influence on the economy of a particular region and the whole state can be documented by added value which the libraries create and by their activities which influence the society. Measuring the value of public libraries service requires a broad a considerable attention.

Czech libraries began to be evaluated from the point of view of their effectiveness in 2011, when the project "Methodology of measuring the value of library services" started. The "Lucky number for the library" project continues until today and is the only project providing valuable data needed to quantify the value of Czech public libraries services. The mentioned project has more and more participants from the libraries themselves every year. That means that the management of participating libraries realizes the importance of evaluating their performance. The project brings the Czech public libraries closer to foreign libraries whose effectiveness and activities have long been evaluated for many years. Despite the significant time delays, Czech libraries got very positive results.

The results of analyzed foreign studies confirm that public libraries generate public services within the range of values $ 2.3 -10.18 for every $1.00 invested during the period 2006 and 2015. In 2014 Czech libraries generated $ 6 for every $1.00 invested. Conclusions of the analysis are consistent with many foreign surveys, e.g. (Haas Center, 2013; Ko et al., 2012; London Public Library, 2015; Martin Prosperity Institute, 2013; Pyo, 2006).

Thus, thorough and continued management is required in order to maintain the accuracy of statistics on public libraries, including statistics on the use of public libraries. Furthermore, strategic endeavors are needed that help make subsequent more precise studies by subcategorizing statistical categories.

Conclusion

The methodology of Cost/benefit analysis calculation for public service systems is a very valuable tool for regional providers of public services and their investments. It will no longer be a question of making standard decisions under conditions of high uncertainty, applying this methodology will reduce the uncertainty.

Libraries feel increasing pressure to demonstrate their value to their communities. These institutions face a greater competition, rising costs, lower budgets and greater pressure to demonstrate their success. The value demonstrated by a Cost/Benefit study

can be leveraged within the institution to advocate for the library budget. It can also reveal the relative effectiveness of library services contributions toward institutional outcomes, determining which should be prioritized or improved.

In the international standards IFLA, libraries are categorized according to the number of titles, size of area etc. None of the IFLA standard does sort public libraries according to the number of registered users. Performed analysis showed that the value of B/C in the analyzed 37 Czech libraries with different numbers of registered users does not differ. The analysis thus showed that the efficiency of the library is not affected by the number of users. For a library with a small number of readers, every $1.00 spent brings back to the taxpayers almost the same amount like a "big library". The resulting total value of 6.03 is quite comparable to results from similar studies conducted in other developed countries.

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ON THE INCONSISTENCY OF PAIRWISE COMPARISONS: AN EXPERIMENTAL STUDY

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Abstract*: A problem of the inconsistency of pairwise comparisons is of focal interest in the analytic hierarchy process (AHP), but, up to date, we know only little about how much are real decision makers inconsistent, and whether the number of objects to be compared influences the inconsistency of their judgments. Therefore, the aim of this paper is to experimentally assess how the inconsistency of pairwise comparisons in the AHP framework changes when the number of objects to be compared (alternatives and/or criteria) increases. In our study, the method of a blind experiment was selected: subjects of the study, who were familiar with the AHP, were instructed to pairwise compare from 3 to 7 objects not knowing the true objective of the study. The main result obtained via ANOVA method is that the consistency ratio was not affected by the increasing number of compared objects, the result that might be likely attributed to the apparent redundancy of pairwise comparisons in the AHP which "corrects" inconsistent judgments. Also, it was found that only 3% of pairwise comparison matrices provided by decision makers were fully consistent, while for 36% of pairwise comparison matrices the consistency ratio CR exceeded the threshold of 0.10.*

Keywords*: AHP, consistency index, consistency ratio, experiment, inconsistency, pairwise comparisons.*

JEL*: C44, C92.*

Introduction

Pairwise comparisons as a tool for a decision making or a measurement were already considered in the works of Franciscan tertiary Ramon Llul, see (Llul, 1275) or Marquis de Condorcet, see (Condorcet, 1785). The theory of pairwise comparisons was provided for the first time by L. L. Thurstone in 1927, see (Thurstone, 1927).

Since the early 1980s, the pairwise comparisons became the central point of the analytic hierarchy process (AHP) and the analytic network process (ANP) introduced by T. L. Saaty along with his fundamental scale for pairwise comparisons ranging from 1 to 9 (Saaty, 1980 and 1989). AHP/ANP proved to be a useful tool in many areas of human action where a multiple criteria decision making is involved, such as economics, management and marketing, construction, medicine, politics, environmental protection, etc. An overview of the AHP/ANP applications can be found e.g. in (Zahedi, 1986), (Vargas, 1991 and 2001) or (Vaidya and Kumar, 2006). The latter paper alone provides a list of more than 150 papers on application of the the analytic hierarchy process.

Pairwise comparisons of more than two objects give a rise to the problem of inconsistency of these comparisons. If, for example, comparing objects A, B and C, an

expert may say that A is two times better than B, and B is three times better than C. Then, A should be exactly six times better than C by a transitive property. In such a case pairwise comparisons are considered *consistent*. Any value different from six would mean *inconsistency*.

To measure inconsistency of pairwise comparisons, (Saaty, 1980, 1989, 2004 and 2008) proposed to use his consistency index (*CI*) and consistency ratio (*CR*) (see hereinafter). Later, many other indices were proposed, see e.g. (Koczkodaj, 1993), (Alonso and Lamata, 2006), (Brunelli and Fedrizzi, 2015), (Koczkodaj and Szybowski, 2016) or (Mazurek, 2016). Recently, various comparative studies on inconsistency indices emerged, see e.g. (Brunelli et al., 2013), (Kazibudzki, 2016) or (Mazurek, 2016). In the last years, the study on inconsistency of pairwise comparisons focused mainly on the problem of axiomatic properties of inconsistency indices in general, see e.g. (Koczkodaj and Szwarc, 2014), (Brunelli and Fedrizzi, 2015) or (Mazurek, 2016)

However, there is a problem dealing with the pairwise comparisons which was not studied so far: is inconsistency growing when the number of compared objects, for example alternatives or criteria, is getting larger? Is it simpler (or more common) for a decision maker to be consistent when comparing only a small number (3 or 4) of objects rather than a large number (5 and more)?

Therefore, the aim of this paper is to experimentally assess how the inconsistency of pairwise comparisons changes when the number of objects to be compared increases. In our study, the method of the blind experiment was selected: subjects of the study were instructed to pairwise compare from 3 to 7 objects not knowing the true objective was to infer the consistency index and the consistency ratio from their evaluations (both values were inaccessible during the experiment).

The paper is organized as follows: in section 1 the analytic hierarchy process and pairwise comparisons are briefly described, in section 2 the experiment setting and its results are provided, and conclusions close the article.

1 The analytic hierarchy process, pairwise comparisons and inconsistency

In the AHP, objects are organized into a hierarchy with a goal on the top, and criteria and alternatives in the following lower levels. All objects from the same level are considered independent, and are pairwise compared with regard to a superior element of a hierarchy on the so called Saaty's fundamental scale from $\{1/9, 1/8, ..., 1, ..., 8, 9\}$, where $s_{ij} \in \{1/9, 1/8, ..., 1, ..., 8, 9\}$ expresses relative importance of an object *i* with respect to an object *j*, see Table 1.

Tab. 1: Saaty's fundamental scale

Intensity of importance	Definition
1	Equal importance
2	Weak or slight
3	Moderate importance
4	Moderate plus
5	Strong importance
6	Strong plus
7	Very strong importance
8	Very, very strong importance
9	Extreme importance

Source: (Saaty, 2004).

In the AHP it is assumed the pairwise comparisons s_{ij} are *reciprocal*:

$$s_{ij} = \frac{1}{s_{ji}}, s_{ii} = 1, \forall i, j .$$

(1)

A reciprocal matrix S (s_{ij}), the so called *pairwise comparison matrix*, is formed:

$$\begin{pmatrix} 1 & s_{12} & \dots & s_{1n} \\ s_{21} & 1 & \dots & s_{2n} \\ \dots & \dots & 1 & \dots \\ s_{n1} & s_{n2} & \dots & 1 \end{pmatrix}$$

Then, weights w of all objects (criteria and alternatives) are usually determined by Saaty's eigenvalue method as the principal right eigenvector w of the matrix S (Saaty, 1980, 1989, 2004 and 2008):

$$Sw = \lambda_{\max} w,$$

(2)

Also, several other methods for deriving weights from a pairwise comparison matrix were proposed, such as the geometric mean method (the least logarithmic squares method), which gives the same vector of weights in the case of $n = 3$, but slightly different vector for the larger n.

The aggregation of preferences proceeds as follows: let the weight of the i-th criterion be v_i and the weight of the j-th alternative with respect to a criterion f_i be $w_j(f_i)$, then the overall weight E_j of j-th alternative (in a three level hierarchy) is:

$$E_j = \sum_{i=1}^{m} v_i \cdot w_j(f_i),$$

(3)

where $j=1, 2, ..., m$.

At the end, all alternatives are ranked according to their value of E_j.

Pairwise comparisons are *consistent*, if and only if the following condition is satisfied:

$$s_{ij} \cdot s_{jk} = s_{ik}; \forall i, j, k$$

(4)

However, decision makers are seldom fully consistent in their judgments, so the following measures of consistency, the consistency index *CI* and the consistency ratio *CR* were proposed (Saaty, 1980,1989 and 2004):

$$CI = \frac{\lambda_{max} - n}{n - 1},$$ (5)

$$CR = \frac{CI}{RI},$$ (6)

where *n* in (5) is the order of a pairwise comparison matrix, and *RI* in (6) is the so called *random consistency index*, its values are provided in Table 2.

It should be mentioned that values in Table 2 were obtained via Monte Carlo simulations (a generation of a large number of random matrices of a given order) by Saaty, but other authors claim to obtain slightly different results, see (Alonso and Lamata, 2006).

According to (Saaty 2004 and 2008), the acceptable degree of inconsistency is if *CR* is smaller or equal to 0.10. If this condition is not met, a decision maker is asked to revise his or her judgments. However, this "rule of thumb" was criticized by some authors, see e.g. (Dyer and Forman, 1992) or (Koczkodaj, 1993).

During recent decades, the AHP was extended to the fuzzy AHP or interval AHP to encompass uncertainty often present in a real-world decision making, see e.g. Buckley (1985), (Demirel et al. 2008), (Ramík and Korvíny, 2010), (Zadnik and Groselj, 2013) or (Ramík, 2016).

For the number *n* of compared alternatives with respect to a given criterion there is $\binom{n}{2} = \frac{n(n-1)}{2}$ pairwise comparisons. Hence, for larger *n* the task of comparisons becomes more tedious and time consuming.

Moreover, according to the pioneer study of (Miller, 1956), a human brain is capable of processing only up to 7 pieces ("chunks") of information at the same time. This indicates that the more alternatives are compared, the more inconsistent these comparisons will be. Nevertheless, the proof for this claim is missing, as there are no studies known to authors investigating the issue.

Tab. 2: Random consistency index (RI)

number of alternatives	1	2	3	4	5	6	7	8
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41

Source: (Alonso and Lamata, 2006).

2 The experiment

2.1. Experiment setting

The experiment was conducted on 42 students in a role of decision makers, including 32 women and 10 men of the undergraduate course "The decision analysis

for managers" who were familiar with the AHP. The experiment took place in a computer classroom.

Decision makers were instructed by a teacher to pairwise compare from 3 to 7 alternatives of a fictional problem not knowing the true objective of their task: the evaluation of consistency of their pairwise comparisons (the values of *CI* and *CR* were not available to the students during the experiment).

Each decision maker acted independently and utilized DAME (*Decision Analysis Module for Excel*) software, which is the free Excel built-in module substitution of commercial products for the AHP. DAME offers two-language environment (Czech and English), and it is constructed for the 3-level hierarchy: goal-criteria-alternatives. The use of DAME is described in a more detail in (Ramík and Perzina, 2014).

To conclude, each and every decision maker (a student) provided one $3{\times}3$ pairwise comparison matrix, one $4{\times}4$ pairwise comparison matrix, and so on, with the $7{\times}7$ pairwise comparison matrix being the last.

2.2. Results: descriptive statistics

Every decision maker (DM) pairwise compared from 3 to 7 alternatives, so 210 pairwise comparison matrices were constructed in total.

Only in 5 cases (2.4% of all cases) DMs were fully consistent (their *CI* = 0), in 205 cases (97.6%) they were inconsistent. Furthermore, 134 (64%) pairwise comparisons matrices had the consistency ratio *CR* smaller or equal than 0.10, for the remaining 76 (36%) pairwise comparison matrices the consistency ratio *CR* exceeded the value of 0.10, so, in practice, decision makers who provided these matrices would be asked to revise their judgments.

Average values of *CI* and *CR* of all 42 DMs and for 3-7 alternatives are provided in Table 3. Moreover, Table 3 provides the number of DMs with consistency ratio smaller or equal to 0.10, the inconsistency still acceptable according to Saaty. As can be seen from Table 3, the consistency ratio was rather decreasing with the increasing number of alternatives, and the number of DMs with *CR* up to 0.10 was increasing.

2.3. A correlation between *CR* and the number of alternatives

The correlation between *CR* and the number of alternatives (k) was examined via Pearson's correlation coefficient: $r = -0.836$, indicating indirect proportionality between *CR* and k.

Statistical significance of the value r was examined via t-test as well:

The null hypothesis H_0: $r = 0$.

The t-statistics $t = \dfrac{|r| \cdot \sqrt{n-3}}{\sqrt{1-r^2}} = 2.64$ (where $n = 5$) was compared with the critical value for $\alpha = 0.05$: $t_{crit.} = 3.18$. The result is that the null hypothesis cannot be rejected.

Hence, the correlation coefficient is not statistically significant at 0.05 level. This outcome was rather expected due to the very small sample of 5 pairs.

2.4. ANOVA analysis of *CR*

To find whether the number of alternatives was a factor behind the changes of the consistency ratio *CR*, one-way ANOVA (analysis of variance) method was employed.

The method divides the variance into two parts, into treatments $S_{y,m}$ and error $S_{y,v}$ parts, and their comparison via F-test with $k - 1$ and $n - k$ degrees of freedom, where k denotes the number of values of a given factor (in our case $k = 5$), and n denotes the total number of cases ($n = 210$).

The null hypothesis H$_0$: *The mean value of CR for all k is equal.*

The F-test with the values $S_{y,v} = \sum_{i=1}^{k}\sum_{j=1}^{n_i}\left(y_{ij} - \overline{y}_i\right)^2 = 15.42$, $S_{y,m} = \sum_{i=1}^{k} n_i\left(\overline{y}_i - \overline{y}\right)^2 = 0.678$, $n = 210$ and $k = 5$ yields:

$$F(4,205) = \frac{\dfrac{S_{y,m}}{k-1}}{\dfrac{S_{y,v}}{n-k}} = 2.25 \,. \tag{7}$$

The value of the test criterion (7) is (slightly) lower than the critical value $F_{0.05}(4,205) = 2.37$. Therefore, the null hypothesis that the sample means for 3-7 alternatives are equal cannot be rejected at 0.05 level. In other words, the effect of the number of alternatives on consistency ratio *CR* was not confirmed.

Tab. 3. The results of the experiment: the last three columns give the number of pairwise comparisons matrices satisfying given values of CR.

Number of alternatives	Average *CI*	Average *CR*	*CR* > 0.1	*CR* ≤ 0.10	*CR* = 0
3	0.1376	0.2373	19	23	3
4	0.1085	0.1206	17	25	1
5	0.1075	0.0960	14	28	0
6	0.1270	0.1024	14	28	1
7	0.10033	0.0782	12	30	0

Source: authors.

Conclusions

The aim of this paper was to investigate the inconsistency of pairwise comparisons provided by decision makers for different numbers of compared objects (alternatives) in a blind experiment.

Somewhat surprisingly, the inconsistency measured in terms of the consistency ratio *CR* was not statistically significantly increasing with the growing number of alternatives. By the ANOVA method, the influence of the number of alternatives on *CR* was not found significant at 0.05 level. The correlation between *CR* and the number of alternatives was not statistically significant either.

Perhaps the most surprising result of the study is that out of 210 pairwise comparison matrices provided by decision makers and examined in this study, only 5 were completely consistent. This inconsistency is understandable for 6 or 7 alternatives, when decision makers provided 15 and 21 pairwise comparisons

respectively, the numbers well above the "magical number 7" threshold found in the study of (Miller 1956), who states that humans are only capable of handling up to 7 pieces of information at one time. Otherwise, the so called "cognitive overload" makes it impossible to process information correctly. In this study, however, even in the case of only 3 alternatives, when decision makers carried out just 3 pairwise comparisons in total, astonishing 93% of decision makers were inconsistent. Therefore, this outcome indicates some other explanation of inconsistent judgments is needed. Perhaps, the consistency defined by relation (4) is too strong for a practical use, and might be substituted by a simple transitivity of preferences (if A is better than B, and B is better than C, then A is better than C).

Further research may focus on more than 7 alternatives, and the research sample could be expanded. Also, the examination of other measures of inconsistency (than *CI* and *CR*), such as the inconsistency proposed in (Koczkodaj, 1993), would be useful. Another interesting possibility is to examine whether the inconsistency depends on the gender, which couldn't be examined in this study due to the limited sample of decision makers.

Acknowledgments

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REQUIREMENT ANALYSIS OF AGILE INFORMATION SYSTEMS AND BUSINESS PROCESSES: AN AGRICULTURAL CASE STUDY

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Abstract: The development of modern information systems is demanding and characterized by agility. Consequently, the extensive requirement analysis of these systems and the supported business processes has become vital for analysts, developers and the participating stakeholders. Use Cases are tested tools for analyzing the requirements of information systems. However, the difficulty in capturing use cases has triggered the proposal of methodologies which can derive use cases from business models. Nevertheless, modern agile information system development demands the reverse transformation as well. The current paper proposes the latter transition for analyzing business process requirements and describes it via a computer based pest scouting business process case study. The target business model for depicting business process representation workflows is the Business Object Relation Modeling method. The agricultural case study was selected because both the Business Object Relation Modeling method and the Use Case method have been already proposed for agricultural, food supply and environmental business process representation, and they are both easily comprehensible by all the involved stakeholders including farmers, growers and agronomists.

Keywords: Use Cases, Business Object Relation Modeling (BORM), Use Case To BORM Transformation Algorithm (UCBTA), Pest Scouting, Business Process Models.

JEL Classification: M15, Q16.

Introduction

Modern information and communication technologies, hereinafter ICT, are applied to the majority of scientific domains. Agriculture, and especially the pest management domain, is one of the fields where the adoption of ICT tools is a necessity. When information systems are developed in order to be utilized in executing agricultural processes, a commonly understandable methodology between IT experts and agricultural practitioners is highly demanded during the requirement analysis phase of the developed systems. An ideal way for information sharing between IT specialists and domain experts is via conceptual models. According to Cakula et al (2015) conceptual schemes consist of data structures, which depict classes of objects, their relations, restrictions and characteristics.

Another way to merge ICT concepts to the execution of agricultural processes is the depiction of the latter through easily comprehensible business process models. Thus, an ideal approach to implement domain knowledge sharing is the incorporation of business process models which have also recommended as ontological tools to analyze ICT based business processes. The Business Object Relation Modeling (BORM) approach is one of these proposed theories. Pergl (2011) analyzes BORM from an ontological point of view. However, even if the BORM business process

modeling solution has already been applied in agricultural and environmental sciences, a strong requirement documentation method, such as the Use Case approach, is a prerequisite before depicting the relative workflows.

The main goal of the current work is the depiction of a modern approach to analyzing requirements of ICT based processes by transforming Use Cases into BORM through a case study from agriculture and a software application developed by the author for this purpose. The transformation is achieved through an algorithmic procedure which has its roots in the finite automaton theory (Cooper, 2004).

An explanatory case study from Integrated Pest Management, namely pest monitoring, is used to demonstrate the functionality of the approach. The specific domain was selected since the agricultural, food and environmental business systems are specially such cases, when we need 'smart' modelling tools, because processes and data are instantly changing and modifying through the whole life cycle of such systems (Molhanec et al, 2011).

First partial goal of the paper is related to the promotion of the agile software development techniques for such scientific domains as the agriculture. The more active is the end users' participation during the whole software development process the more efficient the final software solution will be. Second partial goal is to enhance the software engineering skills of the end users and contribute to the amelioration of their communication with IT developers and experts. Final partial goal of the current work is the achievement of an in depth requirement analysis of software based pest management tasks even by domain users with limited computer skills.

1   State of art – Problem statement

Automation in agriculture and towards the protection of cultivations is a critical issue for today's global economy. Multiple experts have proposed modern software tools for protecting plants from pest infestations. In a recent study (Sharma et al, 2014) an ICT based management system for sustainable pulse production in India is delineated. The authors of the same study state that ICT based technologies are helpful in making quick decisions in order to apply appropriate plant protection measures as per level of pest infestation.

Moreover, multiple software requirement analysis methodologies have been proposed as assisting tools throughout the development life cycle of such applications. The BORM method has been proposed for the modeling of agricultural and environmental ICT based processes (Merunka, 2003, Nedvedova, 2015). Furthermore, the use case approach has also been applied to model agri-food supply networks (Lehmann et al, 2010). The specific approach is another widely accepted method towards the analysis of system requirements and is an important part of the Unified Modeling Language (UML).

Cruz et al (2014) state that a popular way to capture and describe those requirements is through the UML use case models. Thus, a possible combination of both the aforementioned methods, with Use Cases as a prerequisite, can lead us to an ideal and without gaps requirement analysis procedure. In the same study (Cruz et al, 2014) the authors underline that multiple experts have so far attempted to derive use cases from business process models. The main reason for attempting these

transformations is the difficulty in successfully identifying use cases from scratch. These efforts, even though they follow the opposite direction from the approach used in the current paper, also reveal a possible gap in analyzing requirements using only use cases or business process models.

The currently proposed method enhances the BORM business model through standard use case requirements documentation and covers the missing workflow depiction in the use case model via BORM. Through the specific algorithm, which has never been proposed by any other expert so far, a business model is generated from use cases. This attempt is considered to be highly significant by the author since IT projects include several iterations which may force developers and analysts create business process models from use cases. Dietz (2003) underlines that the use cases' strong point is that once they are identified the development of the software application goes well.

Furthermore, the derivation of the business process model from the use case method is achieved through a specific software tool developed by the author. The tool is entitled UCBTA Projects and its delineation is beyond the scope of the present paper. The incorporation of a user friendly software application that can efficiently infer a business process model from use cases can prove to be time – saving, effective and more suitable for non-experts and end-users.
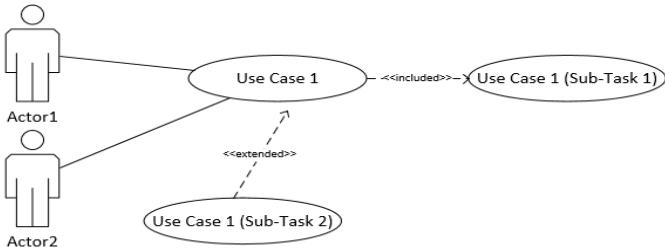
2 Methods

2.1 The UML Use Case Model

Use Cases have gained widespread acceptance as a means to describe interactions between a system and its environment (Neill, 2003) .The concept of Use Cases was first introduced by Ivar Jacobson in 1987 as a tool for modelling functional requirements (Jacobson, 2003). Hoffmann et al (2009) mention that the so-called use case model is actually a composite model consisting of two parts. One part is a UML model, capturing the use cases and their relationships, the other part is a set of textual descriptions of the behaviour represented by these use cases (Hoffmann et al, 2009).

On the one hand, the UML model is defined by the Use Case diagram (Figure 1). The Use Case diagram is a graphical representation of a process and completes its textual delineation. The diagram clearly depicts the actors, associations, the use cases and the possible extensions of each use case. On the other hand, the textual description of the model is typically illustrated via the template which has been proposed by Cockburn (2003).

Fig.1 A simple Use Case Diagram


Source: (Authors)

2.2 The BORM Model

As already stated, despite its analytical business process definition, workflow absence is the main disadvantage of the use case method. As a consequence, the use case method must be followed by another business model which includes the representation of the business process workflow. The BORM (Business Object Relationship Modelling) approach is considered ideal for representing the process workflow.

The method has been in development since 1993 and has been a considerably effective and popular tool for both users and analysts. Moreover, BORM has been applied to various agricultural and environmental case studies due to its advantage to involve only small number of concepts required combined with a considerable expressiveness (Merunka, 2003). This makes it easy to understand even for the first-time users with almost no knowledge of business analysis (Picka et al, 2011).

The BORM method uses for visual presentation of the information a simple BORM diagram (Fig. 2) that contains the following concepts (Polák et al, 2003):

Fig.2 The BORM business diagram elements and symbols
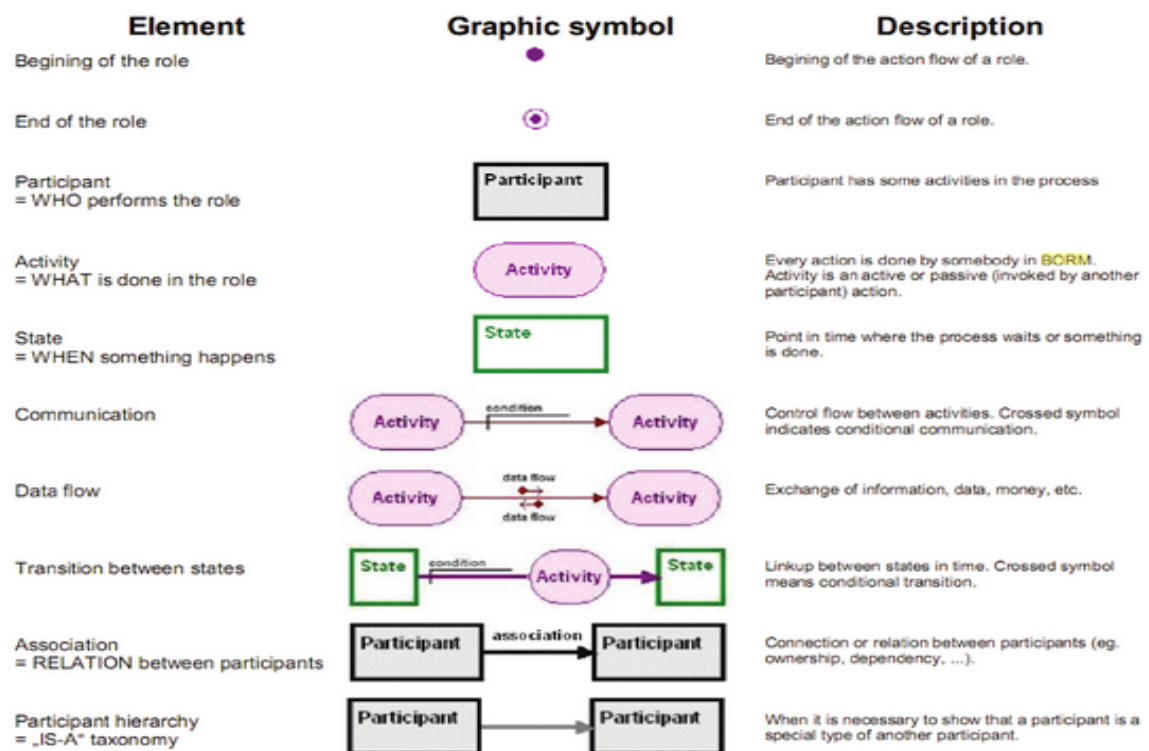
Source: (Molhanec and Merunka, 2012)

Participant: an object representing the stakeholder involved in one of the modelled processes, which is recognized during the analysis.

State: sequential changes of the participants in time are described by these states.

Association: data-orientated relation between the participants.

Activity: represents an atomic step of the behaviour of the object recognized during the analysis.

Communication: represents the data flow and dependencies of activities. Data may flow bidirectionally during the communication.

Transition: connects state-activity-state and represents changes of the states through activities.

Condition: expresses constraint that holds for the communication or activity.

2.3 The Use Case to BORM Transition Algorithm (UCBTA)

The approach has been developed and described by the author (Podaras et al, 2012) as a simple and efficient algorithmic method for analyzing both software and business process requirements. The main advantage of the contribution is the utilization of two tested methods, such as Use Cases and BORM, and the mapping of their elements. The mapping is performed in order to fill the gaps in both methods. Even though the UML Use Case approach is a globally accepted tool for the standard definition of business process steps, it lacks a process workflow representation. Moreover, the BORM method has an excellent workflow representation, but lacks a formal definition of the steps of the delineated business process.

The combination of both methods and the transformation from the use case model to BORM through standard algorithmic steps ensures the successful delineation of ICT business processes. The algorithmic procedure is based on the finite automata theory and is represented by a flowchart (Fig. 4). The mapping between the Use Case model and the target BORM model is also depicted (Fig. 3). The approach is also useful for agile information system development projects where iteration issues are a major challenge for analysts and developers. The analysts should take into consideration the fact that the Use Case is the same or a subset of the BORM general function when implementing the UCBTA approach.

Fig. 3 Mapping between Use Case and BORM Models [19]
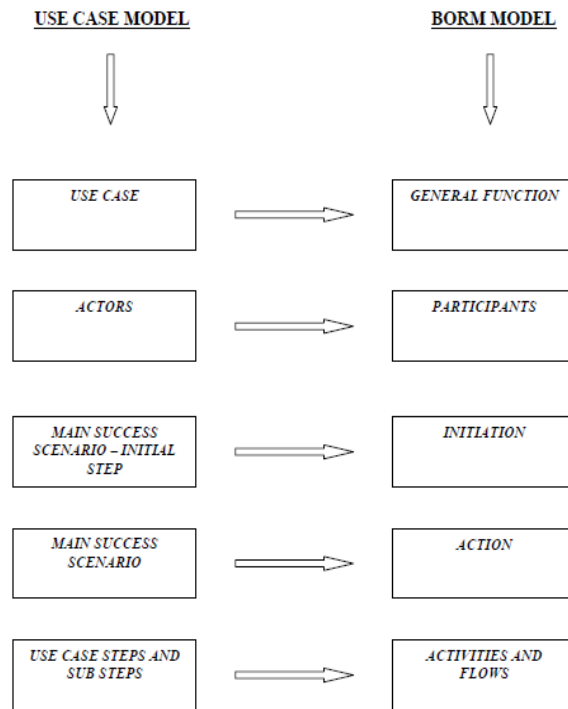
Source: (Authors)

Fig.4 Flowchart of the UCBTA Algorithm

Source: (Authors)

115
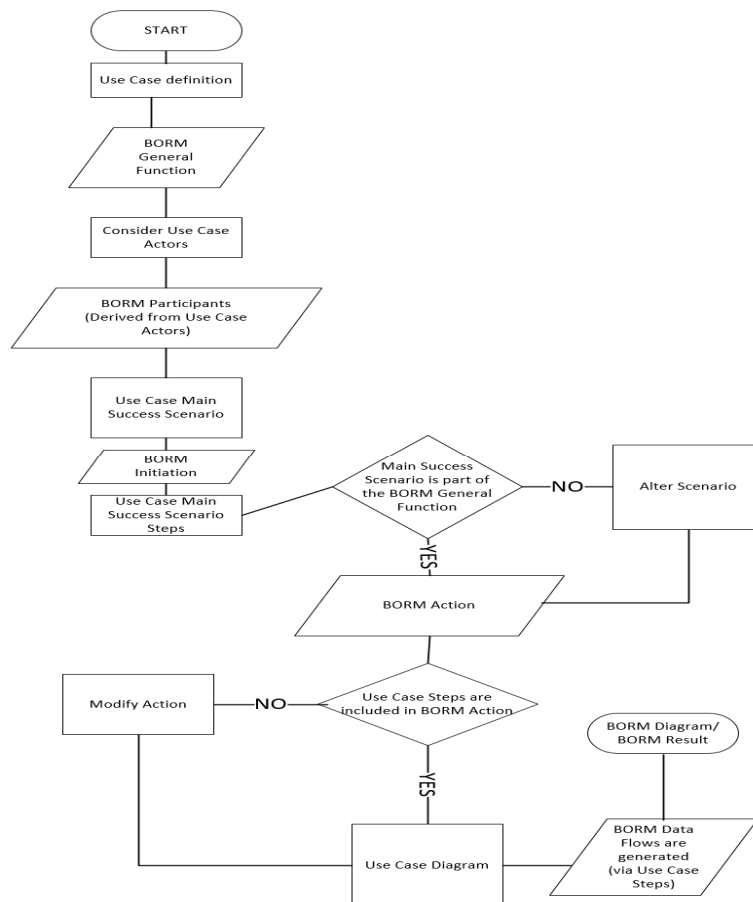
2.4 Monitoring for Efficient Pest Control

The primary goals of monitoring, else called scouting, are to locate and identify insect, mite and disease problems and to observe changes in the severity of infestation (Schnelle and Rebek, 2008). According to Dreidstadt (2001), regular scouting enables the grower gain the following profits:

- Prevent problems or reduce the amount of damage and the cost of control by providing early warnings that pest problems are developing
- Determine the specific cause and severity of the problem
- Identify the locations that require immediate and absolute treatment, so as to avoid unnecessary control actions
- Determine the most effective and economical timing and method of treatment
- Use slower-acting methods that are more environmentally friendly and much safer for workers
- Evaluate control efficacy.

The specific agricultural business process (Scouting - else Monitoring), has been selected as a requirement analysis case study due to the fact that, in order to support its execution, a demanding information system has to be designed and developed. Other agricultural business processes might have been selected but scouting is ideal due to the fact that it is related with various complicated decision making tasks (i.e. measurement of the degree of pest infestation, evaluation of pesticide effectiveness e.t.c.) which may even require the presence of a business intelligence system or a data warehouse. In contrast, simple record keeping of pests and the infected plant types can be supported by database tools or even worksheets in excel.

3   Results

3.1 Use Case model and BORM diagram of the pest monitoring (scouting) process

In order to analyze and describe in detail the scouting business process, according to the rules of the UCBTA algorithm, the delineation of the Use Case model is the primary step. The textual representation of the scouting use case model is based on the proposed by Cockburn (2003) template (Table 2) and its graphical depiction is implemented via the corresponding Use Case Diagram (Fig. 6).

It must be mentioned, that not all of the elements included in Cockburn's use case model are demanded in order to transform a use case model into a BORM model (Fig. 5). Only the underlined elements (Tab. 1) are the necessary preconditions for generating the BORM business model as suggested by the author. The specific mapping has been done based on common elements in both approaches.

Tab.1 Use Case textual delineation of the Scouting (Monitoring) business process

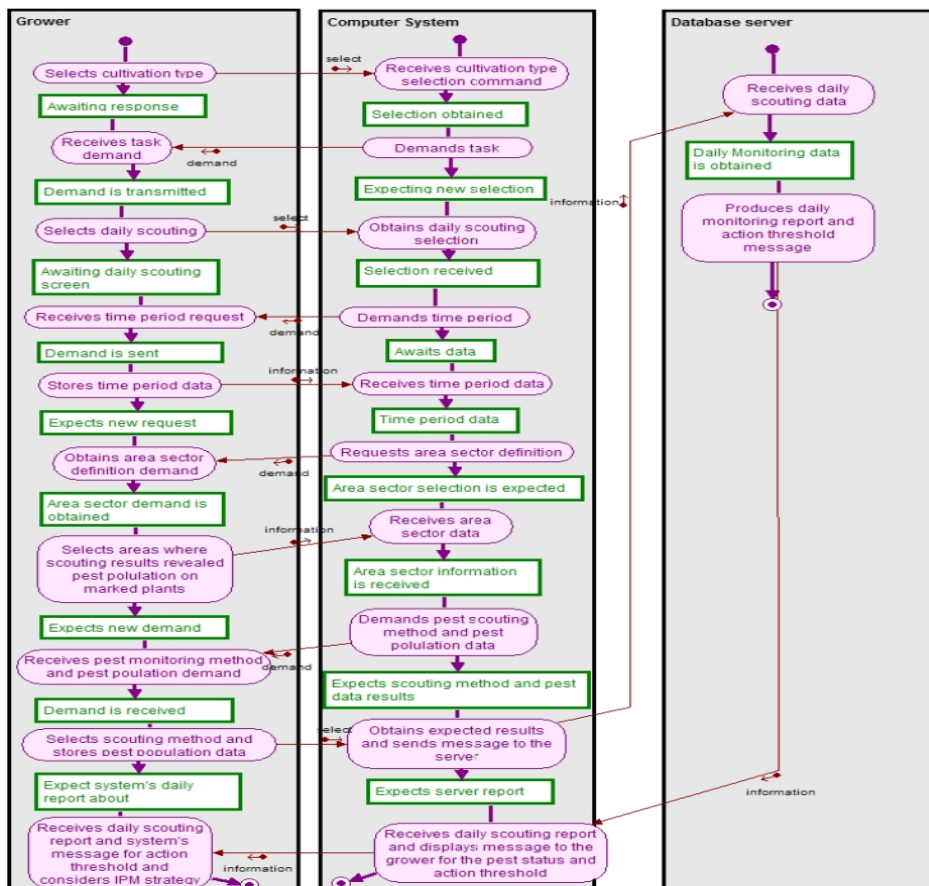| Element	Description of the element
Use case name	Performing Daily Scouting Record Keeping.
Context of use	Economic Integrated Pest Management administration
Scope	Economic, timely and ecologic pest management practices that

	include precise quantities of applied pesticides and only in the necessary areas of the cultivation, as they are proposed by the target information system.
Level	Economic, timely and ecologic pest management practices that include precise quantities of applied pesticides and only in the necessary areas of the cultivation as they are proposed by the target information system.
Primary actor	Integrated pest management system. Includes, a computer system and a Database server
Stakeholders and interests	Growers (i.e. farmers, agronomists)
Precondition	Process feasibility, computer based pest control is suggested by agronomists according to the size of the cultivation
Minimal guarantee	Efficient pest control (even if production is not increased)
Success guarantee	Efficient control of pest population based on computer based monitoring, including the increased production levels.
Trigger	The grower selects cultivation type in order to perform daily scouting, control pest population and keep the necessary records.
Main success scenario	Grower selects cultivation type Computer system demands task Grower selects daily scouting (monitoring) Computer system demands time period Grower stores time period data to the system Computer system requests area sector definition Grower selects areas where scouting results revealed pest population on marked plants Computer system demands pest scouting method and pest population data Grower selects scouting method and stores pest population data Computer system sends message to the server (Database server) Database server produces daily monitoring report and action threshold message Computer system displays message to the grower for the pest status and the action threshold
Extensions	1a) Grower awaits response 1b) Selection is obtained 1c) Computer system receives cultivation type selection command 2a) Computer system is expecting new selection 2b) Demand task is transmitted 2c) Grower receives task demand 3a) Grower awaits daily scouting screen 3b) Computer system obtains daily scouting selection 3c) Selection received 4a) Computer system awaits time period data

|	5a) Grower expects new request 5b) Computer system receives time period data 6a) Grower obtains area sector definition demand 6b) Area sector demand is obtained 7a) Grower expects new demand 7b) Computer system receives area sector data 7c) Area sector data is stored 8a) Computer system expects scouting method and pest data 8b) Grower receives pest monitoring method and pest population demand 8c) Demand is received 9a) Computer system obtains expected results 10a) Computer system expects server report 10b) Database server receives daily scouting data by the computer system 10c) Daily monitoring data is obtained 11a) Computer system receives daily scouting report 12a) Grower receives daily scouting report and the system's message for action threshold and considers Integrated Pest Management strategy

Fig.5 BORM Diagram of the IPM Scouting Process

Fig.6 Use Case Diagram of the IPM Scouting Process
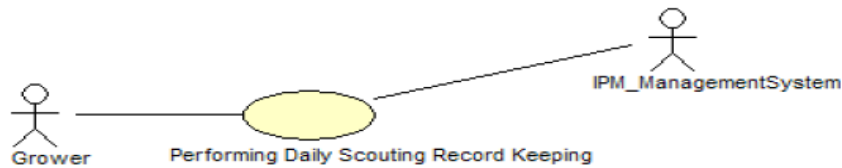
Source: (Authors)

4 Discussion

When modern scientific methods are proposed, their validity should be examined from various aspects. Firstly, the method should be based on standard and tested theories. Secondly, the method's novelty, practicality and necessity should be justified. Thirdly, when the method is developed scientific gaps should be eliminated. Finally, when case studies from specific scientific domains are utilized, the method's value for these domains, has to be demonstrated. The UCBTA algorithm has all these characteristics. Firstly, the method is based on Use Case theory from UML for analyzing system requirements and, also, on the BORM model for depicting business process workflows. A unification of these 2 methods, yet without the presence of precise mapping between the elements neither with transition rules, has also been proposed in order to measure the complexity in IT projects (Struska, Merunka, 2007). This method, correctly, uses the elements of Use Case Points to derive the elements of BORM points. On the contrary, the current contribution deals with another issue, namely *business process requirement analysis* and utilizes precise mapping (Fig.3) and specific transition rules (Podaras et al, 2012) which, correctly though, are not present in the initial unification.

Secondly, the method's novelty is obvious due to the derivation of a business process model from Use Cases, contrary to the approaches described by (Cruz et al, 2014). Moreover, the creation of business models from use cases can be significantly practical, especially when developing modern information systems where agile methods are applied. Agile approaches to information system development include iterations. Agility is characterized by the breakdown of work in short, regular and frequent cycles of finished tasks, involvement of the customer in the process of planning (Antlová, 2014). This makes the derivation of a business process model from use cases extremely practical. Also, the involvement of the customer, or the practitioner, towards the design of an information system or an application makes the use of a business process modelling method that is comprehensible even by people with no IT skills or knowledge a necessity.

Thirdly, a critical issue with which the author had to deal when developing the method was to ensure data integrity. Data loss during the transition from use cases to BORM is prevented with the existence of the UCBTA transition rules (Podaras et al, 2012). The incorporated software tool performs transition according to these rules and the corresponding mapping between the two methods, thus eliminating all possible gaps in the model.

Finally, the selected case study, which is a scouting process for controlling pests, is a demanding agricultural task where automation needs are highlighted by agronomists. Greer and Diver (1999) claim that monitoring records should be kept in computer because computers are usually better for producing graphs, which show trends more easily. As a consequence, better and more precise diagnostic results with respect to IPM scouting will be produced when the supporting software/information system has been developed according to the requirement analysis rules of the UCBTA approach.

The approach which is analyzed in the current paper can practically assist agronomists in participating actively throughout an agile development of an agricultural information system. Use Cases and BORM diagrams are both comprehensible even by users which have no experience with the development of information systems but who are utterly confident regarding the required target tasks which should be executed via the developed software system.

A final issue to be discussed is the reason for mapping Use Cases to BORM and not to another business process modeling tool such as the BPMN (Business Process Model and Notation)? BPMN is not proposed due to the fact that it includes symbols, such as getaways (parallel, exclusive e.t.c.) which are not comprehensible by end users. Moreover, in BPMN a Participant can be a specific PartnerEntity (e.g., a company) or can be a more general PartnerRole (e.g., a buyer, seller, or manufacturer) (OMG, 2013). However, an Actor in a Use Case diagram specifies a role played by a user or any other system that interacts with the subject. Actors may represent roles played by human users, external hardware, or other subjects (OMG, 2007). It is thus difficult to map Use Case model with a BPMN in the occasion when the analyzed business process involves technical actors or interfaces, such as web servers, database servers, webpages, database systems and many more.

Conclusion

The UCBTA algorithm has been created based on a multidisciplinary logic. The core idea is to merge concepts and terminologies from information systems modelling with various scientific disciplines. The success of the proposed approach in analyzing information systems' requirements is based on the use of not one but two highly accepted methods, the Use Case and BORM. Deriving business models from use cases is highly demanded, especially in agricultural ICT projects where agility practically leads to multiple iterations. As a consequence, the produced business model derived from use cases and comprehensible by all stakeholders is a critical issue for the success in the execution of ICT projects in various scientific domains. The selected target business process representation model is BORM, which has been already proposed for modeling agricultural processes. Thus, the pest monitoring case study for the demonstration of the overall approach was not arbitrarily selected. The transition from the use case method to BORM is supported by specific transition rules which ensure data integrity during the transition. The target business model is expressed in the form of a BORM diagram. Future work will include a web-based platform, which is currently under development, for the automatic transition from the Use Case model into BORM. Web tools can be more easily accepted by agronomists nowadays since many of them are prompted to utilize modern ICT technologies, databases, and mobile devices. From this aspect, many agricultural practitioners, such as farmers, growers,

greenhouse owners, as well as experts from other scientific disciplines will be more willing to participate in future agile ICT projects.

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DETERMINANTS OF THE NUMBER OF PATENTS IN THE CZECH REPUBLIC

DETERMINANTY POČTU PATENTŮ V ČESKÉ REPUBLICE

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Abstract: Knowledge represents an important national, regional or firm asset that creates a source of competitive advantages. However, there are no standard methods that are able to determine the extent to which an economy is based on knowledge and to measure the outputs of knowledge economy. Economists had already begun to use the number of patents to investigate an entire range of relationships, for example, to analyse their relationship to company size, investment and innovation activities. Therefore, the aim of this paper is to analyse the influence of selected determinants of the knowledge economy that affect its output (the number of patents in the Czech regions). The analysis is realized by using own original multiple linear regression model. Data for the analyses were obtained from the Czech Statistical Office's databases between the years 2007-2011. The results confirm the importance of the human factor during the process of patent creation. The role of increasing expenditure on research and development activities was proven to be insignificant in the Czech regions. In the Czech Republic, there is a lack of studies measuring knowledge economy and its determinants. Therefore, we provide an initial analysis of determinants influencing knowledge economy.

Keywords: Patents, human capital, analysis, Czech regions, multivariate regression model

JEL Classification: O11, O13.

Introduction

Currently, competitiveness is a topic that is frequently discussed and dealt with in economic analysis. This applies not only to individual companies or sectors but also to regions by whatever definition. Competitiveness is an entity's ability to be successful in a competitive environment so that its goals are achieved to the greatest possible extent (and in the most effective way; Prokop, Stejskal, Kuvikova, 2017). In fact, competitiveness is considered to be one of the most significant determinants of economic development; gradual increase of this determinant results to the fulfilment of objectives of regional policy and to the growth of welfare, quality of life and long-term economic development (Amin, 1999).

Knowledge and the ability to transform it into innovation are becoming the foundation for individual regional and national economic systems. These often try to support the creation, acquisition and transfer of knowledge – both financially and non-financially. In this way, the economy often becomes dependent or based on knowledge. Regarding each government's limited financial possibilities, the question arises as to the effectiveness of such attempts (and support for such attempts) to create and develop a knowledge economy (Stejskal, Merickova, Prokop, 2016). There are no standard, generally recognized methods that are able to determine to what degree an economy is based on knowledge (Kitson, Martin, Tyler, 2004). Various studies argue about whether

economies' knowledge base is measurable or how to measure a knowledge economy's outputs, which are necessary for different types of economic analysis (Leydesdorff, Dolfsma, Van der Panne (2006). In many analyses, renowned authors have used an indicator based on the number of patent applications and registered patents in the given country (Acs, Anselin, Varga, 2002; Hudec, Prochadzkova, 2013; WB, 2016). In the Czech Republic, there are no studies evaluating to what degree Czech economy is based on knowledge and the determinants of the knowledge economy.

Therefore, the goal of this paper is to provide an initial analysis and evaluate the influence of selected determinants of the knowledge economy on the selected output – i.e., the number of patents in the Czech Republic's regions – and provide some practical implications for policy makers not only in the Czech Republic. The analysis will be conducted by using a multivariate linear regression model constructed by the authors using data for the Czech regions from 2007—2011 provided by the Czech Statistical Office (period of time is dependent on the period for which the complete data sets are available). The remainder of this paper is divided in the following way. The first two sections are focused on the problematic of the knowledge economy and its measurement, not only in general but also focusing on the use of patents as an indicator of knowledge processes. The third section describes the methodology and analysis results. The last section comprises the research's concluding evaluations and provides practical implications for policy makers.

1 Patents as an Indicator of Knowledge Processes

Using patent statistics as an indicator of technological activity has been used in Western countries since the 1960's. At that time, economists had already begun to use the number of patents to investigate an entire range of relationships, for example, to analyse their relationship to

- company size;
- investment activities; and
- the degree and trend of innovators' activities (Pavitt, 1985).

In 1984, Pakes and Griliches (1984) followed up on this and proved in their studies that patents can be a suitable tool for measuring the differences in knowledge advancement between individual companies. Subsequently, Jaffe (1986) also emphasized the influence of spillover effects between neighbouring companies; he stated that the R&D activities of companies with neighbours that focus largely on research and development produce many more patents per dollar.

Patents, including subsequent patents (patents that have developed from the original patents), provide a very useful way to measure innovation performance, because patent data can be used not only to monitor the activities of competitive companies, but also to create an evaluative system of research and development performance within companies and, not least, to help identify current trends in technology development (Katila, 2000). For these reasons, patents are often used in various studies as an indicator for measuring the output of innovation activities (from the microeconomic perspective) or the knowledge economy (from the macro- or mezzo-economic perspective).

There are a number of studies that have analysed other component aspects within this problematic. For example, Agrawal and Henderson (2002) examined the extent to

which patents can represent the size, direction and impact of knowledge effects from universities. Acs and Sanders (2012) tested the role of patents using an endogenous growth model and confirmed that companies using patent protection are more motivated to invest in research and development and to generate more new knowledge. Similarly, the positive influence of new knowledge on entrepreneurial activity, innovation activity and growth was also confirmed by this study. Bottazzi and Peri (2003) dealt with measuring companies' innovation output in regions by using the overall number of patents granted to manufacturers in the given fields. McAleer and Slottje (2005) arrived at a simple new method for measuring innovation called the Patent Success Ratio (PSR), which determines the ratio of successfully awarded patents to the overall number of patent applications. Acs et al. (2002) contributed to the discussion with a summary of the phases of the innovation process, for which he also lists a measurable indicator. This is

- the amount of the inputs into the patent process (indicator: expenditure on R&D);

- the intermediate output (indicator: the number of inventions that were patented); and

- the direct measurement of innovation outputs (indicator: sales revenues from the innovation's commercial use over a specific time period, for example).

From the preceding information, it can be concluded that patents represent a significant variable for measuring the output of the knowledge economy.

On the other hand, there are studies that criticize this means of measurement, primarily because not all innovations are patented. Naturally, it can only be speculated as to how many innovation outputs are patented and how many of these outputs are not. Fontana et al. (2013) posit the opinion that there are three types of reasons why inventors decide not to patent their outputs:

- it is not possible to patent the innovations – the inventor is convinced that it is not necessary to patent the given output;

- the innovation is patentable, but the innovator assumes that the inventive steps of his innovation processes are large enough to warrant a patent;

- the inventor decides not to patent their output, because they prefer to keep the given innovation secret.

Despite the above, it is still clear that the number of patents represents an important indicator of the knowledge economy's level and, consequently, of the innovation performance of a region's economic entities. Table 1 shows number of patent application to the Industrial Property Office of the Czech Republic by domestic applicants, number of patent applications to the European Patent Office (EPO) in EU 28 between 2007-2011 and Czech Republic's position in the global competitiveness rating between 2007-2012. From Table 1 we can see that the number of patents in the Czech Republic increased slightly, the situation in the EU28 has mostly downward trend.

Table 1: Number of patent applications in EU28 and the Czech Republic

	2007	2008	2009	2010	2011
Czech Rep.	711	710	788	869	782
EU 28	58 578	57 049	56 815	56 769	57 445
	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Position of the Czech Republic in the global competitiveness rating	33	33	31	36	38

Note: number indicates the share of each Applicant by their belonging to the home state
Source: Author's own analysis using the sources from Czech Statistical Office and www.vyzkum.cz,
WEF (2017), and Eurostat (2017)

It appears to be necessary to continue to investigate the factors that can be influenced by the public decisions of national or regional authorities. Three hypotheses were defined in order to achieve the paper's goals.

H1: The level of education of the population in the Czech Republic's regions has a positive influence on the number of patents registered by enterprises located in the Czech Republic's regions.

This hypothesis is derived from the assumption that increasing competitiveness is influenced by knowledge, which is primarily created and disseminated by institutions from the tertiary education sector and, consequently, an increasing number of individuals with tertiary education. Therefore, we test the influence of the growth of individuals having completed tertiary education on the number of patents registered by enterprises located in the Czech Republic's regions. The next hypothesis H2 originated in conjunction with this assumption.

H2: An increase in the number of employees in research and development in the Czech Republic's regions has a positive influence on patent creation for inventors located in these regions.

This hypothesis develops the previous assumption and deals with the significance of the human factor in practice, represented by equivalent of people in R&D (FTE - full-time equivalent), including research, technical and other staff. Good human resource management can certainly predetermine the future success of individual companies and, thus, regions. Moreover, Dakhli and De Clercq (2004) state that investment into the human capital of science and research workers represent a determinant of an increase in both productivity and competitiveness at the company level.

Financial support from public budgets is also considered significant; currently, this is very common in the Czech Republic and has been observed by a number of authors, for example Maroušek et al. (2014). Therefore, the influence of public support on patent creation in individual regions is tested in hypothesis H3.

H3: Increasing expenditures for supporting research and development in the Czech Republic's regions has a positive influence on the number of patent applications.

2 Methodology

Data for analysis was acquired from the Czech Statistical Office's database for the Czech Republic's NUTS3 regions from 2007—2011 and from the Analysis of the Existing State of Research, Development and Innovation in the Czech Republic. A total of 11 variables were chosen for analysis (one output, i.e., dependent, and ten input, i.e., independent); they are listed in Table 2. The variables are factors influencing the

knowledge economy as used by the World Bank in the Knowledge Assessment Methodology (KAM). The knowledge economy indicators selected were subsequently used to compose regression models investigating their influence on patent creation in the Czech Republic's regions. The changes in variable values for 2007—2011 that were used in the analysis were calculated in percentages and are listed in Table 2, rounded off to the third decimal place.

For analysing the relationship between variables, multivariate linear regression models were used. These models were created for the purpose of investigating the relationship between one dependent variable (the predicated variable) y and independent variables (predictors) x_1, x_2, …, x_n. The dependent variable was represented by the number of patents granted by the Industrial Property Office of the Czech Republic (IPO) to domestic applicants between 2007 and 2011. The independent variables were created by aggregate values for the Czech Republic's individual regions and are also listed in Table 2.

Table 2: The Dataset

Region	PAT	GDP	ZAM	EXP	TECHi	VZOR	TERC	CENT	POD	TECHe	NEZ
PHA	0.485	0.108	-0.001	0.012	0.624	0.658	0.420	0.070	0.098	0.844	0.846
STC	-0.052	0.074	0.078	-0.018	0.837	0.489	0.738	0.296	0.060	0.867	0.665
JHC	2.500	0.046	0.161	0.214	0.334	0.434	0.214	0.143	0.151	-0.162	0.683
PLK	-0.396	0.067	0.124	1.246	-0.430	1.824	0.542	0.369	0.528	0.909	0.581
KVK	-1.000	0.087	0.456	0.597	-0.164	0.823	0.108	0.000	-0.479	0.293	0.344
ULK	11.000	0.098	0.017	0.133	-0.233	0.439	0.375	0.171	0.044	-0.413	0.180
LBK	0.429	0.043	0.226	0.418	-0.458	0.618	0.599	0.257	0.937	40.778	0.563
HKK	0.164	0.142	0.285	0.321	0.463	0.223	0.156	0.270	0.081	1.450	0.592
PAK	0.000	0.130	0.096	0.263	-0.757	0.146	0.381	0.270	0.296	0.924	0.555
VYS	-0.167	0.129	0.198	0.451	0.088	0.057	0.313	0.318	0.296	1.158	0.676
JHM	1.595	0.171	0.441	0.951	6.224	0.505	0.438	0.386	0.206	1.415	0.417
OLK	0.125	0.183	0.149	0.407	0.069	-0.195	0.302	0.206	-0.147	1.374	0.689
ZLK	0.886	0.152	0.153	0.226	-0.432	0.813	0.329	0.321	0.015	0.266	0.553
MSK	0.270	0.174	0.437	0.787	0.655	0.269	0.319	0.370	0.710	0.507	0.163

Note: PHA = Prague; STC = Central Bohemia; JHC = South Bohemia; PLK = Plzeň; KVK = Karlovy Vary; ULK = Ústí nad Labem; LBK= Liberec; HKK = Hradec Králové; PAK = Pardubice; VYS = Vysočina; JHM = South Moravia; OLK = Olomoucký; ZLK = Zlínský; MSK = Moravskoslezský; PAT = overall increase in patents granted to domestic applicants by the Industrial Property Office of the Cz. Rep.; GDP = GDP per capita; ZAM = the overall number of employees in R&D; EXP = overall expenditure on R&D conducted in the Cz. Rep.; TECHi = payments for importing technological service into the Cz. Rep.; VZOR = the overall increase in utility models granted by the Industrial Property Office of the Cz. Rep.; TERC = the number of individuals having completed tertiary education; CENT = the overall number of centers conducting R&D activities; POD = overall direct R&D support from the Cz. Republic's national budget (institutional and special-purpose; basic and applied research); TECHe = revenues from exporting technological services from the Cz. Rep.; NEZ = registered unemployment.
Source: Author's own analysis using the sources from Czech Statistical Office, WB (2016), and Tödtling, Lehner, Kaufmann (2009)

In general terms, the most frequently used multivariate linear regression model (e. g. Ernst, 2001; Hou, Lin, 2006; Hingley, Park, 2016) takes the following form (Vlachogianni et al., 2011; Wright, Coff, Moliterno, 2014):

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n + \varepsilon \tag{1}$$

where:

y is the dependent variable;

x_1, x_2, …, x_n are the independent variables;

ε is the error term creating variability in the variable y that cannot be explained by the linear effects n of the independent variables;

β_1, β_2 … β_n are called regression parameters and represent the unknown constants that should be established (estimated) from the given data.

To assess the validity of the regression model (or a regression estimate) and to reflect the fraction of variation in the Y-values that are explained by the regression line, coefficient of determination R^2 is subsequently used. Coefficient of determination is defined as follows (Schneider, Hommel, Blettner, 2010):

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

where:

n is the number of observations;

$\hat{y}_i$ is the estimated value of the dependent variable for the ith observation, as computed with the regression equation;

y_i is the observed value of the dependent variable for the ith observation;

$\bar{y}$ is the mean of all n observations of the dependent variable.

R^2 is the fraction of the overall variance that is explained. The closer the regression model's estimated values $\hat{y}_i$ lie to the observed values y_i, the nearer the coefficient of determination is to 1 and the more accurate the regression model is.

Before composing the analysis, verification whether the data were not correlated was conducted by using Spearman's test. After fulfilling the first prerequisite and dismissing the possibility of multicollinearity in the model, the analysis itself was conducted. Formula of the Spearman´s test has following general form:

$$r_s = 1 - \frac{6\sum d_i^2}{N^3 - N} \tag{3}$$

Spearman´s Coefficient measures the strength of the linear relationship between two variables. Values of each variable are rank-ordered from 1 to N, where N represents the number of pairs of values (the N cases of each variable are assigned the integer values from 1 to N inclusive and no two cases share the same value). Difference between ranks for each case is represented by d_i.

3 Results

During the course of the analysis, investigation was also focused on the knowledge economy indicators' influence and on further potential variables that could, according to the World Bank, be used as indicators for measuring the knowledge economy. Subsequently, an increase in GDP per capita and also registered unemployment were selected as given dependent variables. However, no significant results were attained for

any of the models created. On the other hand, the model attained significant values for the dependent variable of patents.

The final regression model, whose values are listed in Table 3, records both the resulting set of knowledge economy indicators and the occurrence of a number of strong ties between the variables. The value of the correlation coefficient R of this model was measured at 0.981. The value of the coefficient of determination R^2 achieved a value of 0.963, and the value of the adjusted coefficient of determination was 0.880. The model's p-value amounted to 0.015. The result of the p-value demonstrated that the model is reliable at a level of significance of $p < 0.05$ and allowed for the rejection of the null hypothesis about the insignificance of this model. The model's quality was verified using the Breusch-Pagan test, whose value was 0.309. Therefore, the null hypothesis was not rejected and the data are homoscedastic.

Overall, 9 of the 10 selected indicators were used in the resulting model (independent input variables). Only the EXP variable was excluded from this model – because of its impact in creating insignificant results. The model detected the significant influence of a total of 4 of the 9 (44 %) knowledge economy indicators on the chosen dependent variable, i.e., the overall increase in patents awarded by the Czech IPO by domestic applicants. The most significant relationships were identified for the ZAM, NEZAM and TECHi variables. These variables were significant at a level of $p < 0.01$. Another significant result was recorded for the TERC variable, which was significant at a level of $p < 0.05$. The results indicate the human factor's strong influence in the patent creation process – both for the ZAM variable, representing the overall number of employees in R&D, and for the TERC variable, which denotes the number of individuals having completed tertiary education. However, the variables representing the provision of financial support and an overall increase in expenditure on research and development were proved to be entirely insignificant during the course of the analysis.

On the basis of the results listed above, it is possible to accept hypotheses H1 and H2. It was demonstrated that an increase in the number of individuals with tertiary education (TERC) as well as the number of employees at R&D workplaces positively influence the dependent variable and contribute to an increase in patent creation in Czech regions. However, hypothesis H3, which investigates the influence of expenditure and support for research and development, was rejected; a significant influence on the increase in granted patents was not seen for the Czech regions.

Table 3: The Resulting Model and Its Values

Variable	p	sd	t
ZAM	0.001***	3.454	-7.834
TERC	0.022**	3.165	-3.660
CENT	0.333	4.906	1.098
POD	0.416	1.558	-0.905
NEZAM	0.001***	1.772	-8.771
GDP	0.101	10.459	-2.119
VZOR	0.396	0.779	-0.949
TECHe	0.108	0.047	2.064
TECHi	0.007***	0.237	5.038

Note: p = p-value; sd = standard error; t = t-statistic; ***significant at a significance level of p < 0.01; **significant at a significance level of p < 0.05

Source: own research

During the course of analysis, it was demonstrated that neither the EXP (overall expenditure on R&D conducted in the Czech Republic) nor POD (overall direct R&D support from the national budget) variables influence the dependent variable. For the variables representing expenditure on R&D, only TECHi (payments for importing technological services into the Czech Republic) attained significant results. For this reason, H3 was rejected.

4 Discussion

The analysis results confirmed the significance of human (knowledge) resources when creating patents in the Czech Republic. The same results were confirmed by McAleer and Slottje (2005) or Clarysse and Wright (2014) and many others.

Hypotheses H1 and H2 were confirmed using the results. From the results of H1, the significance of an increase in education level is evident for the creation of patents in the Czech regions. Significant impact of higher education level can be seen in number of the patent in the Czech Republic (see table 1), and also in Sweden (Arvemo and Gråsjö (2014), in UK (Guerrero, Cunningham, Urbano, 2015). But it can not be argued that an increased proportion of university-educated people are directly proportional to the number of patents (the evidence from CEE states is in Prokop, Stejskal and Kuvikova, 2017).

It is therefore necessary to continue to support the development of universities and institutions of the tertiary education sector. This support should not be provided only to increase the number of these institutions, but also with the goal of preserving a certain standard of quality. Some scholars highlight the importance of new forms of collaboration. For example the national government in Italy decided to intensify the cooperation and the effectiveness of the university R&D activities by the "entrepreneurial univesity" concept application (Perkmann, Fini, 2013). Their studies show that this concept leads to enhance the successful commercialization of academic research. However, there are also some studies what show the inefficient effects of this collaboration (Banal-Estañol, Jofre-Bonet, Lawson, 2015).

However, the cooperation on patents is implemented in the firm even without the involvement of universities or R&D organizations (in-house or based on external cooperation with other firms). There are many studies that highlight the positive effects on the firms´ productivity (for example: Andries, Thorwarth, 2014). Some other studies proved that the location influence the innovation ability. The firms´ location in Science and Technology Parks or Business Incubators strengthen relationship between internal knowledge acquisition and collaboration (Montoro-Sánchez et al., 2011).

The results of H2 produce similar conclusions to that of H1. In this case, it is necessary to focus on an increase in the number of qualified workers in research and development in the Czech regions. Placing emphasis on the professional qualifications of employees in such positions represents an important condition for the success of this prerequisite. On the other hand, an increase in expenditures for supporting research and development did not influence the creation of patents in the Czech regions. For this reason, H3 was rejected. Ineffective use of expenses is a relatively topical subject. The Banal-Estañol, Jofre-Bonet, Lawson (2015) postulated the same results. Therefore, it is necessary to focus more on the problematic of expenditures for supporting research and development – not only across the Czech Republic as a whole, but also at the regional level.

5 Conclusions

In recent years, the role played by knowledge in the processes of creating innovation and increasing the competitiveness of individual companies and regions continues to be more frequently documented. However, insufficient relevant data presents a barrier to measuring the level of the knowledge economy. Therefore, patents emerge as a significant output that can be used to measure innovation performance in certain cases. The goal of this paper was to evaluate the influence of selected knowledge economy determinants that affect innovation output. It also proved to be necessary to investigate factors that could be influenced by the public decisions of national or regional authorities.

Following the results of this research, we provide some practical implications for policy makers (not only in the Czech Republic). It is clear, that human resources represent one of the most important determinants influencing knowledge economy and patent creation signals one form of growth in intangible knowledge capital, increases in the size of the science and engineering workforce that subsequently lead to firms´(or regional/national) growth (Powell, Snellman, 2004). It is supported by the significant results in previous section. Importance of determinants: (i) the overall number of employees in R&D and (ii) the number of individuals having completed tertiary education; confirms this assertion. Therefore, it is necessary to support education and research and development centres. On the other hand, it is not the rule, that increasing number of public subsidies and increasing number of employees/R&D centres leads only to better results. As it was shown, variables CENT (the overall number of centres conducting R&D activities) and POD (overall direct R&D support from the Czech Republic's national budget - institutional and special-purpose; basic and applied research) did not affect dependent variable – PAT: overall increase in patents granted to applicants by the Industrial Property Office of the Czech Republic. The similar results are emerged by Agrawal, Henderson (2002) or Hingley, Park, (2016). Therefore, policy

makers should carefully decide which projects and centres they will support (from national or European funds) and which not.

For all these reasons, future research has been planned that will monitor the influence of R&D on the development of knowledge in regions – with respect to a longer time period in order to better record the effects of providing public support, because certain effects appear over a much longer time period. It is evident that not all inventions are created immediately after public support has been provided and that, in many cases, subsequent granting of patents can extend to a longer period of time. The researchers are also conscious of the current absence of resources from European budgets in terms of the analysis that has been conducted and therefore we plan their inclusion in the next investigation of this problematic. We also plan to analyse the situation of the Czech Republic in the European Research Area in conjunction with the Europe 2020 Strategy in the area of research and development to capture the effects and impact of key determinants of knowledge economy.

Acknowledgement

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ĽUDSKÝ KAPITÁL A LOKÁLNY EKONOMICKÝ RAST NA SLOVENSKU

HUMAN CAPITAL AND LOCAL ECONOMIC GROWTH IN SLOVAKIA

Oliver Rafaj, Štefan Rehák

Abstract: Modern growth theories consider human capital as an important factor of economic growth. Cities play an important role in the production and concentration of human capital play. On their territories are located educational institutions such as universities or colleges that provide opportunities for economic actors to increase their education. They also create a space for the emergence and rapid spread of spill overs that spread inside and also outside of their territories. This article aims to examine the role of human capital in local economic growth in Slovak Republic. All 79 Slovak districts were examined and the observed time period was between the years of 2001 and 2015. For discovering the influence of the factor of human capital on the local economic growth a regression analysis was used. The main result is that the selected factor of human capital (represented by the growth index of inhabitants with tertiary education) had a positive and statistically significant influence on the economic growth of Slovakia's districts (represented by the growth index of wages).

Keywords: Local economic growth, human capital, spill overs, districts, cities, econometric model.

JEL Classification: B13, C21, R11.

Úvod

Novšie teórie rastu tvrdia, že investície do ľudského kapitálu, inovácií a šírenia poznatkov, zohrávajú významnú úlohu v ekonomickom raste krajiny. Zásadný počin v tejto oblasti učinil Paul Romer, ktorý do neoklasického modelu ekonomického rastu zakomponoval poznatky ako vstupný faktor (Romer, 1986). Konkrétne vo svojom modeli dlhodobého rastu použil poznatky ako vstup do produkcie, ktoré majú rastúcu hraničnú produktivitu, čím zabezpečil dlhodobosť rastu. Na jeho prácu nadviazal Robert Lucas (Lucas, 1988), ktorý na základe použitia skutočných makroekonomických údajov zistil, že krajiny, ktoré vynaložili zdroje do podpory vzdelania, respektíve do vedy a výskumu, dosahovali v dlhodobom horizonte vyšší ekonomický rast, ako krajiny, ktoré tak neučinili. Významnosť ľudského kapitálu, ako vstupného faktora v ekonomickom raste krajín, potvrdila aj skupina amerických výskumníkov (Mankiw, Romer, Weil, 1992), ktorá zakomponovala investície do ľudského kapitálu do Solowho neoklasického modelu modelu rastu. Ich hlavným zistením bolo, že rozdiel v príjme na obyvateľa medzi krajinami spočíva predovšetkým v rozdielnej miere úspor, populačnom raste a vzdelaní. V neposlednom rade dôležité závery vyplývajú aj z výskumu Roberta J. Barro (Barro, 1999). Aj z jeho makroekonomickej analýzy vzišiel úzky vzťah medzi ekonomickým rastom a vplyvom ľudského kapitálu. Na základe analýzy vyše sto krajín, ktorých sledované ukazovatele boli skúmané od roku 1960 do 1995 zistil, že medzi rastom indikátora hrubého domáceho produktu (HDP) na obyvateľa a priemerným počtom rokov školskej dochádzky v druhom a treťom stupni

štúdia, existuje silná pozitívna väzba. Z vypracovanej analýzy vyplynulo, že krajiny, v ktorých školská dochádzka vo vyšších stupňoch štúdia bola dlhšia, dosahovali vyššie HDP na obyvateľa, ako krajiny, v ktorých bola školská dochádzka kratšia. Na empirických údajoch poukázalo na pozitívny vplyv faktora ľudského kapitálu pre tvorbu ekonomického rastu mnoho štúdií a výskumov (napr. Barro, 1991; Bassanini, Scarpetta, 2002; alebo Engelbrecht, 2003).

Osobitný význam majú vedecké prístupy skúmajúce vzťahy medzi ekonomickým rastom a ľudským kapitálom na hierarchicky menších územiach, ako na území celého štátu, na koľko aj v rámci jedného štátu existuje veľa rozdielov a špecifík.

1 Formulácia problematiky

V otázkach lokálneho ekonomického rastu sa v súčasnosti veľká pozornosť sústreďuje na mestá, respektíve mestské aglomerácie alebo metropolitné oblasti, pretože tie zohrávajú v ekonomike kľúčovú úlohu, najmä vďaka veľkej koncentrácii ekonomických aktérov, ktorí sa lokalizujú v tesnej blízkosti. Tí medzi sebou intenzívne pôsobia a uskutočňujú rôzne ekonomické aktivity. Podľa klasických teórií zaoberajúcimi sa aglomeračnými výhodami (Jacobs, 1970; Marshall, 2013) sú mestá pre firmy atraktívne z dôvodov, že im poskytujú rôzne výhody, ako napríklad veľkú zásobu pracovnej sily, široký výber špecializovaných dodávateľov a odberateľov a umožňujú medzi nimi vytvárať priesaky znalostí (tzv. spillover efekty). Vo vzťahu k ľudskému kapitálu, mestá na jednej strane generujú a koncentrujú vysoko vzdelaných ľudí, pretože sa v nich nachádzajú vzdelávacie inštitúcie ako napríklad vysoké školy, univerzity a rôzne iné vzdelávacie organizácie a na strane druhej umožňujú získavať nápady, zručnosti a poznatky od jednotlivých aktérov, ktorí sa v mestách nachádzajú (Moretti, 2004). Pojem ľudský kapitál je ťažko definovať, nakoľko jeho tematika je rozsiahla a jeho vymedzenie je veľmi široké. Napríklad Theodore W. Schultz (Schultz, 1961) pokladal za ľudský kapitál nadobudnuté zručnosti a poznatky, ktoré vytvárajú rozdiel medzi kvalifikovanou a nekvalifikovanou pracovnou silou. Jacob Mincer (Mincer, 1981) ho vnímal nielen ako zosobnenie ľudských poznatkov, ale aj ako produkciu nových poznatkov, ktoré sú zdrojom inovácií a technologickej zmeny, ktoré poháňajú všetky faktory produkcie. Podľa Garyho Beckera (Becker, 1994) možno za ľudský kapitál považovať za personálnu „výbavu", ktorou disponuje každý človek. Pre nejednotnosť definície ľudského kapitálu existuje niekoľko metód, respektíve prístupov jeho merania, pričom každá metóda má svoje výhody a nevýhody použitia. Podľa štúdií OECD (Kwon, 2009; Boarini, d'Ercole, Liu, 2012) možno jednotlivé metódy merania klasifikovať na dva základné typy. Jeden druh meraní je založený na meraní prostredníctvom indikátorov (tzv. indicators-based measures) a druhý typ je založený na monetárnom meraní (monetary-based measures). Častejšie používanou metódou merania ľudského kapitálu vo výskumných prácach je metóda indikátorov.

O kvantifikovanie vplyvu ľudského kapitálu v lokálnom raste sa pokúsilo viacero výskumníkov prostredníctvom skonštruovania ekonometrických modelov. Medzi významné práce, ktoré sa zaoberali touto problematikou patrí model Jamesa E. Raucha (Rauch, 1993), ktorý sa zaoberal vplyvom ľudského kapitálu na produktivitu v mestách. Z jeho modelu vyplynulo, že mestá s vyššou koncentráciou ľudského kapitálu dosahovali vyššiu produktivitu, čo sa preukázalo vo vyšších mzdách. Podobne aj modely ďalších významných ekonómov a geografov preukázali pozitívny vplyv medzi koncentráciou ľudského kapitálu v mestách a ich ekonomickým rastom. Viacero štúdií

potvrdilo pozitívny vzťah medzi zvyšujúcou sa koncentráciou vysokoškolsky vzdelaných obyvateľov a nárastom zamestnanosti a úrovní miezd v mestách (Glaeser, Sheinkman, Shleier, 1995; Eaton, Eckstein, 1997; Shapiro, 2003). Nemenej dôležitú úlohu v lokálnom raste zohrávajú spillovery. Z prác Edwarda L. Glaesera (Glaeser, Kallal, Scheinkman, Shleifer, 1992; Glaeser, Resseger, 2010) a Curtisa Simona (Simon, 1997) vyplýva, že spillovery sú väčšie a intenzívnejšie v tých aglomeráciách, v ktorých sa sústreďuje väčšie množstvo ľudského kapitálu.

Väčšina uvedených prác a modelov vychádza predovšetkým z údajov zo Spojených štátov amerických, preto cieľom tohto článku je preskúmať, akú úlohu zohrával ľudský kapitál v lokálnom ekonomickom raste v podmienkach Slovenskej republiky.

2 Metódy

Na preskúmanie stanoveného cieľa bol skonštruovaný jednoduchý lineárny ekonometrický model, ktorý vychádzal z nasledujúcej rovnice:

$$\Delta Y = \beta_0 + \beta_1 Y + \beta_2 \Delta L + \beta_3 \Delta K + \beta_4 \Delta \text{ĽK} + \beta_5 \Delta \text{MA} + \varepsilon \qquad (1)$$

Ekonomický rast, ako závislá premenná Y, bola v modeli zastúpená indexom rastu miezd. Na koľko údaje o hrubom domácom produkte na lokálnej úrovni Štatistický úrad Slovenskej republiky neeviduje, použitá závislá premenná bola výška priemernej nominálnej mesačnej mzdy, ktorá sa štandardne používa aj v spomenutých, zahraničných modeloch. Nezávislými premennými bol L ako faktor práce zastúpený indexom rastu zamestnanosti, K ako kapitál bol zastúpený indexom rastu firiem. Na koľko Štatistický úrad Slovenskej republiky neeviduje objemy investícií na lokálnej úrovni, bol použitý ukazovateľ celkového počtu firiem. Vhodnosť tohto ukazovateľa vyplýva z predpokladu, že čím viac firiem sa nachádza na danom území, tým viac kapitálu je k dispozícii na trhu. Faktor ĽK ako ľudský kapitál bol zastúpený indexom rastu počtu vysokoškolsky vzdelaných obyvateľov. Pri použití faktora ľudského kapitálu sa predpokladalo s rovnakými úrovňami technológii v sledovaných územiach. A faktor MA ako miera aglomerácie bola zastúpená indexom rastu hustoty obyvateľstva. Pridaná bola aj hodnota miezd z počiatočného roka, ktorá poslúžila ako kontrolná premenná.

Skúmanie lokálneho ekonomického rastu na Slovensku bolo vykonané na všetkých 79 okresov Slovenskej republiky, na koľko Štatistický úrad Slovenskej republiky neeviduje a nezbiera údaje o metropolitných oblastiach, alebo mestských oblastiach. Preto úroveň okresov najviac zodpovedá skúmanej lokálnej úrovni z uvedených modelov a štúdií. Použité údaje pochádzajú z databázy DATAcube Štatistického úradu Slovenskej republiky (ŠÚSR, 2016). Kvôli obmedzenej dostupnosti ukazovateľov tvorili sledované obdobie roky 2001 a 2015. Použitou výskumnou metódou bola prierezová regresná analýza (metóda nejmenších čtvercov). Prehľad použitých jednotlivých premenných s ich podrobným popisom, postupom výpočtu, zdrojom údajov a ďalšími informáciami, poskytuje nasledujúca Tabuľka 1.

Tab. 1: Prehľad použitých ukazovateľov

Typ premennej	Názov	Skratka	Vzorec	Zdroj	Poznámka
Závislá	Index rastu miezd	mzda1501	$$\frac{\text{priemerná nominálna mesačná mzda v roku 2015}}{\text{priemerná nominálna mesačná mzda v roku 2001}}$$	Štatistický úrad Slovenskej republiky	
Nezávislá, kontrolná	Nominálna hodnota mzdy	mzda2001	priemerná nominálna mesačná mzda v roku 2001	Štatistický úrad Slovenskej republiky	
Nezávislá, faktor práce	Index rastu zamestnanosti	zam1501	$$\frac{\text{priemerný evidenčný počet zamestnancov v roku 2015}}{\text{priemerný evidenčný počet zamestnancov v roku 2001}}$$	Štatistický úrad Slovenskej republiky	Údaje o počte zamestnancov sú za podniky s 20 a viac zamestnancami
Nezávislá, faktor kapitálu	Index rastu firiem	firmy1501	$$\frac{\text{celkový počet firiem v roku 2015}}{\text{celkový počet firiem v roku 2001}}$$	Štatistický úrad Slovenskej republiky	
Nezávislá, faktor ľudského kapitálu	Index rastu vysokoškolsky vzdelaných obyvateľov	vsvz1501	$$\frac{\text{počet vysokoškolsky vzdelaných obyv. v roku 2015}}{\text{počet vysokoškolsky vzdelaných obyv. v roku 2001}}$$	Sčítanie obyvateľov, domov a bytov v rokoch 2001 a 2011	Údaje o počte vysokoškolsky vzdelaných obyvateľov za rok 2015 sa získal štatistickou extrapoláciou hodnôt za roky 2001 a 2011.
Nezávislá, faktor miery aglomerácie	Index rastu hustoty obyvateľstva	ho1501	$$\frac{\text{hustota obyvateľstva v roku 2015}}{\text{hustota obyvateľstva v roku 2001}}$$	Štatistický úrad Slovenskej republiky	

Zdroj: vlastné spracovanie autorov podľa (ŠÚSR, 2016)

Obrázok 1 poskytuje prehľad základných štatistických charakteristík použitých ukazovateľov. Priemerná hodnota mzdy na Slovensku v roku 2001 bola 384 eur. Najvyššia priemerná mzda bola v okrese Bratislava I (656.84 eur) a najnižšia v okrese Sobrance (293.87 eur). Priemerná hodnota závislej premennej predstavovala 2.28. To znamená, že priemerná nominálna mesačná mzda v skúmaných 79 okresoch Slovenska, sa v priemere, medzi rokmi 2001 až 2015, viac ako zdvojnásobila. Najviac sa priemerná mzda zvýšila v okrese Kysucké Nové Mesto (2.93164). Najmenší nárast miezd nastal v okrese Humenné (1.965988). Dosiahnuté hodnoty indexu rastu miezd sa medzi okresmi veľmi nelíšili, čo dokazuje hodnota štandardnej odchýlky (0.1746302). Z nezávislých premenných dosiahli najväčšie rozpätia medzi minimálnymi a maximálnymi hodnotami indexy rastu kapitálu a ľudského kapitálu. Index rastu

kapitálu sa najviac zvýšil v okrese Komárno (5.375276) a najmenej v okrese Medzilaborce (1.566667). Index rastu ľudského kapitálu sa najviac zvýšil v okrese Košice – okolie (4.807298) a v okrese Bratislava I sa počas sledovaného obdobia dokonca znížil (0.8608915). Index rastu hustoty obyvateľstva sa medzi sledovanými regiónmi v skúmanom čase veľmi nemenil. Maximálnu hodnotu ukazovateľa dosiahol okres Kežmarok a najnižšiu okres Bratislava I.

Obr. 1: Deskripcia štatistík použitých ukazovateľov

Variable	Obs	Mean	Std. Dev.	Min	Max
mzda1501	79	2.288371	.1746302	1.965988	2.93164
mzda2001	79	384.5833	74.20234	293.87	656.84
zam1501	79	.9996889	.2763552	.4393064	1.665643
firmy1501	79	3.04353	.6854155	1.566667	5.375276
vsvz1501	79	2.389917	.6580778	.8608915	4.807298
ho1501	79	1.004255	.0936684	.8766644	1.534032

Zdroj: vlastné spracovanie autorov podľa (ŠÚSR, 2016)

Prehľad hodnôt korelačných koeficientov použitých ukazovateľov poskytuje Obrázok 2. Zo získaných hodnôt vyplýva, že medzi jednotlivými ukazovateľmi indexov nezávislých premenných neexistuje významnejšia korelácia, pretože hodnoty všetkých koeficientov sú nižšie ako 0.5, respektíve -0.5. Záporné koeficienty vzišli medzi ukazovateľmi indexu rastu zamestnanosti a indexu rastu vysokoškolsky vzdelaných obyvateľov, ako aj medzi indexom rastu miezd a indexom rastu miery aglomerácie.

Obr. 2: Korelačná matica použitých ukazovateľov

	mzda1501	mzda2001	zam1501	fir~1501	vsvz1501	ho1501
mzda1501	1.0000					
mzda2001	-0.2221	1.0000				
zam1501	0.1998	0.5755	1.0000			
firmy1501	0.1125	0.0162	0.3059	1.0000		
vsvz1501	0.1859	-0.5347	-0.1406	0.2592	1.0000	
ho1501	-0.0394	-0.0225	0.3136	0.2342	0.3617	1.0000

Zdroj: vlastné spracovanie autorov podľa (ŠÚSR, 2016))

3 Rozbor problému

Obrázok 3 znázorňuje mierne pozitívnu závislosť medzi hodnotami indexu rastu miezd (na osi y), a hodnotami indexu rastu vysokoškolsky vzdelaného obyvateľstva (na osi x), skúmaných 79 okresov. Z obrázku vyplýva, že v skúmanom období nastal vyšší ekonomický rast v tých okresoch, v ktorých sa ľudský kapitál zvýšil najviac.

Obr. 3: Závislosť medzi lokálnym ekonomickým rastom a faktorom ľudského kapitálu v sledovanom období
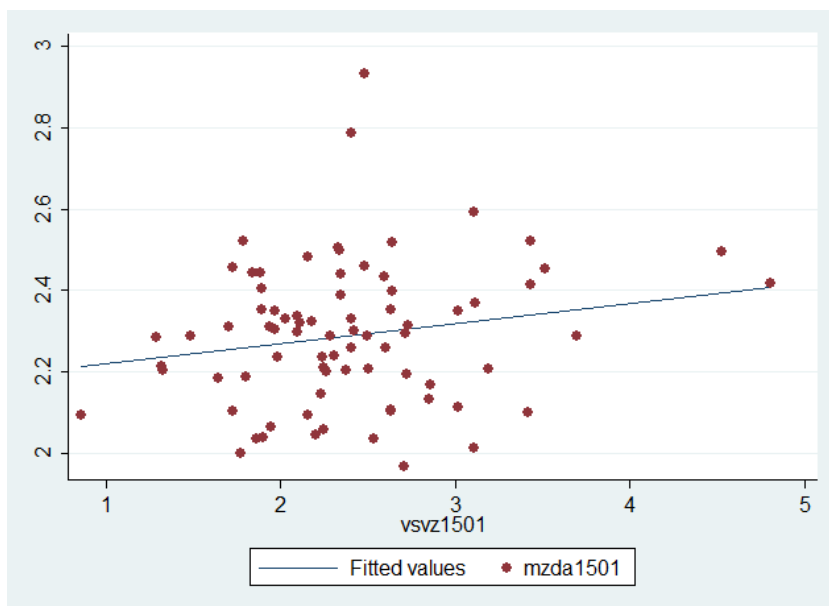
Zdroj: vlastné spracovanie autorov podľa (ŠÚSR, 2016)

Z výsledkov prierezovej regresnej analýzy vyplýva, že vytvorený model lokálneho ekonomického rastu je štatisticky významný, pretože hodnota *p(F)* je nižšia ako 0.05 (hodnota modelu je 0.0004). Z údajov štatistickej významnosti jednotlivých ukazovateľov iba ukazovateľ index rastu kapitálu nie je pri ekonomickom raste skúmaných okresov štatisticky významný (hodnota *p* bola 0.813). Z údajov koeficientov jednotlivých ukazovateľov ďalej vyplýva, že index rastu firiem, index rastu miery aglomerácie a počiatočná výška mzdy majú negatívny vplyv na index rastu miezd. Podrobné výsledky spracovanej regresnej analýzy poskytuje Obrázok 4.

Obr. 4: Výsledky prierezovej regresnej analýzy

Source	SS	df	MS		
Model	.629080964	5	.125816193		
Residual	1.74958431	73	.023966908		
Total	2.37866527	78	.030495709		

				Number of obs =	79
				F(5, 73) =	5.25
				Prob > F =	0.0004
				R-squared =	0.2645
				Adj R-squared =	0.2141
				Root MSE =	.15481

mzda1501	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
mzda2001	-.0012451	.0003491	-3.57	0.001	-.0019409	-.0005493
zam1501	.3856265	.0887558	4.34	0.000	.2087365	.5625165
firmy1501	-.0067415	.0283775	-0.24	0.813	-.0632978	.0498149
vsvz1501	.0247738	.0357539	0.69	0.491	-.0464837	.0960312
ho1501	-.5038023	.2185798	-2.30	0.024	-.9394312	-.0681734
_cons	2.84897	.2353151	12.11	0.000	2.379988	3.317952

Zdroj: vlastné spracovanie autorov podľa (ŠÚSR, 2016)

Pri použitej metóde OLS bola preskúmaná aj heteroskedasticita údajov. Avšak po použití metódy Robust Standard Errors sa výsledky regresnej analýzy príliš nelíšili. Prehľad výsledkov regresnej analýzy s opravenou heteroskedasticitou zobrazuje Obrázok 5.

Obr. 5: Výsledky prierezovej regresnej analýzy s opravenou heteroskedasticitou

Linear regression

				Number of obs =	79
				F(5, 73) =	3.99
				Prob > F =	0.0030
				R-squared =	0.2645
				Root MSE =	.15481

mzda1501	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
mzda2001	-.0012451	.0003494	-3.56	0.001	-.0019415	-.0005487
zam1501	.3856265	.1131642	3.41	0.001	.1600905	.6111625
firmy1501	-.0067415	.0304977	-0.22	0.826	-.0675234	.0540404
vsvz1501	.0247738	.0277711	0.89	0.375	-.0305739	.0801215
ho1501	-.5038023	.168517	-2.99	0.004	-.8396562	-.1679483
_cons	2.84897	.2244429	12.69	0.000	2.401656	3.296284

Zdroj: vlastné spracovanie autorov podľa (ŠÚSR, 2016)

4   Diskusia

Súčasné teoretické prístupy vysvetľujúce lokálny ekonomický rast, považujú za významný faktor ľudský kapitál. Vychádzajúc z aktuálnych teoretických koncepcií, by

na lokálny ekonomický rast na Slovensku mal mať faktor ľudského kapitálu pozitívny vplyv. Z obrázku 3 vyplýva pozitívna závislosť medzi indexom rastu miezd a indexom rastu vysokoškolsky vzdelaného obyvateľstva. Toto zistenie je v súlade so štúdiami (Glaeser, Sheinkman, Shleier, 1995; Eaton, Eckstein, 1997; Shapiro, 2003), ktoré poukazovali na pozitívny vzťah medzi zvyšujúcou sa koncentráciou vysokoškolsky vzdelaných obyvateľov a nárastom zamestnanosti a úrovní miezd v mestách. Z výsledkov vypracovanej prierezovej regresnej analýzy slovenských okresov vyplynulo, že faktor ľudského kapitálu reprezentovaný indexom rastu vysokoškolsky vzdelaného obyvateľstva bol štatisticky významný (hodnota p bola nižšia ako 0.05). Zároveň jeho rast pozitívne vplýval na rast miezd (koeficient použitého ukazovateľa mal kladnú hodnotu, 0.875512). Zaujímavé zistenie vzišlo z negatívneho znamienka ukazovateľa indexu rastu miery aglomerácie. Záporné znamienko indikuje, že rast miery aglomerácie mal negatívny vplyv na index rastu miezd. Vychádzajúc z klasických teórií zaoberajúcich sa aglomeračnými výhodami (Jacobs, 1970; Marshall, 2013) a štúdiami (Glaeser, Kallal, Scheinkman, Shleifer, 1992; Simon, 1997 ; Glaeser, Resseger, 2010), ktoré tvrdia, že spillovery sú väčšie a intenzívnejšie v tých aglomeráciách, v ktorých sa sústreďuje väčšie množstvo ľudského kapitálu, je tento výsledok odlišný.

Záver

Tento príspevok mal za cieľ preskúmať úlohu ľudského kapitálu v lokálnom ekonomickom raste v podmienkach Slovenskej republiky. Na dosiahnutie stanoveného cieľa bol vypracovaný jednoduchý, ekonometrický model. Prostredníctvom cross-section regresnej analýzy bol zistený pozitívny a štatisticky významný vplyv faktora ľudského kapitálu na lokálnom ekonomickom raste na Slovensku. Zistenia v tomto príspevku ohľadne pozitívneho vzťahu koncentrácie ľudského kapitálu a ekonomického rastu na lokálnej úrovni, sú tak v súlade s tvrdeniami vyplývajúcimi z modelov zahraničných výskumníkov. Je nutné zvýrazniť, že v tomto príspevku bol použitý jednoduchý ekonometrický model, ktorý neobsahuje viacero alternatívnych ukazovateľov, ktoré sú bežne používané zahraničnými autormi a na viac v ňom absentuje efekt regionálnej špecializácie. Tieto obmedzenia však predstavujú pre autorov príležitosť pre pokračovanie a prehlbovanie výskumnej činnosti týkajúcej sa lokálneho ekonomického rastu v podmienkach Slovenska.

Poďakovanie

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ČASO-PROSTOROVÁ DYNAMIKA VYBRANÝCH DEMOGRAFICKÝCH UKAZATELŮ BRNĚNSKÉ METROPOLITNÍ OBLASTI V LETECH 2001 A 2011 S VYUŽITÍM PROSTOROVÉ AUTOKORELACE

TIME-SPATIAL DYNAMICS OF SELECTED DEMOGRAPHIC INDICATORS IN BRNO METROPOLITAN AREA IN 2001 AND 2011 USING SPATIAL AUTOCORRELATION

Aleš Ruda, Kateřina Pavlíková

Abstract: Time-spatial dynamics illustrates a change of significant spatial patterns in time. These analyses help to identify spatial associations pointing at socio-spatial distribution. Reflecting important demographic changes during last decades a specific feedback of politicians is expected as a result of ongoing suburbanization process. Confirmed spatial autocorrelation among examined demographic variables approved to use a set of spatial statistic tools distinguishing the change between inner core and the periphery within Brno metropolitan area (BMA). In fact, Moran´s I criterion indicating the intensity of autocorrelation and Getis-Ord Gi* statistic generating hot spots and cold spots were applied. According to results it is clear that the city of Brno lost between 2001 and 2011 its population dominance. The age structure correlates with suburbanization process. It was also proved that spatial associations of indicators dealing with age structure, level of education and employment were detected in the periphery of BMA, especially in southern area the rise of population in productive age group, low level of education and high unemployment in agricultural sector is significant.

Keywords: demographic changes, suburbanization, hot spot analysis, spatial pattern, city development.

JEL Classification: C46, D11.

Úvod

Brněnská metropolitní oblast (BMO) je mezi léty 2001 a 2011 charakteristická výraznou proměnou demografických ukazatelů. Pozice města Brna z hlediska populační velikosti od roku 2001 ztrácí na svém významu zejména ve svém jádru. Demografický jev sílících suburbanizačních procesů výrazně ovlivňuje vývoj ostatních demografických ukazatelů a projevuje se proměnou věkové struktury v prostorových jednotkách, která je jedním z faktorů ovlivňující trh práce. Demografický problém stárnutí populace města Brna je na úrovni Jihomoravského kraje (JMK) i BMO aktivně řešen a implementován v širokém měřítku do strategických dokumentů s prioritním cílem zabránit marginalizaci sociálních skupin a neudržitelnému růstu nákladů na sociální potřeby stárnoucí populace. Nezbytnými podklady pro aplikaci nástrojů veřejných politik se tak stávají výsledky studií reflektující prostorový rozsah problematiky. Cílem článku je proto identifikovat prostorové vzorce změn

demografického vývoje obyvatelstva v BMO v letech 2001 a 2011 mezi zázemím Brna a města Brna za účelem determinace odlišností mezí jádrem a jeho zázemím.

1 Formulace problematiky

Vzhledem k markantnímu rozvoji geoinformačních technologií se v současnosti geografické informační systémy (GIS) stávají stále významnější součástí v oblasti regionálního rozvoje a vytváří tak novou výkonnou sadu nástrojů s vysokým potenciálem pro prostorové analýzy. V geoinformační terminologii je geodemografie pojímána jako analýza obyvatelstva dle místa jejich bydliště, a to zejména podle druhu sousedství (Smith et al., 2007). Ačkoliv Martin (2003) zdůrazňuje význam prostorového rozměru při populačních analýzách, upozorňuje však, že potenciál pro uplatňování nástrojů GIS v sociálně-ekonomických studiích nebyl dosud plně realizován. Přesto v posledních několika letech došlo k posunu směrem k tzv. demografickým informačním systémům kombinující informace o populaci s vybranými funkcemi GIS (Harris et al., 2005). Již od prvních populačních cenzů a průzkumů je cílem analytiků snaha porozumět prostorovým vzorcům charakteristik obyvatelstva. Berry a Kasarda (1977), Frisbie a Kasarda (1988) a McKenzie (1924) se již v populační dynamice zabývali prostorovou autokorelací a považují ji za implicitní v několika demografických a sociologických teorií a empirických studií věd, jako jsou ekologie člověka, sociologie města a venkova. Neomarxisté studovali prostorové dimenze populační dynamiky zejména se záměrem na populační přerozdělování, demografické změny počtu obyvatel a struktury měst tak spatřují jako výsledek kapitalismu (Hall, 1988; Jaret, 1983). Geodemografie se v této problematice zabývá také venkovskými oblastmi a prostorové analýzy využívá ve výzkumech migrace, rozložení obyvatelstva a predikcích (Beaujeu-Garnier, 1966; James, 1954; Trewartha, 1970; Zelinsky, 1966). Prostorové difúzní teorie tvrdí, že populace má tendence rozšiřovat se do okolních oblastí, což znamená, že populační růst je prostorovou autokorelací (Hudson. 1972). Yu a Wei (2008) využili právě prostorové autokorelace s modelem prostorové regrese k rozlišení městských a venkovských prostorových struktur. V rámci prostorového využití demografických dat modeloval Su (1998) vnitřní prostředí měst (urban modelling) a naznačil nutnost vývoje nových přístupů ke konceptualizaci prostoru a času. Peterson (2011) zkoumal užitečnost použití geodemografie jako prostředku k zacílení čtvrtí v kampaních veřejného zdraví. Kážmér (2016) aplikoval metody bayesovského mapování pro hodnocení vývoje úmrtnosti populace velkých měst v letech 2001 – 2011 z pohledu jejich časoprostorových struktur a diferencí na úrovni příslušné intenzity, a to podle různých příčin smrti. Mimo výše uvedené aplikace zdůrazňuje Kraus (2008) možnost zkoumat regionální diference na příkladu plodnosti žen s využitím širšího spektra geostatických analýz. Kukuliač a Horák (2014) k otázce prostorového rozložení zaměstnanosti uvádí závislost prostorové distribuce high-tech průmyslových odvětví na blízkosti městského centra a výskytu typově shodného odvětví. Nosek a Netrdová (2009) analýzou regionálních rozdílů identifikují sociálně prostorové územní diferenciace s použitím Theilova indexu, jehož výsledky společenských nerovnoměrností v geografické dimenzi poskytují podobnou informaci o relativním rozměru nerozměrnosti jako Moranovo I kritérium.

2 Metody

Prostorová závislost je považována za jednu ze základních vlastností prostorových dat, která jednak ovlivňuje možnosti použití standardních statistických metod, ale právě

v geografickém výzkumu je vlastním předmětem zkoumání. Anselin (1988) z obecného pohledu chápe princip prostorové autokorelace jako existenci určitého funkčního vztahu mezi pravděpodobností výskytu určitého jevu v prostorové jednotce a pravděpodobností výskytu tohoto jevu v jednotkách j, které jsou si prostorové blízké. Formálně lze tento vztah vyjádřit ve tvaru (1):

$$p_{i\,(y)=} f\left\{\varepsilon_i\, w_{ij}\, p_j\,(y)\right\}, \qquad (1)$$

kde $p_{i\,(y)}$ je pravděpodobnost výskytu jevu y v jednotce i, $w_{ij}\, p_j \neq j$ je stanovená váha. V případě tendencí vytvářet shluky vysokých hodnot proměnné v některých územních oblastech analyzovaného území a nízké hodnoty v jiných oblastech, se tak jedná o pozitivní prostorovou autokorelaci. V opačném případě, jestliže vysoké hodnoty tíhnou k tomu nacházet se v těsné blízkosti nízkým hodnotám a naopak, hovoříme o negativní prostorové autokorelaci. Jsou-li data lokalizována tak, že neexistuje žádný vztah mezi blízkými hodnotami, jedná se o nulovou prostorovou autokorelaci. Dle Fotheringhama a kol. (2002) ovšem většina prostorových dat vykazuje určitou formu pozitivní prostorové autokorelace. Jako ukazatel sloužící k měření prostorové autokorelace kvantitativních dat spojitého měřítka bylo užito Moranovo I kritérium, které je definováno (2):

$$I = \frac{\sum i \sum j\, w_{ij}\, c_{ij}}{s^2\, \sum i \sum j\, w_{ij}}, \qquad (2)$$

kde $c_{ij} = (z_j - \bar{z})(z_j - \bar{z})$ a $s^2 = \frac{\sum i(z_i - \bar{z})^2}{n}$, přičemž n je počet analyzovaných jednotek, i, j jsou indexy charakterizující nějaké dvě jednotky, z_i značí hodnotu proměnné v jednotce i a $\bar{z}$ aritmetický průměr sledované proměnné (Cliff, Ord, 1973).

Index Moranova *I* kritéria nabývá hodnot od -1 (negativní prostorová autokorelace) do 1 (pozitivní prostorová autokorelace). Pro výpočet Moranova *I* kritéria je užíváno vah z binární nebo stochastické matice. Následně se zjišťuje statisticky významný rozdíl mezi hodnotou indexu a očekávanou hodnotou. Z jejich rozdílu se pomocí míry rozptylu vypočítá hodnota *z-score*, která naznačuje, zda můžeme zamítnout nulovou hypotézu o absenci prostorového shlukování. Čím je *z-score* větší/menší, tím je shlukování intenzivnější, hodnoty blízké nule indikují statisticky nevýznamné shlukování (Spurná, 2008). *p-value* je pravděpodobnost, se kterou zavrhneme nulovou hypotézu. Následně provedená hot spot analýza počítá statistiku Getis-Ord Gi* pro jednotlivé funkce v datové množině a identifikuje rozmístění prostorových shluků vysokých hodnot (hot spots) a prostorových shluků nízkých hodnot (cold spots). Getis-Ord statistika je dána (3):

$$G_i^* = \frac{\sum_{j=1}^{n} w_{i,}\, x_j - \bar{X} \sum_{j=1}^{n} w_{i,j}}{S\, \sqrt{\dfrac{\sum_{i=1}^{n} w_{i,j}^2 - \left(\left(\sum_{j=1}^{n} w_{i,j}\right)\right)^2}{n-1}}}, \qquad (3)$$

kde kde x_j je atributová hodnota prvku j, $w_{ij,}$ je prostorová váha mezi prvky i a j, n je počet prvků a dále $\bar{X} = \frac{\sum_{i=1}^{n} w_j}{n}$, $S = \sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - (\bar{X})^2}$. Výstupem pro každou prostorovou jednotku jsou hodntoy *z-score* a *p-value* (Getis, Ord, 1966). Kladná, vysoká hodnota *z-score* a hodnota *p-value* < 0,05 signifikuje existenci prostorového shluku vysokých hodnot v okolí – vznik hot spot. Naopak nízké hodnoty *z-score* a

hodnoty p-value < 0,05 identifikují existenci prostorového shluku nízkých hodnot v okolí – vznik cold spot. Lokální součet hodnoty prvku a hodnot jeho okolí je proporcionálně srovnáván se součtem hodnot všech prvků v území. Pokud je lokální součet značně odlišný od očekávaného lokálního součtu, znamená to, že tento rozdíl nemůže vzniknout náhodně a jedná se tedy o statisticky významný výsledek (*z-score*). Prostorové vztahy vyjádřené prostorovými vahami w_{ij}, byly modelovány prostorovým vztahem „Contiquity edges only", tedy pouze sousední polygony, které sdílejí hranici nebo se překrývají, ovlivní výpočty pro danou funkci cílového polygonu. Ke zpracování dat byly využity geostatistické nástroje Hot spot analysis a Spatial autocorrelation v programu ArcGIS 10.2.

3   Rozbor problému

3.1 Brněnská metropolitní oblast

Brněnská metropolitní oblast (Obr. 1) je dle Mulíčka a kol. (2013) obecně charakterizována jako „areál" překračující svým rozsahem administrativní území jádrového města a reprezentující relativně jednotný pracovní a bytový trh. Brněnská aglomerace je sídelním a ekonomickým systémem tvořeným Brnem a několika desítkami obcí v okolí, kde každodenní společenské, ekonomické, dopravní a další jiné procesy a vazby překračují jejich vymezené administrativní hranice tvořící jeden funkční celek s diferencovanými úkoly a rolemi jednotlivých sídel (MMR, 2014). Z administrativního hlediska je BMO tvořena celkem 167 obcemi včetně Brna (29 městských částí), v nichž žilo v roce 2011 celkem 609 114 obyvatel, tedy asi 5,84 % obyvatel ČR na celkové ploše 1 755,3 km². Velikostní struktura obcí podle počtu obyvatel naznačuje, že naprostá většina obcí (téměř 96 %) spadá do kategorie do 5 000 obyvatel a více než polovina obcí do kategorie do 1000 obyvatel. Celkem 16 obcí má status města a 10 obcí status městyse.

Obr. 1: Vymezení Brněnské metropolitní oblasti
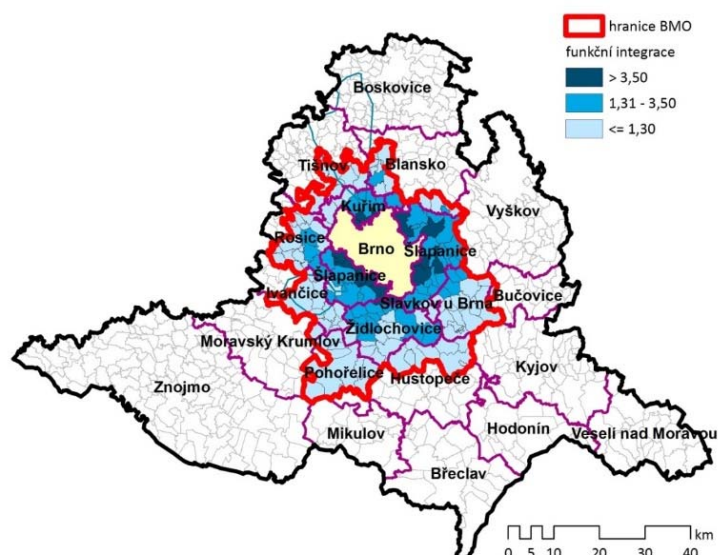
Zdroj: Mulíček et al. (2013)

3.2 Data

Data použitá pro zpracování práce pocházejí ze Sčítání lidu, domů a bytů (SLDB) z let 2001 a 2011, které byly poskytnuty zprostředkovaně Magistrátem města Brna od

Českého statistického úřadu. Údaje byly zjišťovány za nejmenší územní jednotky BMO. Volba jednotlivých demografických ukazatelů byla provedena s ohledem na identifikaci struktury obyvatelstva v BMO selektivním výběrem na základě diskuze s Magistrátem města Brna, pro něhož byly podklady připravovány. V úvahy byly vzaty tři kategorie struktury obyvatelstva zahrnující biologické, kulturní a sociální a ekonomické znaky (Tab. 1)

Tab. 1: Výsledky prostorové autokorelace

|	Ukazatele	2001			2011		
		I	*z-score*	*p-value*	**I**	*z-score*	*p-value*
	Počet obyvatel	**0,7338**	17,3304	0,0000	**0,7343**	17,3437	0,0000
věková struktura	Podíl žen z obyvatel	0,2133	5,1175	0,0000	0,1416	3,4252	0,0006
	Podíl předproduktivní složky obyvatel	0,2627	6,2658	0,0000	0,1829	4,3918	0,0000
	Podíl produktivní složky obyvatel	0,1449	0,1449	0,0004	0,1393	3,3774	0,0007
	Podíl poproduktivní složky obyvatel	0,1194	2,9133	0,0036	0,1498	3,6323	0,0003
	Index stáří	0,1586	3,8376	0,0001	0,1825	4,4061	0,0000
struktura vzdělanosti	Podíl obyvatel se základním vzděláním, včetně bez vzdělání	**0,6255**	14,7030	0,0000	**0,6180**	14,5355	0,0000
	Podíl obyvatel se středním vzděláním, vyučen bez maturity	**0,6348**	14,9384	0,0000	**0,7474**	17,5372	0,0000
	Podíl obyvatel s maturitou, VOŠ včetně nástaveb	**0,6373**	14,9693	0,0000	0,5513	13,0121	0,0000
	Podíl obyvatel s VŠ vzděláním	**0,7963**	18,6958	0,0000	**0,8053**	18,8737	0,0000
ekonomický pot.	Podíl ekonomicky aktivních z obyvatel	0,1761	4,2418	0,0000	0,0921	2,2719	0,0231
	Podíl žen ze zaměstnaných	0,2651	6,3778	0,0000	0,3008	0,3008	0,0000
	Podíl nepracujících důchodců z celku obyvatel	0,2138	0,2138	0,0000	0,1624	3,9144	0,0001
	Podíl nezaměstnaných z ekonomicky aktivních	0,1320	3,2155	0,0013	0,1490	3,6126	0,0003
struktura zaměst.	Podíl zaměstnaných v primárním sektoru	0,4621	10,9218	0,0000	0,3541	8,4535	0,0000
	Podíl zaměstnaných v sekundárním sektoru	0,4294	10,1886	0,0000	**0,6040**	14,2004	0,0000
	Podíl zaměstnaných v terciárním sektoru	0,3443	8,1482	0,0000	0,3435	8,2434	0,0000
	Podíl zaměstnaných v kvartérním sektoru	**0,6750**	15,8522	0,0000	**0,7559**	17,7254	0,0000

Zdroj: vlastní zpracování

Základní jednotkou analýzy byla „základní sídelní jednotka". Pro SLDB 2001 a 2011 byla oblast Brna-města rozčleněna do 183 základních sídelních jednotek (ZSJ), areál zázemí BMO pak na 306 ZSJ. Do analýzy však nevstupovaly všechny ZSJ, 53 z nich není vůbec obydleno, některé další vykazují velmi nízký počet obyvatel. Tyto ZSJ byly vyloučeny, neboť by způsobily extrémně nízké/vysoké hodnoty ukazatelů a přinesly by

tak jisté zkreslení. Analýza dat obsahuje pouze ZSJ s více než 100 obyvateli, v SLDB 2011 bylo bráno v potaz celkem 442 ZSJ. Ztrátu sociálně-demografických informací lze však považovat za zanedbatelnou. Data po eliminaci parametrově nevyhovujících ZSJ nesou informaci o 99,5 % obyvatelích Brněnské metropolitní oblasti. Jednotlivé demografické ukazatele byly pro každý rok a pro každou obec vymezené lokality sumarizovány a výsledná data za celé obce byla přepočtena na relativní hodnoty s výjimkou počtu obyvatel. V souvislosti se prostorovou analýzou dat bylo území BMO rozděleno do prostorových jednotek, které odpovídají administrativnímu vymezení obcí.

3.3 Prostorová analýza

Demografické ukazatele byly na základě výsledků Getis-Ord Gi* statistiky rozděleny do skupin (věková struktura, struktura vzdělanosti, ekonomický potenciál a struktura zaměstnanosti) tak, aby mezi nimi bylo možno interpretovat vzniklé prostorové vzorce (Tab. 1). Hodnoty ukazatele počtu obyvatel nabývají vysoké hodnoty Moranova *I* kritéria (0,73) a s provedením hot spot analýzy měly prostorové jednotky v rámci BMO tendenci ke shlukům pouze vysokých hodnot, a to v obou letech v oblasti všech městských částí Brna, vyjma městské části Kníničky a Chrlice patřících k okrajovým částem Brna-města. Populace města Brna vykazuje decentralizační tendence projevující se stěhováním obyvatel (konkrétně úbytkem obyvatel) z městských částí Vinohrady, Brno-střed, Žabovřesky, Kohoutovice a Nový Lískovec do zázemí. Zbývající městské části vykazují přírůstek. Tyto prostorové jednotky s vyššími přírůstky jsou specifické svojí periferní polohou na okraji Brna-města, výjimkou je městská část Židenice. Na základě toho lze v BMO identifikovat dva typy dekoncentrace: dekoncentraci od centra města Brna k jeho okrajovým částem a dekoncentraci od města Brna jako celku k zázemí BMO projevující se suburbanizací. Demografická dynamika v rámci BMO (zejména migrace obyvatel v nižší věkové kategorii) umocňuje výraznou nevyváženost ve věkové struktuře v lokalitách BMO. Vývoj jednotlivých věkových kategorií signifikuje výraznou proměnu v letech, která se projevuje stárnutím populace ve městě Brně. Jižní část BMO je charakteristická přírůstkem produktivní složky a úbytkem předproduktivní složky obyvatelstva, naopak severní část BMO vykazuje v meziročním srovnání přírůstky dětské složky (Obr. 2). V městských částech Brna-města je lokalizován výrazný nárůst poproduktivní části obyvatel. roce 2001 lze na základě Hot Spot analýzy vymezit oblasti v centru BMO (Obr. 3), převážně v městských částech, kde je převaha prostorových jednotek s nejnižšími podíly předproduktivní složky (při hladině spolehlivosti 99 % v roce 2001: Brno-střed, Královo Pole, Řečkovice a Mokrá Hora, Brno-sever, Židenice, Jundrov, v roce 2011 ubyla městská část Brno-sever a přibyly Kohoutovice, Nový Lískovec a Černovice.

Obr. 2: Přirozený pohyb podílu předproduktivní složky (vlevo) a poproduktivní složky (vpravo) v BMO mezi roky 2001 a 2011Název obrázku
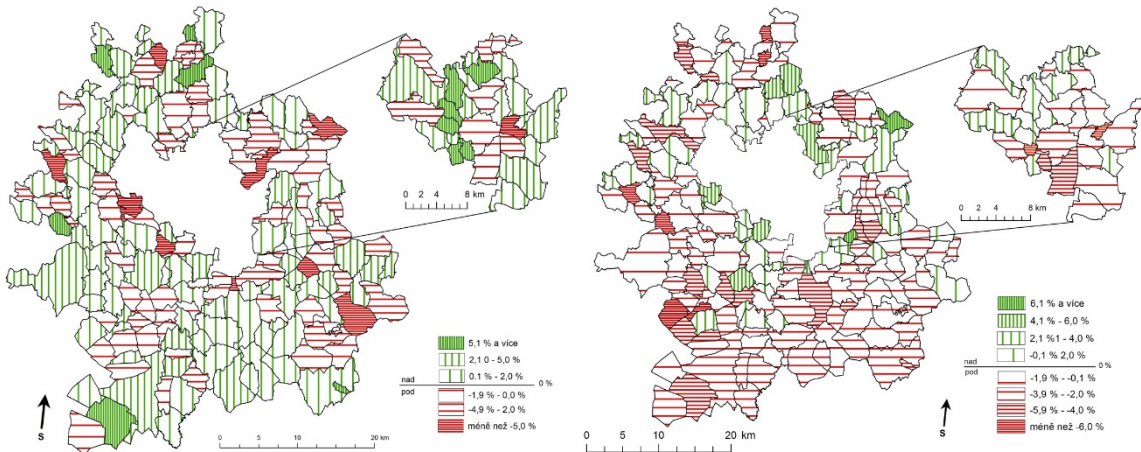
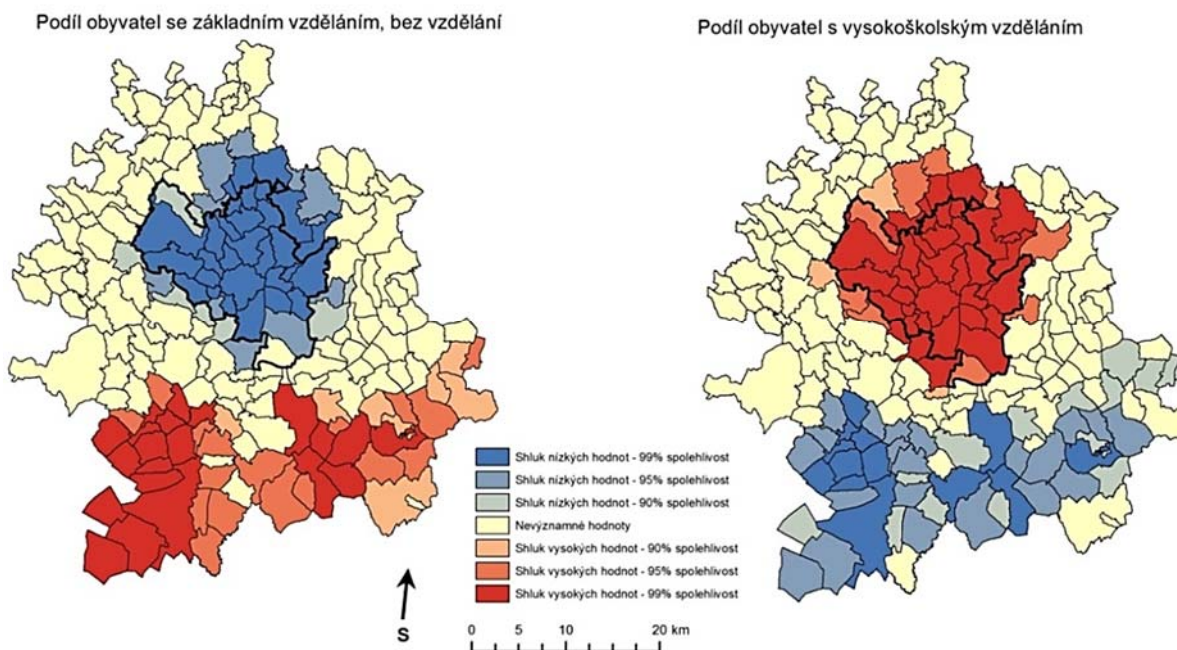**Obr. 3: Hot Spot analýza podílu předproduktivní složky v BMO v roce 2001 a 2011**
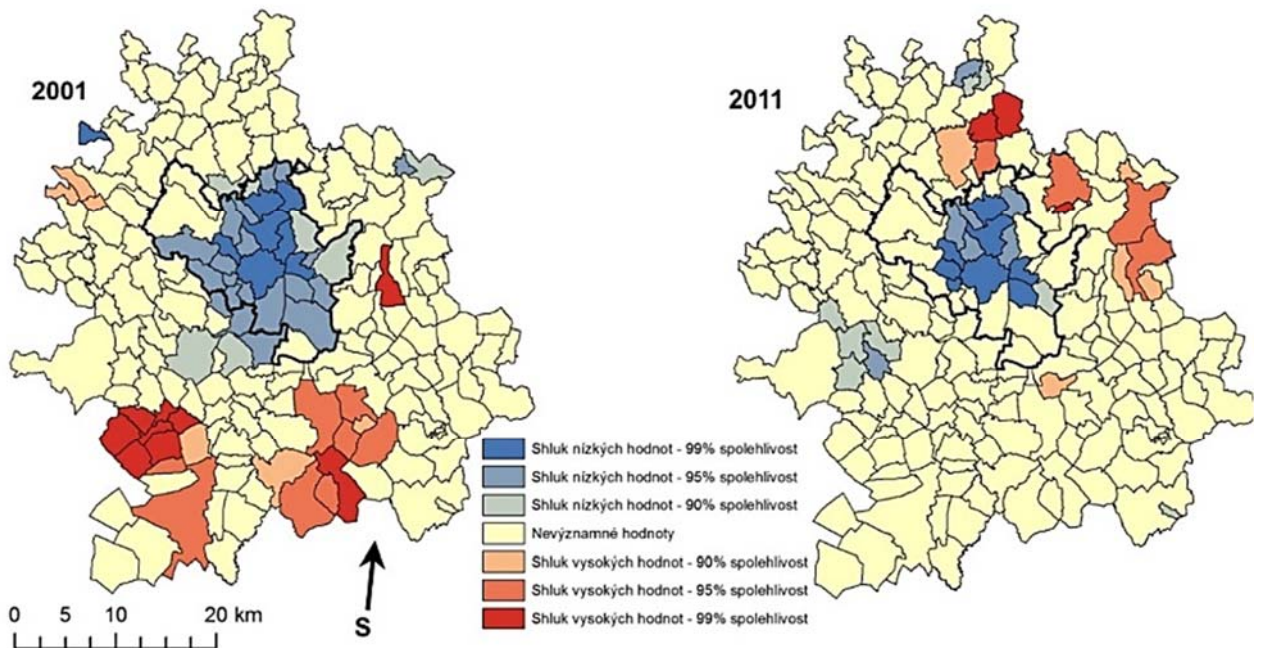
Naopak v jižní části BMO lze vymezit dvě oblasti s nejvyšším podílem dětí, v roce 2001 při hladině spolehlivost 99 % se jedná o shluk prostorových jednotek v jihovýchodní čísti BMO: Jezeřany-Maršovice, Loděnice, Malešovice, Kupařovice, Trboušany a jižní části: Nikolčice, východní: Tvarožná. V roce 2011 se shluky s nejvyšším zastoupení nacházejí v severovýchodní části, kdy se na hladině spolehlivosti 99 % jedná o prostorovou jednotku Šebrov-Kateřina (20,47 %) a Svinošice (21,97 %). Srovnáním s indexem stáří v roce 2001 je patrná zcela inverzní situace, co se oblastí s nejvyšším zastoupením indexu stáří týče. Z vývoje zkoumaných ukazatelů je možno si povšimnout dvou významných událostí vznikajících v souvislosti s vývojem ostatních demografických ukazatelů. V prvé řadě se jedná o zastoupení vysokého podílu ekonomicky aktivních obyvatel s vyšším stupněm vzdělání a nízkými hodnotami indexu stáří v okrajových částech města Brna (Líšeň, Nový Lískovec, Medlánky), naopak

městské části ve středu města Brna (Žabovřesky, Královo Pole, Brno-střed) vykazují nižší podíl ekonomicky aktivních obyvatel (v rozmezí 46,1 % – 48,83 %) s vysokými hodnotami indexu stáří (152,54 % - 224, 37 %). Obdobné tendence jsou charakteristické pro oblast BMO, které je možno sledovat na vybraných prostorových jednotkách z periferní oblasti (Příbram na Moravě, Malá Lhota, Vysoké Popovice) a ze suburbií v blízkosti Brna-města (Měnín, Rebešovice, Troubsko). Periferní oblasti Brna-města vykazují vysoký podíl poproduktivní složky (index stáří dosahuje v obci Malá Lhota až 175 %), na úkor toho je nižší procentuální zastoupení ekonomicky aktivních obyvatel.

Zázemí BMO je charakteristické podílem nižšího stupně vzdělanosti, v roce 2001 BMO tvořilo vzdělanostní strukturu 20,18 % obyvatel se základním vzděláním, 34,2 % se středním vzděláním bez maturity, v roce 2011 základního vzdělání dosahovalo 19,9 % obyvatel, středního vzdělání bez maturity 33,9 %. Brno-město vykazuje nejvyšší zaměstnanost v terciérním a kvartérním sektoru (nárůst z 67 % na 68 %). Průměrná zaměstnanost zázemí BMO v sekundárním sektoru v roce 2001 tvořila 35,7 %, v roce 2011 35,6 %. Tato oblast vykazuje v porovnání s Brnem-městem také vyšší zastoupení primárního sektoru. Hodnoty shlukové analýzy identifikovaly jižní část BMO jako oblast se zastoupením prostorových jednotek s nejnižším stupněm vzdělání a nejvyšší zaměstnaností v primárním sektoru v rámci BMO, severní část (převážně oblast Brna-střed) jako oblast s nejvyšším stupněm vzdělání a nejvyšší zaměstnaností v kvartérním sektoru (Obr. 4 a Obr. 5).

Obr. 4: Srovnání výsledků hot spot analýzy ukazatele podílu obyvatel se základním vzdělání, bez vzdělání a podílu obyvatel se vzděláním vysokoškolským v roce 2011
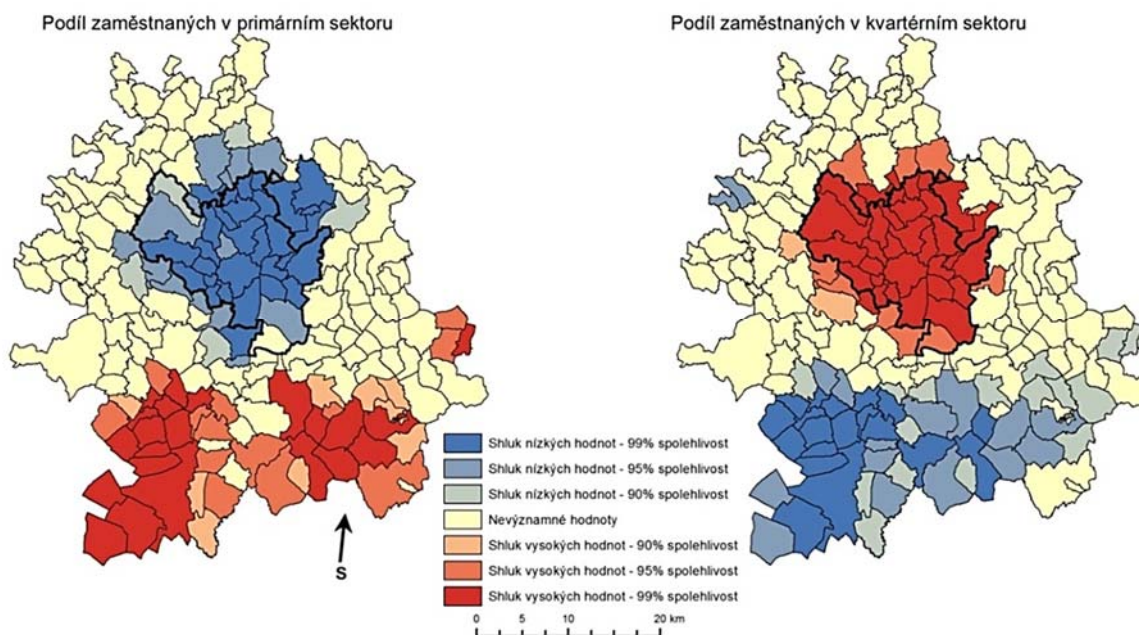
Zdroj: vlastní zpracování

4 Diskuze

Vývoj a pohyb obyvatel v BMO na základě vyhodnocených dat vykazuje silné růstové tendence v zázemí v blízkosti hranice města Brna. Shodně s Posovou a Sýkorou (2011) byla zjištěna dominance městského jádra. Věková struktura obyvatelstva v severovýchodní části BMO je tvořena vyšším podílem poproduktivní populace oproti populaci předproduktivní. Město Brno je zatíženo procesem stárnutí obyvatel. Přiléhající prostorové jednotky města Brna vykazují pokles podílu poproduktivní složky obyvatel kompenzovaný přírůstky předproduktivního a produktivního obyvatelstva. V prognóze demografického vývoje v ČR Ouředníček a Špačková (2013) shodně deklarují výraznou proměnu věkové struktury v suburbánních oblastech projevující se rostoucím indexem stáří a poukazují na zřetelně se projevující rozdíl mezi obcemi v zázemí města Prahy a městy nad 10 000 obyvatel. Burjanek (2014) v sociodemografické analýze Brněnské metropolitní oblasti na základě rozboru dílčích demografických ukazatelů s použitím shlukové a faktorové analýzy shodně identifikuje suburbánní tendence v metropolitní oblasti Brna. Nástroje veřejné správy reagují na tento demografický trend při tvorbě strategických dokumentů. Gregorová, Vidovićová (2007) spatřují mainstreaming věku jako strategii managementu populace zatížené stárnoucí populací a zdůrazňují její zapracování do komunitních plánů a strategií obcí, měst, krajů. Dle výsledků si lze povšimnu koncentrace prostorových vzorců v BMO, jedná se oblast jižní a severní části, které z demografického hlediska vytváří bipolární oblasti (nízká úroveň vzdělanosti, vyšší zaměstnanost v primárním sektoru v jižní části BMO, vyšší úroveň vzdělanosti, vyšší zaměstnanost v terciárním, kvartérním sektoru). Ouředníček a Novák (2009) analyzují podíl vzdělanosti v městských regionech s využitím měr segregace (index segregace) a územní koncentrace (lokalizační kvocient) dle statistického zpracování dat SLDB 1991, 2001 a následné kartografické vizualizace

kartogramem s výsledným zvyšováním sociální polarizace. Uvádí však relativně rovnoměrně rozmístěné obyvatelstvo se základním vzděláním na území ORP v rámci ČR. Rozdílnost výsledků lze vysvětlit výrazně menším analyzovaným územím v této práci, jimž je BMO, které je navíc ovlivněno silnou koncentrací jevů v jádru města. Prostorové rozložení podílu zaměstnanosti v sektorech národního hospodářství vykazuje silné tendence k shlukování nejnižších a nejvyšších hodnot, přičemž oblast města Brna a přilehlých obcí vykazuje shluky prostorových jednotek na hladině spolehlivosti 95 % nejvyššího zastoupení primárního, sekundárního sektoru a opačně nejnižších hod-not terciárního, kvartérního sektoru. Shluk prostorových jednotek s nejvyššími hodnotami zastoupení terciárního sektoru je identifikován v severní/severovýchodní části BMO, kvartérního sektoru v jižní části BMO.

Závěr

Brněnská metropolitní oblast od roku 2001 vykazuje silně rostoucí populační vývoj v nejpřilehlejších prostorových jednotkách za administrativní hranicí města Brna společně se vznikem suburbií. Pozice města Brna z hlediska populační velikosti od roku 2001 ztrácí na svém významu zejména ve svém jádru. Demografický jev sílících suburbanizačních procesů výrazně ovlivňuje vývoj ostatních demografických ukazatelů a projevuje se proměnou věkové struktury v prostorových jednotkách, která je jedním z faktorů ovlivňující trh práce. Rozložení věkové struktury BMO v meziročním srovnání v období 2001 – 2011 koreluje se suburbanizačními procesy a na základě výsledků prostorové analýzy vykazuje BMO shluky prostorových jednotek s nejvyššími a nejnižšími hodnotami ukazatelů věkové struktury, vzdělanosti obyvatel a zaměstnanosti v sektorech národního hospodářství. Determinovány jsou tak z demografického hlediska diametrálně odlišné oblasti. Jižní oblast BMO (bráno od nejjižnějšího bodu administrativní hranice města Brna směrem na jih) je charakteristická přírůstky obyvatel ve věkové kategorii produktivních obyvatel, koncentrací obyvatel se základním vzděláním, bez vzdělání a oblastí shluku prostorových jednotek vykazujících nejvyšší zaměstnanost v primárním sektoru. Meziroční vývoj v komparaci mezi zázemím BMO a města Brna vykazuje sílící růst vysokoškolsky vzdělaného obyvatelstva v Brně-městě a zaměstnanosti v kvartérním sektoru. BMO v komplexním měřítku od roku 2001 vykazuje nejvyšší zastoupení sektoru sekundárního a kvartérního se sílící tendencí. Strategické cíle jsou vytvářeny s ohledem na silné zastoupení Brna-města jako centra vzdělání, vědy, výzkumu a inovativního prostředí a vytvářejí strategický záměr udržení a posílení silné konkurenceschopné pozice Brna-města prostřednictvím marketingových nástrojů (podporujících image Brna-města jako centra univerzitního vzdělání), podpory investiční politiky vysokých škol, sladění poptávky trhu se vzdělanostní strukturou obyvatel.

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EKONOMICKÁ ODOLNOST REGIONŮ A MĚŘENÍ KOMPLEXITY: PŘÍKLAD EVROPSKÝCH REGIONŮ

ECONOMIC REGIONAL RESILIENCE AND MEASURING COMPLEXITY: EXAMPLE OF EUROPIEN REGIONS

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Abstract: *This study aims to validate the relationship between the degree of complexity (e.g. the degree of chaos) in regional time series and economic resilience. The analysis builds on previous studies that tried to prove the relationship between Lyapunov exponent and regional resilience. Unlike previous empirical research, the goal of our investigation is to verify the usefulness of selected indexes of complexity for quantifying regional resilience in the context of the economic crisis of 2008. The research questions formulated in other studies quietly anticipated the existence of stochastic dependence between the degree of complexity and sensitivity of the region to the economic downturn. We will describe an empirical application, in which the resilience of the regional labour market at the level NUTS 2 from 12 EU's countries in the period 1998 - 2014 is going to be investigated by use of an algorithm for business cycle detection and method for complexity measurement. The results suggest that the relationship between the regional resilience and the degree of complexity depends on the selection of the appropriate measure of complexity. In this work has been analysed the relationship of regional resilience with Lyapunov exponent and the generalised Hurst exponent.*

Keywords: *Resilience, Engineering resilience, Ecological resilience, Evolutionary resilience, Spatial economics, Complexity.*

JEL Classification: B52, O18, R10, R11.

Úvod

Regionální odolnost byla v posledních letech předmětem výzkumu již v mnoha studiích, které na základě posouzení dopadů velkého spektra negativních šokových jevů usuzovaly na odolnost (nebo neodolnost či zranitelnost) zkoumaných regionů. Obsáhlý přehled uskutečněného empirického výzkumu poskytuje příspěvek od autorů Modica a Reggiani (Modica, Reggiani, 2014) a podrobně seznamuje čtenáře s odlišnostmi i analogiemi v pojetí ekonomické odolnosti. V průběhu let totiž vznikla tři odlišná pojetí odolnosti (resilience), která se liší v úhlu pohledu na to, co je základním charakterem této schopnosti, jejímž nositelem je určitý územně vymezený region.

Na rozdíl od dosavadních empirických výzkumů, které pracují s mírami komplexity jako s ukazateli použitelnými ke kvantifikaci regionální odolnosti z hlediska „ekologického" či „evolučního" pojetí, je cílem námi předkládaného výzkumu ověření předpokladu o reálné použitelnosti vybraných měr komplexity časové řady pro účely kvantifikace regionální odolnosti v kontextu hospodářské krize roku 2008. Výzkumné otázky námi předkládaného výzkumu tedy formulují v jiných výzkumech tiše předpokládanou relaci o existenci stochastické závislosti mezi mírou komplexity a citlivostí regionu na hospodářský pokles. Výsledky ukazují, že úspěch měření regionální

odolnosti prostřednictvím měr komplexity časových řad je značně ovlivněn nejen volbou zkoumaného vzorku, ale i volbou metody, která se pro měření komplexity časové řady aplikuje.

Článek nejprve stručně pojednává o třech pojetích regionální resilience. Na základě literární rešerše je poskytnut stručný vhled do této problematiky. V analytické části se text článku věnuje samotné aplikaci vybraných přístupů na příkladu časových řad zaměstnanosti regionů úrovně NUTS2 12 států Evropské Unie v období let 1998 až 2014.

Ekonomická odolnost regionů a její různá pojetí

Výzkum regionální odolnosti souvisí s problematikou regionálního rozvoje[1], jelikož adekvátní regionální odolnost podmiňuje dosažení stabilního regionálního rozvoje. Vymezení pojmu regionální odolnost však není triviální záležitostí. Přes existenci řady formulačně odlišných definic je možné vidět obecnou podstatu tohoto pojmu ve schopnosti regionu dobře odolávat vnějšímu vychýlení. Výstižnou definici ekonomické odolnosti regionu uvádí kupříkladu Hill a kol., kteří ji vymezují jako schopnost ekonomiky regionu (Hill et al., 2011): „...*úspěšně se zotavit z otřesů, které vedly k podstatnému odklonu dosavadního vývoje regionu a způsobily hospodářský pokles*“. Přes základní shodu o charakteru odolnosti však existují odlišná pojetí odolnosti, jež je možné vnímat jako uchopení téhož z odlišné perspektivy.

Za základní pojetí regionální odolnosti je považováno tzv. pojetí "technické", které vychází z představy statické rovnováhy regionu vychylované vnější událostí. Podstatnou charakteristikou tohoto přístupu je posouzení schopnosti regionu „vrátit se zpět“ do původní rovnováhy[2]. Přes početný soubor uskutečněných empirických studií využívajících tohoto přístupu (především díky své snadné uchopitelnosti) se aplikace „technického“ pojetí setkala i s nemalou kritikou, která postupně vedla k rozvinutí dalších dvou pojetí. V prvním z nich je odolnost nahlížená z ekologické perspektivy, za jehož autora je považován kanadský ekolog Holling (Holling, 1973). Podstatou tohoto pojetí je kladení důrazu na schopnost regionu odolávat vnějšímu působení díky existenci více rovnovážných stavů, mezi nimiž region postupně přechází.

Další přístup, který bývá v některých studiích považován jen za rozšířenou obdobu „ekologického“ pojetí, je označován jako "adaptivní" (někdy též "vývojový" či „evoluční“) - viz např. (Martin, Sunley, 2012). Vznikl v reakci na kritiku některých autorů (např. (Martin, Sunley, 2007)), kteří za slabinu prvních dvou pojetí vidí nedostatečně zahrnuté hledisko vývoje ekonomiky v dlouhodobém časovém horizontu. Odolná ekonomika regionu se dle tohoto přístupu z hlediska své vnitřní struktury neustále proměňuje a minimalizuje tak preventivně dopady destabilizujících jevů. Adaptivní pojetí odolnosti je odvozeno z teorie „komplexních adaptivních systémů“, která je základním paradigmatem „ekologického“ i „adaptivního“ pojetí. Proto není překvapivé, že se za vhodný nástroj pro měření odolnosti (s ohledem na tato dvě pojetí) používají v některých empirických studiích míry komplexity.

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[1] Mezi studie zabývající se problematikou spojenou s regionálním rozvojem lze uvést např. (Vahalík, Staníčková, 2014) a (Zdražil, Kraftová, 2016).
[2] Například se může jednat o návrat tempa růstu zaměstnanosti daného regionu na hodnotu odpovídající předkrizovému období (Martin, Sunley, 2012).

Metodika výzkumu

Cílem výzkumu popsaného v tomto textu je ověření předpokladu o reálné použitelnosti vybraných měr komplexity časových řad pro účely kvantifikace regionální odolnosti v kontextu hospodářské krize roku 2008. Pro naplnění cíle byly stanoveny následující dvě výzkumné otázky:

1) Míra komplexity časových řad regionální zaměstnanosti měřená před počátkem hospodářské krize roku 2008 reprezentovaná největším Lyapunovým exponentem vykazuje kladnou korelační závislost s Indexem citlivosti regionu na hospodářský pokles.

2) Míra komplexity časových řad regionální zaměstnanosti měřená před počátkem hospodářské krize roku 2008 reprezentovaná Hurstovým exponentem vykazuje kladnou korelační závislost s Indexem citlivosti regionu na hospodářský pokles.

Z důvodu ověření výzkumných otázek byla použita čtvrtletní data o regionální zaměstnanosti regionů úrovně NUTS 2 celkem 12 států[3] EU v období 1998 – 2014 (data byla získána z Výběrového šetření pracovních sil (ČSÚ, 2016)). Volba vzorku regionů z jednotlivých států byla determinována délkou časových řad regionální zaměstnanosti. Aby bylo možné smysluplně konstruovat ukazatele míry komplexity z dostatečně dlouhých časových řad, byly do výzkumného vzorku zařazeny jen regiony těch států EU, u kterých probíhalo Výběrové šetření pracovních sil před rokem 2004. Volba zkoumaného období byla dále motivována zaměřením výzkumu resp. potřebou ověření formulovaných otázek. Pro zajištění adekvátní analýzy čtvrtletních údajů byla data nejprve ošetřena X12-ARIMA filtrem odstraňujícím sezónní výkyvy. Vyhodnocení platnosti uvedených otázek bylo založeno na výsledcích pořadové korelace (parametrickou verzi korelační analýzy nebylo možné použít z důvodu neprůkaznosti normality použitých dat; test normality byl uskutečněn pomocí Shapiro-Wilkova testu).

S ohledem na formulaci výzkumných otázek bylo v další části analýzy přistoupeno k sestavení potřebných indexů založených na datování bodů zvratu. Metody datování bodů zvratu slouží k identifikaci střídajících se fází růstu (oživení, expanze) a poklesu (recese). Detekce těchto bodů je nutnou podmínkou pro stanovení hodnot indikátorů C_{zam}, LLE, H (viz níže) konstruujících se z časových řad na základě znalosti hospodářského cyklu (datovaného v případě naší studie na časových řadách regionální zaměstnanosti).

Pro tyto účely sestavila Organizace pro hospodářskou spolupráci a rozvoj (OECD) doporučení pro tvorbu indikátorů. Dokument (Gyomal, Guidetti, 2012) obsahuje doporučený postup pro identifikaci hospodářského cyklu pomocí Bry-Boschan algoritmu (Bry, Boschan, 1971) resp. jeho modifikované verze pro čtvrtletní data (BBQ algoritmus). Účelem algoritmu je identifikace lokálních minim a maxim na časové řadě vyhlazené Hodrick-Prescott filtrem. V naší studii byl s ohledem na formulaci výzkumných otázek použit pro detekci fáze poklesu regionální zaměstnanosti vyvolané v souvislosti s hospodářskou krizí roku 2008. V rámci BBQ algoritmu jsou na originální časové řadě detekována období začátku a konce fází růstu a poklesu.[4] Výhodou tohoto

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[3] BE – Belgie, CZ – Česká republika, EL – Řecko, ES – Španělsko, FR – Francie, HU – Maďarsko, IT – Itálie, NL – Nizozemí, PT – Portugalsko, RO – Rumunsko, SE – Švédsko, UK – Spojené království
[4] BBQ algoritmus, který byl v rámci našeho výzkumu implementován vývojovým prostředím R studio pomocí knihovny BCDating, pracuje standardně s minimální délkou cyklu (15 měsíců) a minimální

automatizovaného postupu je rychlá a spolehlivá detekce bodů zlomu využitelná při analýze několika časových řad současně.

Pro naplnění cíle výzkumu byla dále použita metodika pro stanovení velikosti citlivosti regionu na hospodářský pokles. Za tímto účelem byl pro každý region ze zkoumaného vzorku stanoven Index citlivosti regionu na hospodářský pokles. Index citlivosti regionu na hospodářský pokles (C_{zam}), který vychází z předchozích výzkumů (např. viz (Martin, 2012)), charakterizuje velikost dopadu negativního hospodářského šoku do oblasti trhu práce daného regionu vůči téže změně měřené však na národní úrovni. Pro každý region je výpočet uskutečněn podle vzorce (1):

$$C_{zam} = \frac{(Z_{R(p1)} - Z_{R(t1)})/Z_{R(p1)}}{(Z_{N(p1)} - Z_{N(t1)})/Z_{N(p1)}}, \text{kde} \tag{1}$$

C_{zam} = Index citlivosti regionu na hospodářský pokles (bezrozměrné číslo),

$Z_{R(t)}$ = úroveň zaměstnanosti daného regionu v čase t (počet osob v tis.),

$Z_{N(t)}$ = úroveň zaměstnanosti na národní úrovni v čase t (počet osob v tis.),

p1 = čas začátku fáze poklesu - stanoven BBQ algoritmem (čtvrtletí),

t1 = čas ukončení fáze poklesu - stanoven BBQ algoritmem (čtvrtletí).

Hodnoty C_{zam} vyšší než jedna indikují významnou citlivost regionu na hospodářský negativní šok (naopak hodnoty nižší než jedna indikují menší citlivost resp. vyšší odolnost regionu vůči hospodářskému negativnímu šoku ve srovnání s celonárodní úrovní).

Dále bylo nutné vyčíslit hodnotu komplexity zkoumaných časových řad. Při výběru vhodné metody pro měření komplexity bylo vycházeno z podobných empirických studií (např. (Modica, Reggiani, 2014)). Za potenciálně vhodné metody měření komplexity byl na základě rešerše zvolen největší Lyapunův exponent (LLE) a Hurstův exponent (H). Oba se vztahují k základním vlastnostem komplexních systémů (mezi něž patří například soběpodobnost nebo nelinearita).

Soběpodobnost je jedním ze základních rysů komplexních systémů. Soběpodobnost může být posuzována z hlediska času (autokorelace) nebo rozlišovací úrovně (dimenze). Obecně lze čas považovat za jednu z dimenzí, tj. je možné považovat časovou a prostorovou soběpodobnost za ekvivalentní. Soběpodobnost z hlediska času je obecně spojena s analýzou časových řad (zpravidla jednorozměrných) a naopak prostorová soběpodobnost je spojena s geometrickými útvary, případně s vícerozměrnými objekty. Soběpodobnost lze kvantifikovat pomocí fraktální dimenze. Klasické euklidovské celočíselné dimenze reprezentují, kolik reálných čísel člověk potřebuje k popisu specifického geometrického útvaru (příp. reálného objektu). Pro výpočet fraktální dimenze existuje řada metod, které se historicky vyvíjely v oblasti problematiky řešení délky pobřeží (Mandelbrot, 1983).

Hurstův exponent se používá pro analýzu časových řad s dlouhodobou pamětí. Historicky byl Hurstův exponent spojen s Haroldem Edwinem Hurstem, který prováděl analýzu hladiny řeky Nil, přesněji určoval optimální velikost přehrady na základě historických dat srážek a sucha (Hurst et al., 1965). V oboru fraktální

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délkou fáze růstu nebo poklesu (5 měsíců). Z důvodu použití čtvrtletních dat byla minimální délka cyklu stanovena na 5 čtvrtletí a minimální délka fáze na 2 čtvrtletí.

matematiky jej generalizoval Benoît Mandelbrot (Mandelbrot, 1983), čímž vytvořil přímý vztah k fraktální dimenzi D. Zobecněný Hurstův exponent měří behaviorální náhodnost časových řad (Mandelbrot, 2010).

Hodnoty Hurstova exponentu leží z intervalu <0;1>, s tím, že hodnoty z intervalu <0;0,5> evokují časové řady s dlouhodobou pozitivní autokorelací, načež hodnoty z intervalu <0,5;1> evokují časové řady, kde se hodnoty pravidelně střídají (oscilují mezi vysokou a nízkou hodnotou). Hodnota Hurstova exponentu 0,5 reprezentuje nekorelovanou časovou řadu. Generalizovaný Hurstův exponent je definován jako H(q), a lze jej určit řešením (např. logaritmováním) následující rovnice (Mandelbrot, 2010):

$$\frac{\langle |x(t+\tau)-x(t)|^q \rangle}{\langle |x(t)|^q \rangle} \sim \tau^{qH(q)}, \tag{2}$$

kde τ reprezentuje časové zpoždění, t reprezentuje čas a $x(t)$ jednotlivé hodnoty časové řady. Pro účely kvantifikace tohoto ukazatele je v tomto příspěvku využita knihovna (Aste, 2013) v prostředí MATLAB.

Dalším populárním nástrojem pro analýzu komplexity je Lyapunův exponent, který se hojně používá při analýze nelineárních časových řad. Pokud je hodnota tohoto ukazatele kladná, značí to situaci, kdy časová řada vykazuje známky chaosu. Pro výpočet Lyapunova exponentu existuje řada metod, např. (Kantz, 1994) nebo (Rosenstein et al., 1993). Pro účely tohoto příspěvku byl Lyapunův exponent kvantifikován na základě Wolfovy metody (Wolf et al., 1985) a postup implementován v prostředí MATLAB (Wolf, 2016).

Pro hodnocení komplexity časové řady regionální zaměstnanosti je konkrétně používán tzv. největší Lyapunův exponent (LLE). Čím je hodnota LLE větší, tím dochází k rychlejší ztrátě predikce dané časové řady. To znamená, že je možné LLE využít pro odhad délky spolehlivé predikce časové řady. Tato vlastnost se nazývá prediktibilita a vyjadřuje kvalitu predikce. Lze ji vypočíst podle následujícího vzorce (Dostál, Rais, Sojka, 2005):

$$P = \frac{1}{LLE}, \tag{3}$$

kde P představuje prediktabilitu (v našem výzkumu vyjádřenou v počtu čtvrtletí).

Výsledky analýzy

Následující tabulky (viz Tab. 1 a 2) obsahují výsledky získané pomocí neparametrické korelační analýzy. Druhý sloupec obou tabulek obsahuje hodnoty Spearmanova koeficientu spočítané pro jednotlivé státy. Třetí sloupec pak obsahuje p-hodnotu pro účely vyhodnocení statistické významnosti. Obě tabulky (Tab. 1 a 2) obsahují kromě uvedených údajů ve čtvrtém a pátém sloupci také počet regionů a následně jejich podíl na celkovém počtu regionů daného státu, pro které bylo možné konstruovat uvedené míry komplexity. Z důvodu příliš krátké délky časových řad regionální zaměstnanosti bylo možné vypočíst Hurstův exponent pouze pro část regionů v případě států Belgie, Španělska, Francie, Itálie, Švédska a Spojeného království.

Tab. 1: Výsledky korelační analýzy[4] – korelační dvojice: LLE vs. C_{zam}

Stát	Spear. koeficient	p-hodnota	N	% regionů pokrytých výpočtem LLE
BE	**0.309**	0.355	11	100%
CZ	**0.048**	0.911	8	100%
EL	**0.560**	0.046	13	100%
ES	-0.086	0.726	19	100%
FR	**0.421**	0.051	22	100%
HU	**0.321**	0.482	7	100%
IT	**0.127**	0.582	21	100%
NL	-0.448	0.145	12	100%
PT	**0.214**	0.645	7	100%
RO	**0.619**	0.102	8	100%
SE	-0.595	0.120	8	100%
UK	-0.167	0.324	37	100%

Zdroj: Vlastní zpracování na základě Výběrového šetření pracovních sil (ČSÚ, 2016)

První výzkumnou otázku je možné potvrdit pouze pro regiony Řecka. U ostatních regionů nebyla prokázána statistická významnost korelačního koeficientu. Mezi státy, u kterých byla nalezena statisticky nevýznamná pozitivní korelace, patří: BE, CZ, FR, HU, IT, PT, RO. Negativní korelace, bez potvrzení statistické významnosti, byla nalezena u států: ES, NL, SE, UK.

Tab. 2: Výsledky korelační analýzy[5] – korelační dvojice: H vs. C_{zam}

| Stát	Spear. koeficient	p-hodnota	N	% regionů pokrytých výpočtem H
BE	-0.418	0.229	10	91%
CZ	**0.262**	0.531	8	100%
EL	**0.159**	0.603	13	100%
ES	-0.103	0.694	17	89%
FR	**0.200**	0.704	6	27%
HU	-0.357	0.432	7	100%
IT	**0.500**	0.667	3	14%
NL	-0.587	0.045	12	100%
PT	**0.179**	0.702	7	100%
RO	-0.762	0.028	8	100%
SE	-0.100	0.873	5	63%
UK	**0.019**	0.919	30	81%

Zdroj: Vlastní zpracování na základě Výběrového šetření pracovních sil (ČSÚ, 2016)

Druhou výzkumnou otázku není možné potvrdit pro regiony žádného ze zkoumaných států (byť byla nalezena pozitivní korelace bez prokázání statistické významnosti pro regiony států CZ, EL, FR, IT, PT, UK). Statistická významnost byla

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[5] šedé podbarvení je použito pro statisticky významné hodnoty, tučně jsou vyznačeny kladné korelační koeficienty

prokázána pouze v případě regionů NUTS 2 v Nizozemí a v Rumunsku. V těchto zemích však pořadová korelace vykazuje opačnou relaci, než která byla na základě předchozích studií očekávána (negativní korelační koeficient).
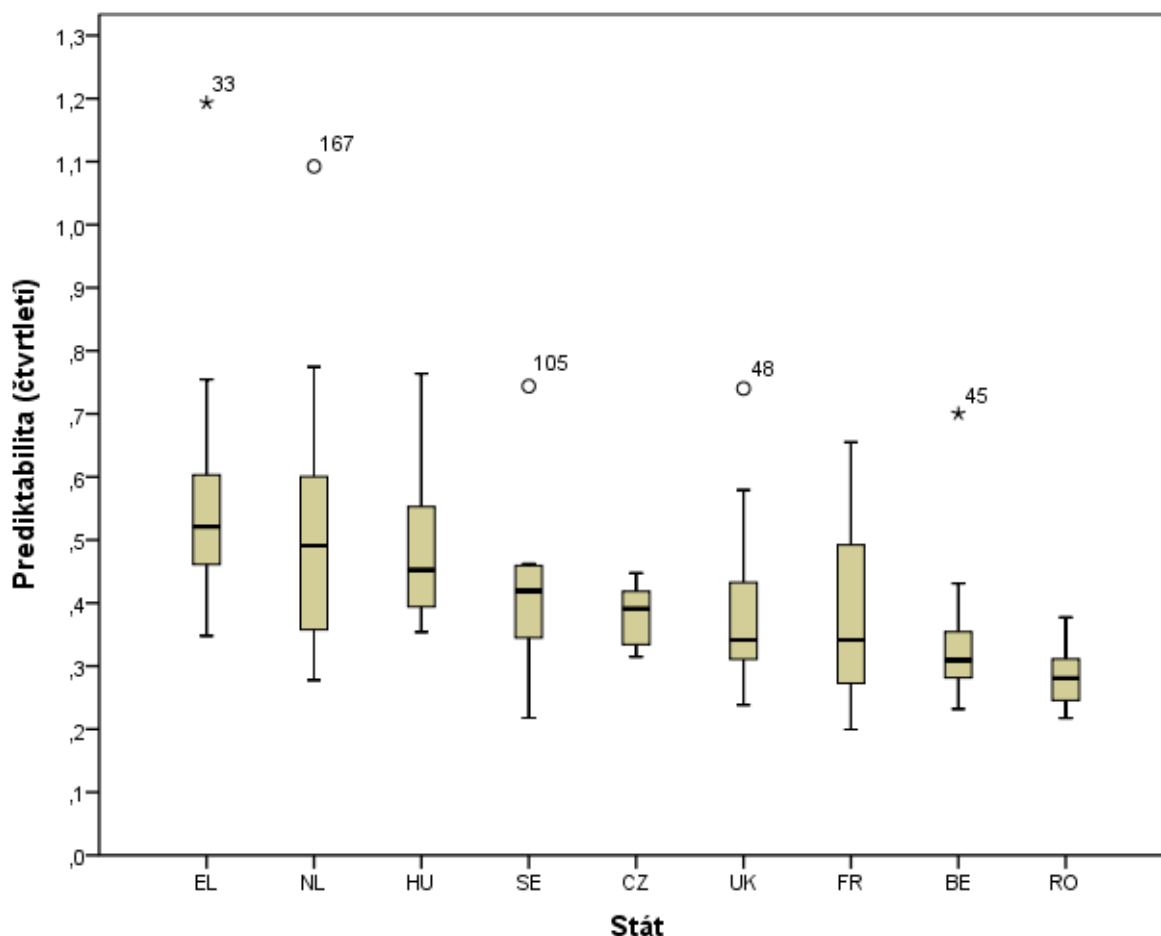
Obr. 1: Box plot – prediktabilita zaměstnanosti regionů NUTS 2 států ES, PT a IT
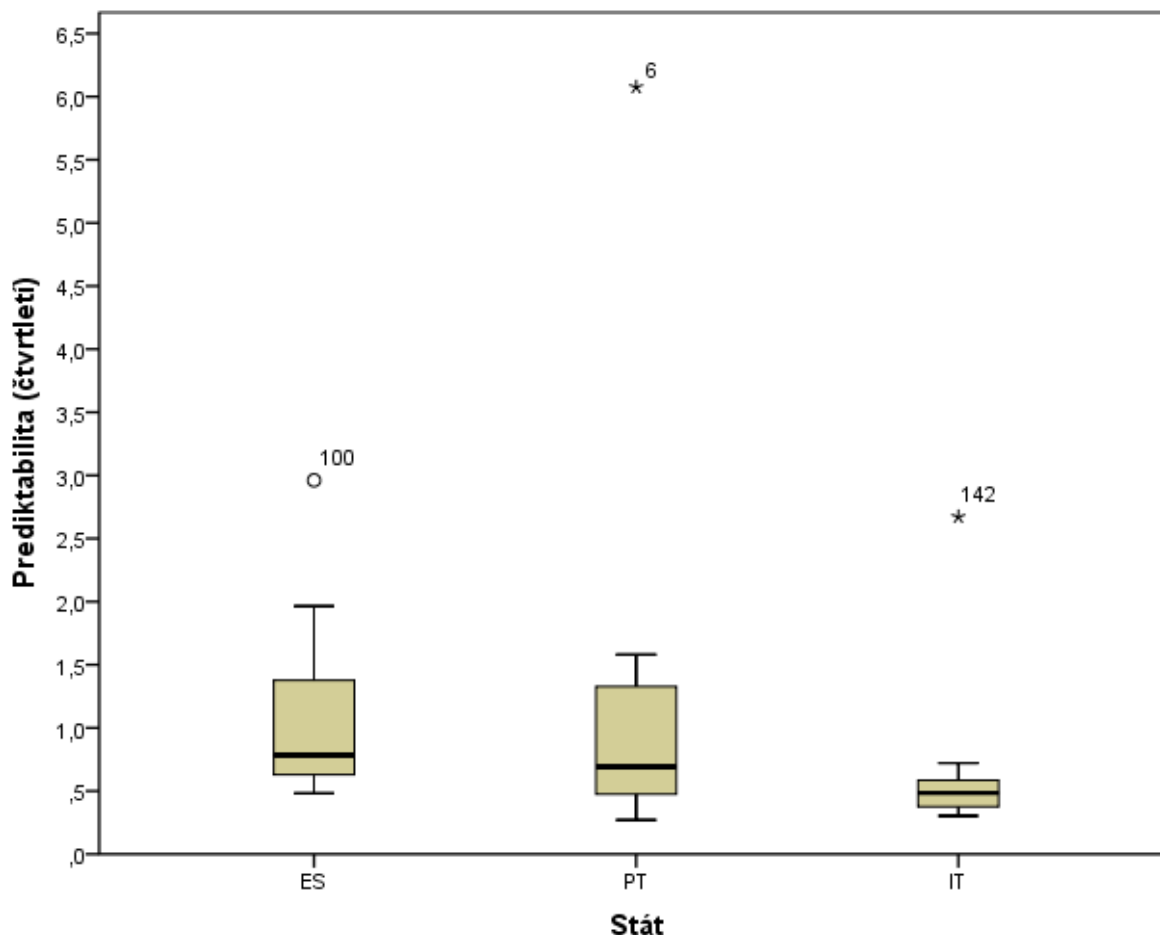
Zdroj: Vlastní zpracování na základě Výběrového šetření pracovních sil (ČSÚ, 2016)

Graf (viz Obr. 1) znázorňuje střední hodnotu (medián), horní a dolní kvartil, maximum a minimum prediktability regionální zaměstnanosti regionů NUTS 2 Španělska, Portugalska a Itálie. Jedná se o státy s nejvyšší prediktabilitou regionální zaměstnanosti z celého zkoumaného vzorku. Střední hodnota prediktability se v případě regionů zmíněných států pohybuje v intervalu 0,5 až 1 čtvrtletí.

Obr. 2: Box plot – prediktabilita zaměstnanosti regionů NUTS 2 států EL, NL, HU, SE, CZ, UK, FR, BE, RO

Graf (viz Obr. 2) znázorňuje stejné charakteristiky pro zbývající regiony ve zkoumaném vzorku. Z grafu lze odvodit, že median spolehlivé délky predikce regionální zaměstnanosti lze v případě Řecka, Nizozemí, Maďarska, Švédska a České republiky očekávat v rozmezí 0,4 až 0,6 čtvrtletí. Menší délku spolehlivé predikce lze předpokládat u časových řad zaměstnanosti regionů NUTS2 států Spojené Království, Francie, Belgie a Rumunska. Střední hodnota prediktability se v případě regionů zmíněných států pohybuje v intervalu 0,2 až 0,4 čtvrtletí.

Diskuze

Ověření předpokladu o reálné použitelnosti vybraných měr komplexity časových řad pro účely kvantifikace regionální odolnosti v kontextu hospodářské krize roku 2008 bylo hlavním cílem této studie. Dosavadní studie námi testovaný vztah většinou pouze předpokládaly bez adekvátního empirického ověření. Uskutečněný výzkum a nalezené výsledky ověřily existenci statisticky významné stochastické závislosti mezi LLE a C_{zam} pouze v případě regionů Řecka, což je v souladu s výsledky jiných studií (srov. např. (Reggiani et al., 2002)). V případě ostatních zkoumaných regionů nebyl potvrzen kladný statisticky významný korelační vztah mezi uvedenými proměnnými. Výsledky v tabulce č. 1 naopak vypovídají o nejednoznačnosti tohoto vztahu (pro regiony Španělska, Nizozemí, Švédska a Spojeného království byla nalezena nevýznamná negativní korelace). Toto zjištění vede k závěru, že v případě LLE je měření komplexity časové

řady vhodným nástrojem k hodnocení ekonomické odolnosti regionů pouze v případě některých zemí a nelze tento závěr zobecnit pro regiony libovolných států.

V případě druhé výzkumné otázky nebyla nalezena žádná skupina regionů, která by ji umožnila přijmout. Naopak byla nalezena statisticky významná negativní korelační relace v případě regionů Nizozemí a Rumunska. Tento výsledek je však nutné brát jako předběžný, jelikož jej nelze srovnat s žádnou předchozí studií. Celkové zhodnocení výsledky v tabulce č. 2 taktéž neumožňuje dosažení zobecnění pro všechny zkoumané regiony.

Dále byla v rámci analýzy ověřena spolehlivost implementace BBQ algoritmu v jazyce R. Zvolený postup se jeví jako dobře použitelný především pro rozsáhlejší soubor dat. Stejně tak se pro výpočet ukazatelů LLE a H osvědčilo použití již připravených programových balíčků v prostředí MATLAB.

Uvedené výsledky jsou zajímavé i s ohledem na vztah mezi komplexitou ekonomiky a velikostí růstu HDP (podrobněji viz (Hidalgo, Husmann, 2009)). V uvedené studii navržený ukazatel ECI, představující další z alternativních přístupů k měření komplexity, vykazuje neobvykle silnou pozitivní korelaci s ukazatelem ekonomického růstu (a to i ve srovnání s celou řadou jiných indikátorů – podrobněji viz (Hausmann et al. 2014)). Reálná použitelnost vybraných měr komplexity časové řady pro účely kvantifikace regionální odolnosti v kontextu hospodářské krize roku 2008 je silně závislá na volbě míry komplexity i na volbě zkoumaného vzorku regionů. Obecné využití měr komplexity pro predikci hospodářských krizí je proto nejednoznačné.

Závěr

Text příspěvku se věnuje problematice tří odlišných pojetí ekonomické odolnosti regionů. Navazuje na předchozí empirické výzkumy vycházející z „ekologického" či „adaptivního" pojetí regionální odolnosti. Smyslem výzkumu bylo ověření předpokladu o existenci stochastické závislosti mezi vybranými mírami komplexity časových řad a citlivostí regionů na hospodářský pokles. Výsledky prokázaly existenci kladného korelačního vztahu mezi hodnotami největšího Lyapunova exponentu (LLE) a Indexem citlivosti regionu na hospodářský pokles (C_{zam}) pouze pro regiony Řecka a nelze jej zobecnit pro regiony ostatních států. Dále nebyl potvrzen předpokládaný korelační kladný vztah mezi hodnotami Hurstova exponentu (H) a ukazatelem C_{zam}. Výsledky ukazují, že úspěch kvantifikace regionální odolnosti v kontextu hospodářské krize roku 2008 prostřednictvím měr komplexity je značně podmíněn volbou metody, která se pro měření komplexity časové řady aplikuje, i zkoumaným vzorkem regionů. Nalezená nejednoznačnost zkoumaných vztahu poskytuje prostor pro další výzkum, který se pokusí ozřejmit rozdílnost ve výsledcích získaných v rámci tohoto výzkumu.

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VÝKONOVÉ FINANCOVANIE UNIVERZÍT – PRÍPADOVÁ ŠTÚDIA SLOVENSKA

PERFORMANCE BASED FINANCING OF UNIVERSITIES – CASE STUDY OF SLOVAKIA

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Abstract:

Innovation and human capital play a crucial role in the economic development. Universities are one the main institutions influencing level of these factors, so states or other public institutions has spent substantial funds on their functioning. Due to political need to spend funds efficiently and effectively, for the last years previous, mainly trust based, funding regimes has been partially replaced by new ways of financing – performance based financing. These new forms have their own advantages and weaknesses, but they are used short time to be able to evaluate their longer term impacts. However, we could see how these forms change the distribution of funding.

In this article, we empirically looked at different types of universities funding and compare how this funding affects different universities in case of Slovakia. We show that the different schemes lead to quite different allocations. More than type of funding is important how the criteria for funding are set up and how different sources are complementary to the needs of universities.

Keywords: Higher Education, University, Performance Based Financing, Project Financing, Slovakia

JEL Classification: H52, I28

Úvod

Ľudský kapitál a inovácie sú čoraz viac zdôrazňované ako základné faktory konkurencieschopnosti a následne tak aj ekonomického rozvoja. Univerzity sú jednou z kľúčových inštitúcií verejného sektora, ktoré významne ovplyvňujú práve tieto faktory, preto sa ich fungovaniu, a pri nedostatku verejných zdrojov najmä ich financovaniu, venuje tiež čoraz väčšia pozornosť. Financovanie univerzít je viaczdrojové a to tak z pohľadu zdrojov ako aj samotného obsahu, čo je v rámci neho financované. Z pohľadu zdrojov pochádza najväčší podiel práve z verejných zdrojov. V rámci Európskej únie sa tento podiel pohybuje od 40% vo Veľkej Británii až po 90% v Dánsku a Nórsku (EUA, 2015). Dôležitou otázkou sa tak stáva spôsob, akým sa tieto verejné zdroje prerozdeľujú medzi jednotlivé univerzity. Vo svete existuje viacero modelov, pričom najčastejšie sú používané tri spôsoby – spätné financovanie prostredníctvom výkonových alebo historických ukazovateľov, prostredníctvom projektov a prostredníctvom negociácie individuálnych zmlúv.

V poslednom období rastie najmä podiel výkonnostne orientovaného financovania (EUA, 2015). Existuje však len málo štúdií, ktoré by priamo identifikovali efekty tohto nárastu. Auranen (2003) na štúdii 8 krajín poukázal na pozitívny vplyv tohto systému financovania, ale identifikoval aj výnimky, ktoré poukazujú na to, že tento vzťah

nemusí byť až taký jednoznačný. Aj projektové financovanie je pomerne novým spôsobom financovania, pričom sa využíva najmä pre financovanie excelentného alebo tematického výskumu.

V tomto článku sa budeme venovať analýze výkonnostne orientovaného a projektového financovania univerzít na príklade Slovenskej republiky. Cieľom príspevku je identifikovať, či výkonovo orientované financovanie viedlo k zmene výstupov univerzít a či existujú empirické rozdiely v poskytovaní rôznych typov tohto financovania medzi jednotlivými univerzitami. V prvej časti sa zameranie na analýzu výhod a nevýhod výkonnostne orientovaného financovania z pohľadu doterajšej teórie a praxe. V druhej časti budeme metódou komparácie a difference-in-differences metódy porovnávať vybrané nástroje financovania univerzít na príklade Slovenskej republiky. Zaoberať sa budeme aj vzájomnými väzbami tohto fungovania, ktorým sa zatiaľ venuje malá pozornosť, ale sú možno ešte dôležitejšie ako samotný výber týchto nástrojov (Lepori et al., 2007). Takýto výskum je o to dôležitejší, že univerzity priamo reagujú a prispôsobujú svoje aktivity nastavenému systému (Agasisti a Haelermans, 2016).

1 Formulace problematiky

Výkonnostne a projektovo orientované financovanie sa používa v systéme financovania vo viacerých krajinách už dlhšiu dobu a v poslednej dobe sa čoraz väčšia časť financovania viaže práve na definované ukazovatele výkonnosti univerzít prostredníctvom dotačných zdrojov (EUA, 2015). Tá je buď pomerovo viazaná na dosahovanie indikátorov jednotlivými univerzitami, alebo je distribuovaná priamo na konkrétne projekty formou konkurenčnej súťaže. Každý z týchto systémov má svoje výhody a nevýhody. V základnej diskusii je to často otázka objektívneho (výkonnostné financovanie) a expertného posúdenia (projektové financovanie) výkonov vo výskume. Kým niektoré štúdie skôr podporujú prvý model, iné naopak druhý (Geuna a Martin, 2001; Pontile a Torny, 2010). Hlavné výhody prvého spočívajú najmä v jeho objektívnosti, dopredu jasných kritériách, priamej väzbe na výkony, malej možnosti ovplyvňovania výsledkov či nízkej finančnej náročnosti (Butler a Mcallister, 2009; Moed et al., 2004). Zástancovia druhého spôsobu skôr poukazujú na nemožnosť objektívne posúdiť rôzne typy výskumov, rôznu publikačnú potrebu jednotlivých disciplín či riziko homogenizácie výskumu (EUA, 2015; Geuna a Martin, 2001; Nederhof, 2006); Norris a Oppenheim, 2007). Viaceré štúdie pritom potvrdili, že meranie kvality tých istých výstupov s použitím expertného posúdenia na jednej strane alebo bibliografického hodnotenia na druhej strane môžu viesť k výrazne odlišnému hodnoteniu kvality týchto výstupov (Bertocchi, 2015).

Výkonnostne orientované financovanie sa riadi základným princípom, ktorý zahŕňa rozdelenie zdrojov na základe konkrétne a presne definovaných vybraných výstupoch univerzít, čím by malo prísť k podpore tých, ktorí sú v daných výstupoch produktívni. Dôvody pre uplatňovanie tohto spôsobu financovania môžu byť okrem podpory efektívnosti použitia verejných zdrojov aj snaha podporiť vybrané ciele verejnej politiky (napr. zvýšenie účasti na VŠ vzdelávaní, zvýšiť medzinárodné zapojenie či spoluprácu s praxou a pod.) a to zaradením na ne orientovaných ukazovateľov do prepočtov výkonnosti. Vytvára sa tak priame spojenie medzi cieľmi politiky a jej financovaním. Samotné parametre výstupov vstupujúcich do výpočtov sú veľmi rôznorodé (viď napríklad prehľad rôznych typov kritérií v štúdii európskej

asociácie univerzít (EUA,2015)). Najčastejšie sa používa meranie publikačných výstupov, projektovej aktivity, patentov a výsledkov doktorandského štúdia. Kľúčové pri systéme výkonovo orientovaného financovania je pritom najmä adekvátne nastavenie ukazovateľov. Priveľké množstvo ukazovateľov s veľkou pravdepodobnosťou povedie ku konfliktným a neprehľadným situáciám (Layzell, 1999). Preto je vhodné skôr menší počet ukazovateľov zameraný na najvyššiu kvalitu (Abramo et al., 2011). Nevyhnutné je naviazanie ukazovateľov na rozvojové priority danej podpory, ktorými potom možno podporiť vybrané konkrétne ciele verejnej politiky (napr. zvýšenie účasti na VŠ vzdelávaní, zvýšiť medzinárodné zapojenie či spoluprácu s praxou a pod.). Výber ukazovateľov by mal umožniť objektívne posúdenie rozvojových potrieb tak, aby sa zachovala potrebná diverzita vysokých škôl (Layzell, 1999). Dôležité je tiež prenesenie tohto mechanizmu aj na nižšie úrovne ako univerzity, keďže variabilita v rámci univerzít je vyššia ako variabilita medzi nimi (Abramo et al., 2011).

Pri tomto spôsobe financovania je problematické najmä financovanie založené na minulých výkonoch za veľmi krátke obdobie, čo vedie k dvom veľmi negatívnym tendenciám – neistote a nestabilite univerzít a snahe o hľadanie krátkodobých riešení. Napríklad podľa platnej metodiky prideľovania zdrojov pre vysoké školy v Slovenskej republike je financovanie vždy len na 1 rok dopredu, pričom často ešte na začiatku roka nie je jasný celkový objem financií a rozpočty univerzít sa bežne schvaľujú až v marci príslušného roku. Rovnako tak berie do úvahy len údaje za posledné dva roky, čo je ale zároveň bežný čas pre zabezpečenie kvalitného výstupu.Tento systém výrazne komplikuje plánovanie a rozvojové zámery univerzít a vedie k rizikám, že univerzity umelo prispôsobia svoju činnosť danému systému. Navyše nevedia dopredu určiť, aké aktivity im môžu priniesť dostatočné zdroje. Najväčším rizikom je preferovanie aplikovaného výskumu, ktorý umožňuje publikovanie aj čiastkových výstupov a väčšinou je takéto publikovanie jednoduchšie a rýchlejšie ako pri základnom výskume. Tým môže dôjsť k deformácii výskumu smerom od reálnych potrieb výskumu k snahe skúmať veci s najvyššou mierou rýchleho výstupu (EUA, 2015), dokonca až snaha len umelo publikovať výstupy bez výraznejšej pridanej hodnoty alebo znižovanie kvality výskumu na úkor kvantity. Príkladom môže byť publikovanie prostredníctvom tzv. „predátorských" časopisov, kde sa v princípe neskúma kvalita publikovaného výskumu. V neposlednom rade je rizikom výkonového financovania znižovanie diverzity a špecializácie škôl, ktoré sa musia potom univerzálne prispôsobovať centrálne vytvorenému systému financovania. Príkladom môže byť zavedenie radikálne výkonnostne orientovaného financovania v Českej republike, kde síce viedlo k nárastu publikácií, ale najmä tam, kde bolo možné systém skôr zneužiť (tvorba monografií, domáce vedecké neindexované časopisy), pričom to viedlo k veľkým výkyvom medzi jednotlivými oblasťami výskumu (Good et al., 2015). K podobným záverom prišiel pri krajinách strednej a východnej Európy Pajic (2015), ktorý poukázal na kvantitatívny nárast publikácií pri súčasnom poklese ich priemernej citovanosti ako ukazovateľa ich kvality.

Projektové financovanie umožňuje lepšie sa zamerať na konkrétne a aktuálne problémy vo výskume, čo sa dá dosiahnuť buď vymedzením okruhu podporovaných tém alebo formou monitorovacích ukazovateľov projektov. Najčastejším argumentom je dosahovanie veľmi špecifických cieľov, ktoré nie je možné realizovať univerzálne (napríklad podpora výskumu obnoviteľných zdrojov energie ako výskumnej priority

štátu alebo podpora rozvoja zaostalejších regiónov) alebo podpora excelentného výskumu (EUA, 2015). Takýmto financovaním sa ľahšie nadväzujú konkrétne priority štátu na vedecký výskum univerzít. Výhodou sú tiež dopredu jasné podmienky, za akých za financovanie uskutoční a aké ciele musia byť dosiahnuté. Najväčšou nevýhodou je diskontunuita vo financovaní, ktorá môže viesť k neefektívnosti vynakladania podpory. Ak sa nepodarí v silnej konkurencii univerzite získať zdroje, musí prerušiť výskum v danej oblasti, možno prepustiť ľudí, ktorých potom už ťažko získa späť. Priveľa konkurencie tiež môže znižovať produktivitu, ak je veľa energie vynaloženej na samotnú súťaž a veľa projektov nebude podporených (Auranen a Nieminen, 2010). Nevýhodou je aj subjektívne posudzovanie projektov a tým aj možnosť ovplyvniť výber projektov aj inými ako objektívnymi faktormi, čím sa otvára možnosť korupcie, ktorá je pri výkonovom financovaní výrazne eliminovaná.

V oboch prípadoch tu existuje problém „uzavretej obálky" a teda vyššie výkony nemusia viesť k vyššiemu financovaniu a to vďaka celkovému stropu pre objem výdavkov zo štátneho rozpočtu, ktorý nie je určovaný výkonnosťou, ale politickým rozhodovaním o výdavkových prioritách. Je preto väčšinou odporúčané kombinovať viaceré systémy, pričom sa zdôrazňuje najmä nutnosť transparentnosti procesov a zabezpečenie fungujúcich systémov kvality, ktoré sú nevyhnutné pre správne fungovanie týchto typov financovania (EUA, 2015). Aj v rámci EÚ prevažujú väčšinou kombinované modely financovania (De Coster, 2007).

Oba tieto prístupy sa vyskytujú aj vo financovaní univerzít v SR. Slovenská republika vynakladá na financovanie vysokého školstva približne 2,5% HDP, čo pod priemerom krajín OECD, ktorý je na úrovni 3,2% (OECD, 2014). Aj v Slovenskej republike dominuje financovanie vysokého školstva zo zdrojov verejného sektora. Kľúčovými sú najmä na základe výkonnosti prideľované zdroje Ministerstva školstva, vedy a výskumu SR (ďalej len MŠ SR) prideľované v rámci podprogramu 077012. V rámci tohto programu sú definované viaceré výkonové ukazovatele, pričom dominujúcim je najmä publikačná a projektová činnosť univerzít (MŠVVaŠ SR, 2016).

 Druhou formou sú projektovo orientované výzvy dostupné všetkým univerzitám, prípadne aj iným výskumným subjektom, pričom vysoké školy mali možnosť čerpali viaceré programy zamerané na podporu výskumu a inovácií ako grantová schéma VEGA a APVV (MŠVVaŠ, 2015). Osobitnými verejnými zdrojmi založenými tiež na projektovom financovaní sú zdroje kohéznej politiky EÚ. Jej primárnym cieľom je najmä podpora rozvoja zaostalejších regiónov s cieľom využívania lokálneho potenciálu pre ich rozvoj. Táto podpora je realizovaná cez viaceré operačné programy a na rozdiel od dotácií štátu je projektovo orientovaná (MŠVVaŠ, 2015).

Obe spomínané spôsoby financovania pritom postupne nahrádzajú pôvodný model financovanie založený skôr na historických princípoch vyjednávania rozpočtov, preto je zaujímavé analyzovať ich vplyv na distribúciu zdrojov medzi jednotlivé univerzity.

Väčšina štúdií výkonovo orientovaného financovania sa pritom venuje najmä vyspelých krajinám západnej Európy, kde je postavenie školstva v inej pozícii ako pri nových členských krajinách. Tu sa toto financovanie začalo výraznejšie uplatňovať len v poslednom desaťročí, preto aj existuje pomerne málo štúdií zaoberajúcich sa týmto regiónom. Orientujú sa pritom skôr na rôzne hypotetické prepočty pri existujúcich modeloch financovania v snahe poukázať na ich slabé miesta (Taušer a Žamberský,

2012; Sýkora, 2015). Alebo sa venujú vplyvu konkrétnych výkonových ukazovateľov na financovanie ako napríklad miere nezamestnanosti absolventov (Koucký et al., 2016). Okrem samotných používaných spôsobov financovania je však tiež dôležitá ich vzájomná interakcia (Lepori et al., 2007), ktorá výrazne ovplyvňuje efektívnosť celého systému a ktorej sa doteraz venuje vo výskume len malá pozornosť. Práve empirické skúmanie rôznych typov financovania na príklade Slovenskej republiky je cieľom tohto článku.

2 Metody

V článku budeme analyzovať štyri najdôležitejšie existujúce spôsoby financovania univerzít v Slovenskej republike z verejných zdrojov. Zameriame sa na posudzovanie rokov 2007 až 2014, čo zodpovedá programovaciu obdobiu jedného cyklu kohéznej politiky, ktorá predstavuje jeden zo hlavných spôsobov financovania výskumu univerzít. Budeme porovnávať ako rozdielne smerujú tieto zdroje do jednotlivých vysokých škôl. Výnimku tvorí len analýza financovania vedy prostredníctvom výkonového rozdeľovania, ktorá platí až od roku 2011. Pri analýze sme pracovali len s verejnými vysokými školami, ktoré sú zahrnuté vo všetkých štyroch systémoch financovania. Vyčlenili sme súkromné školy, ktoré nie sú financované na základe výsledkov vedy. Vyčlenili sme štátne školy, ktorých rozpočty sú stanovované v rámci rezortom, v ktorých pôsobia a teda ich výsledky sú týmto výrazne skreslené. Takisto majú výhodu 100% financovania v prípade zdrojov EÚ. Celkovo pôsobí na Slovensku 21 verejných vysokých škôl, tri z nich sú však umeleckého zamerania, preto sme ich pri analýze tiež vyčlenili. Vedecký výstup týchto škôl je meraný ako umelecké diela, čo je iný charakter výstupov ako pri ostatných vysokých školách a skresľovalo by to tak porovnanie s dosiahnutými publikačnými výstupmi. V rámci analýzy tak pracujeme so 17 verejnými vysokými školami.

V rámci nášho príspevku bude tiež analyzovať zmeny vo výstupoch, ktoré nastali po zavedení položky výkonnostne orientovaného financovania MŠ SR. Za dobrý ukazovateľ objemu výskumného výstupu sú považované vedecké publikácie evidované vo významných databázach (Hicks, 2012; Moed at al. 2004), preto aj v tomto prípade budeme porovnávať objem vedeckých článkov v databáze SCOPUS a to v rokoch 2008 až 2014, teda tri roky pred a tri roky po zmene spôsobu financovania. Použijeme pritom metódu Difference-in-Differences, kde ako vzorka na porovnanie budeme analyzovať výkony Rakúska. Na rozdiel od Slovenska v Rakúsku model financovania je založený na výkonových zmluvách, ktoré sú dohadované medzi vysokými školami a štátnou správou. Okrem kvantitatívnych analýz sú výsledky doplnené o poznatky z interview, ktoré prebiehali na vysokých školách v rámci projektu UNIREG (EU v Bratislave, UMB Banská Bystrica, Žilinská univerzita v Žiline, SPU Nitra a TU Košice).

3 Rozbor problému

Financovanie verejných vysokých škôl na Slovensku je viaczdrojové, pričom objemovo dominuje najmä financovanie na základe výkonového rozdeľovania Ministerstva školstva, vedy, výskumu a športu SR. Táto dotácia funguje podľa pomerne komplikovaného kľúča, ktorý je upravovaný na ročnej báze, v princípe však zahŕňa najmä rôzne hodnotené jednotlivé výstupy publikačnej činnosti, výskumné

projekty a projekty pre hospodársku prax (MŠVVaŠ SR, 2016). V posledných rokoch sa k národným zdrojom pridalo financovanie zo štrukturálnych fondov, ktoré v oblasti výskumu takmer konkuruje financovaniu prostredníctvom MŠVVaŠ SR. Rozloženie podielov môžeme vidieť na Obr.1. Z uvedeného obrázku môžeme vidieť, že vďaka podpore EÚ tvorí projektové financovanie pomerne veľký objem zdrojov na úrovni 2/3 objemu pre výkonové financovanie. Zároveň je vidieť výrazný nepomer medzi EÚ zdrojmi a národnými zdrojmi používanými pre projektové financovanie výskumu.

Obr. 1: Podiel jednotlivých foriem financovania VaV na univerzitách (2007-2014)
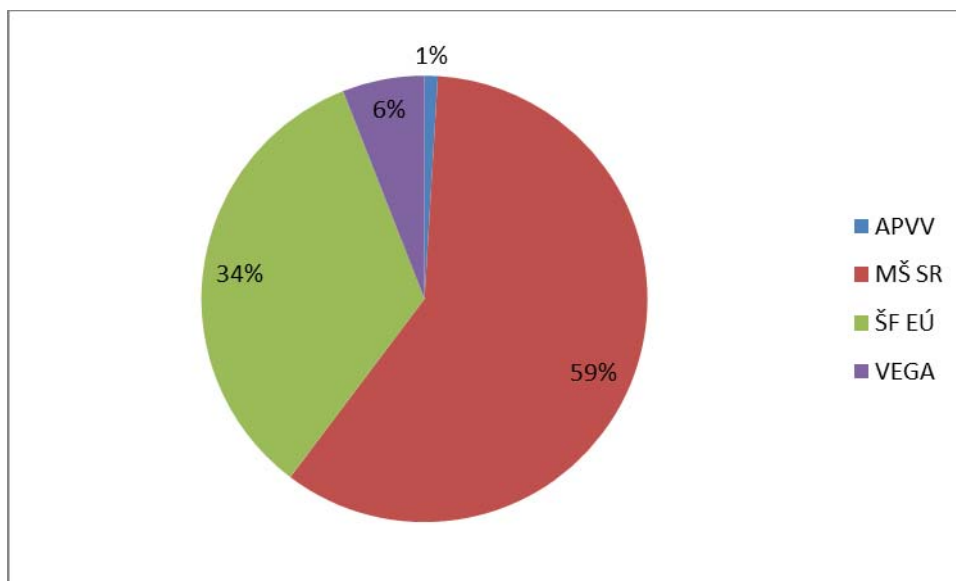
V tabuľke 1 potom môžeme vidieť rozdeľovanie zdrojov medzi jednotlivé univerzity, pričom pre porovnanie uvádzame ešte ich podiel na objeme vedeckých časopisov evidovaných v databáze SCOPUS. Z tabuľky vplýva dominancia bratislavských univerzít, pri jednotlivých druhoch financovania však môžeme vidieť zaujímavé rozdiely. Pri projektovom financovaní z programu APVV vidíme ešte výraznejšiu koncentráciu pri dvoch najproduktívnejších univerzitách, naopak, najslabšie vysoké školy pri tomto spôsobe ešte viac strácajú. APVV má tak aj najvyšší rozptyl údajov, naopak, najnižší má financovanie cez MŠ SR. Rozdeľovanie pomocou štrukturálnych fondov je poznačené tým, že Bratislavský kraj ako vyspelý región nebol oprávnený čerpať podporu z cieľa 1. Aj napriek čiastočnej výnimke tak objem zdrojov z týchto fondov smeroval najmä do iných regiónov. Z tohto zdroja profitovali jednotlivé vysoké školy veľmi rôzne. Nadpriemerne úspešné v rámci regiónov cieľa 1 boli jednak silné univerzity (napr. Žilinská univerzita alebo TU Košice) alebo aj niektoré veľmi slabé univerzity (napr. KU Ružomberok).

Zaujímavé je tiež, že humanitne orientované univerzity ako EU v Bratislave či UMB v Banskej Bystrici mali výrazne väčší podiel na zdrojov meraných výkonovými ukazovateľmi ako pri projektovej podpore. Zároveň tiež mali výrazne nižšie výkony v rámci publikačných výstupov v databáze SCOPUS v porovnaní s komplexnejším výkonovým financovaním MŠ SR.

Tab. 1: Rozdiely v podpore jednotlivých univerzít podľa zdroja financovania

	SCOPUS	APVV	VEGA	ŠF EÚ	MŠ SR
UK Bratislava	29,9	31,74	23,56	17,61	24,42
STU Bratislava	19,53	25,29	21,17	16,89	18,07
UPJŠ Košice	11,77	7,92	7,81	9,24	7,04
TU Košice	11,42	8,39	10,15	12,15	9,98
Žilinská univerzita	5,84	7,42	7,6	15,42	7,37
SPU Nitra	4,68	2,66	6,88	5,75	4,6
TU Zvolen	3,04	3,52	4,39	2,79	2,62
UVL Košice	2,69	2,51	4,78	2,54	2,09
UMB Banská Bystrica	2,5	1,88	2,23	2,41	4,53
UKF Nitra	2,47	1,12	2,05	2,08	4,03
UCM Trnava	1,5	1,53	0,64	1,57	1,57
TU Trnava	1,46	1,51	2,17	1,99	2,22
PU Prešov	1,12	3,4	2,2	3,11	3,62
EU Bratislava	0,9	0,61	3,34	2,07	3,94
UAD Trenčín	0,44	0,49	0,49	0,94	1,23
Selye U Komárno	0,38	0	0,08	0,79	0,37
KU Ružomberok	0,35	0,02	0,47	2,67	2,31
Štandardná odchýlka	7,851585254	8,725157	6,672507	5,760624	6,184177

Zdroj: vlastné prepočty na základe údajov MŠ SR a SCOPUS, čísla predstavujú percentuálny podiel na získaných finančných zdrojoch za roky 2007-2014, pri Scopuse percentuálny podiel na objeme vedeckých článkov publikovaných v databáze za roky 2007 – 2014.

Ako môžeme vidieť v tabuľke 2, celkovo vedú rôzne spôsoby k zásade podobným výsledkom z hľadiska distribúcie podpory medzi jednotlivé univerzity, odlišné je len financovanie prostredníctvom štrukturálnych fondov, čo je dané najmä rozdielnym cieľom tohto financovania, zameraným práve na podporu zaostalejších regiónov. Aj tu je však korelácia pomerne vysoká.

Tab. 2: Korelačná matica jednotlivých spôsobov financovania univerzít

	SCOPUS	APVV	VEGA	ŠF EÚ	MŠ SR
SCOPUS	1				
APVV	0,973303614	1			
VEGA	0,966656065	0,97452	1		
ŠF EÚ	0,87306506	0,869933	0,904693	1	
MŠ SR	0,976181142	0,979796	0,972195	0,890095	1

Zdroj: vlastné prepočty na základe údajov MŠ SR a SCOPUS

Zaujímavým je tiež pomerne výrazný rozdiel medzi projektovou podporou pomocou VEGA schém v porovnaní s APVV. Tu je tento rozdiel tiež čiastočne možné

vysvetliť zameraním, keď najmä APVV deklaruje zameranie sa na podporu najvyššej kvality, čomu zodpovedá aj vyššia koncentrácia použitia týchto zdrojov na univerzitách z vyššími publikačnými výkonmi. Oba tieto nástroje však fungujú na výbere najlepších projektov bez definovania oblastí výskumu, pričom teórie pri projektovom financovaní kladú väčší dôraz práve na tematické zameranie takýchto schém, ako to môžeme čiastočne pozorovať pri projektoch štrukturálnych fondov. Výsledkom je potom riziko, že projektové financovanie bude vykazované „paralelne" s inými zdrojmi financovania. Ako príklad sme si zobrali Ekonomickú univerzitu v Bratislave, kde objem zdrojov z grantov má výrazne menšinový podiel na celkovom financovaní, ale až 70% publikačných výstupov univerzity je priradených k nejakému projektu. Reálne teda financovanie funguje na báze – získam projekt, publikujem a následne štát ešte raz zaplatí za túto publikačnú činnosť pri spätnom výkonovom financovaní. Tento spôsob bol potvrdený aj pri diskusii s riešiteľmi projektov, ktorých tendenciou bolo každý výstup priradiť k existujúcemu projektu. Táto prax univerzít by umožňovala ešte viac podporiť tematické zameranie výskumov pri projektovom financovaní, keby existovala jasná spoločenská objednávka. Bez definovania týchto priorít to len čiastočne duplikuje existujúce iné systémy financovania.

Ak sa pozrieme, ako sa za dané obdobie zmenila samotná publikačná činnosť, môžeme vidieť výrazný nárast publikačnej činnosti. V roku 2014 bol celkový objem publikovaných článkov v databáze Scopus o 62,75% väčší ako v roku 2008. Toto číslo ukazuje na extrémny nárast. Tabuľka 3 ukazuje distribúciu tohto nárastu v rámci jednotlivých skupín, tak ako sú evidované v databáze. Môžeme vidieť, že výrazný nárast bol zaznamenaný najmä v kategórii „Engineering", kam môžeme zaradiť primárne priemyselný výskum s orientáciou na strojársky priemysel v širšom zmysle. Druhou veľkou skupinou s výrazným nárastom boli humanitné a sociálne vedy. Naopak, najmenší nárast bol v medicínskych vedách, pričom jedinou oblasťou s poklesom výstupov za dané obdobie bola psychológia. Keď sa na to pozrieme cez zmeny pri jednotlivých univerzitách, zistíme, že najvýraznejší účinok (merané ako rozdiely v publikačných výstupov pri porovnaní rokov 2008-2011 a 2011-2014) to malo na dovtedy menej produktívne univerzity (UCM Trnava, SPU Nitra, PU Prešov, UMB Banská Bystrica), ktoré tak začali prispôsobovať svoje konanie nastaveným kritériám. Na najmenej produktívne univerzity bol tento vplyv len minimálny (EU v Bratislave, UAD Trenčín), ale rovnako tak bol dokonca záporný v prípade najlepšej slovenskej univerzity UK v Bratislave, ktorá mala výraznejší nárast publikácií v rokoch 2008 až 2011 ako v rokoch 2011 – 2014. Naznačuje to teda, že výkonové financovanie môže fungovať lepšie v podmienkach menej výkonných inštitúcií, ktorých publikačná činnosť je viac motivovaná vonkajšími faktormi.

Ak sa to pozrieme z pohľadu DiD metódy, tak výraznejší nárast po dosiahnutý až po zavedení väčšej váhy výkonového financovania. Celkový nárast medzi rokmi 2008 až 2011 predstavoval 15,80%, kým medzi rokmi 2011 až 2014 bol tento nárast až na úrovni 25,23%. Z tohto pohľadu zavedenie výkonového financovania mohlo viesť k zvýšenej publikačnej činnosti univerzít.

Tab. 3 Najvýraznejšie zmeny vo výkonoch za jednotlivé oblasti (články databázy SCOPUS)

Oblasť	Celková zmena (2014/2008)	Zmena (2014/2011)	Zmena (2011/2008)
Multidisciplinary	471,24%	347,36%	135,71%
Engineering	378,15%	218,97%	172,69%
Business and Management	287,50%	106,25%	270,58%
Social Science	257,85%	184,61%	139,66%
Arts and Humanities	252,80%	154,10%	164,04%
Computer Science	249,38%	134,67%	185,18%

Zdroj: Vlastné spracovanie na základe údajov SCOPUS

Pre porovnanie zmeny výkonnosti sme urobili rovnakú analýzu aj pre Rakúsko, ktoré je susediacou krajinou, ale s odlišným systémom financovania, ktorý je založený na individuálnych negociáciách univerzít s Ministerstvom školstva, pričom rozpočet je prideľovaný na základe spoločenskej potreby štátu a funkcií, ktoré sa od univerzity očakávajú (EUA, 2015). Tu prišlo práve o opačnému vývoju, keď pred rokom 2013 ešte čiastočne výkonové ukazovatele determinovali financovanie.

Keď sa pozrieme na zmeny v rámci Rakúska, aj tu môžeme vidieť výrazný nárast publikačnej činnosti za uvedené obdobie. Celkový nárast publikačnej činnosti za roky 2008 až 2011 predstavoval 28,97%, kým v rokoch 2011 – 2014 tento výkon rástol pomalšie a to o 26,02%, aj keď v absolútnej hodnote narástol. Napriek tomu rástol rýchlejšie ako tomu bolo v prípade Slovenskej republiky. V absolútnych číslach sú tieto rozdiely ešte väčšie, keďže celkový objem publikačnej činnosti v Rakúsku je 2,8 krát vyšší. V tabuľke 2 môžeme vidieť túto zmenu v rámci DiD v absolútnych číslach.

Tab. 4 Celkové zmeny vo Rakúsku a SR (články databázy SCOPUS)

	Zmena (2014/2011)	Zmena (2011/2008)	rozdiel
SR	2021	1093	928
Rakúsko	6268	5411	857
rozdiel	- 4247	- 4318	71

Zdroj: Vlastné spracovanie na základe údajov SCOPUS

Výsledkom je veľmi porovnateľný vývoj celkovej publikačnej činnosti v oboch krajinách, napriek zavedeniu výkonového financovania v SR. Výrazné rozdiely sú však v rámci jednotlivých oblastí. Kým napríklad vo veľkej časti oblastí medicíny sa rozdiely ešte prehĺbili, v ekonomických vedách či strojárstve sa výrazne zmenšili. K pozitívnym zmenám teda prišlo v oblastiach, ktoré sú v danej krajine zastúpené vo väčšej miere. Dôležitejšie ako výkonové financovanie sa tak javí otázka podpory vhodnej špecializácie výskumu a špičkových pracovísk. Kým Rakúsko sa SR „vzďaľovalo" v oblasti medicíny, ktorá je tam relatívne oveľa silnejšia ako v SR, SR dobiehalo publikačnú činnosť v oblastiach, v ktorých malo väčšie relatívne podiely. Takisto je potrebné dané zvýšenie dať do kontextu s celkovým nárastom vedeckých časopisov v uvedenej databáze. Zo samotného regiónu strednej a východnej Európy sa tento počet skoro strojnásobil (Pajic, 2015). Ak by sme teda vychádzali z relatívneho

nárastu časopisov a článkov v regióne, publikačná úroveň sa po zavedení vyššieho podielu výkonovo orientovaného financovania prakticky nezvýšila.

4 Diskuze

Z analýzy môžeme vidieť, že všetky modely zamerané na financovanie kvalitnejšieho výskumu vedú k podobnej distribúcii zdrojov. Zásadný rozdiel nastáva, ak sa do financovania zavedú schémy, ktoré majú aj iné ciele, ako v tomto prípade podpora zo štrukturálnych fondov. Takéto schémy môžu viesť k značne odlišnejšej distribúcii a môžu teda umožniť fungovanie aj menej kvalitným univerzitám v oblasti výskumu. Univerzity plnia aj iné funkcie a teda stanovenie iných cieľov ako podpora kvality výskumu je možná. Do popredia sa však potom dostáva pomer týchto zdrojov a vzájomné ovplyvňovanie týchto schém. Keďže ŠF tvoria výraznú časť financovania výskumu, môžu značne narúšať optimálnu alokáciu zdrojov smerom k ich efektívnemu využívaniu. A to najmä v prípade, keď už samotné výkonové financovanie vedie k vyrovnanejšej distribúcii zdrojov aká by zodpovedala pri rozdeľovaní podľa kvalitných publikačných výstupov. To isté čiastočne platí o schémach VEGA a APVV, ktoré v princípe majú rovnaké zameranie, ale kým v prípade APVV to vedie ku koncentrovanej podpore kvalitnejších univerzít, v prípade schém VEGA to tak nie je. Potom automaticky vzniká otázka o potrebe oboch schém. Navyše tieto schémy nie sú primárne tematicky orientované, čím sa stráca jedna zo základných výhod projektového financovania a to možnosť zamerať ho tematicky na aktuálne potreby a požiadavky verejnej správy. Práve špecializácia výskumu prostredníctvom dobre zameraných projektových výziev by mohla posilniť tie oblasti vedeckého výskumu, ktoré sú konkurencieschopné. Pre úplnosť by bolo tiež potrebné do analýz zahrnúť externé financovanie výskumu, najmä zahraničné granty a dotácie z praxe. Tieto údaje však nie sú kompletne k dispozícii, sú však čiastočne zahrnuté vo výkonovom financovaní MŠ SR. Niektoré univerzity sa pritom môžu orientovať práve na tieto financie a preto ich snaha o financovanie výskumu cez granty môže byť nižšia.

Závěr

Financovanie univerzít je jedným zo základných faktorov ovplyvňujúcich ich výkonnosť. Je preto veľmi dôležité, aby bolo nastavené tak, že podporuje rozvoj a kvalitu vysokoškolského výskumu. V poslednej dobe sa posilňuje najmä úloha projektového a výkonnostne orientovaného financovania univerzít, stále však nie je dostatočne jasné, akým spôsobom tieto typy financovania ovplyvňujú samotnú kvalitu výskumu. V článku sme poukázali na fakt, že po zavedení tohto typu financovania sa zvýšila publikačná činnosť univerzít na Slovensku, avšak porovnateľne napríklad s Rakúskom, ktoré takýto systém nezaviedlo. To skôr poukazuje na iné faktory za nárastom publikácií ako napríklad zväčšujúci sa počet časopisov v databázach. To naznačuje aj fakt, že najvýraznejší bol tento vplyv pri dovtedy menej výkonných univerzitách. Univerzity, ktoré aj dovtedy mali vysoké čísla publikačných výstupov, po zavedení výkonového financovania zmenili nárast objemu svojich výstupov len minimálne. Zároveň sme sa pokúsili empiricky analyzovať rôzne typy financovania, ktoré sú uplatňované v Slovenskej republike. Jednotlivé zdroje vedú k rozdielnej, aj keď pomerne korelovanej, alokácii medzi jednotlivé univerzity. Nie je pritom jednoznačne možné určiť, že niektorý z týchto systémov empiricky viac smeruje do kvalitnejších škôl. Pri projektovom financovaní môžeme vidieť, že aj v zásade rovnako stanovené ciele vedú k značne odlišnej distribúcii podpory, čo poukazuje na

potrebu dôslednejšieho prepojenia cieľom podpory so samotným mechanizmom výberu, implementácie a hodnotenia tejto podpory a zároveň tematického prepojenia na priority štátu. Inak sa projektová podpora výrazne mieša s inštitucionálnou, čím sa stráca opodstatnenosť používania rôznych spôsobov financovania. Z pohľadu ďalšieho výskumu je potom potrebné zamerať sa aj na nižšiu úroveň a analyzovať, či daná podpora vedie k podobným výsledkom aj na nižších úrovniach ako sú napríklad fakulty či katedry.

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ON REPORTING PERFORMANCE OF BINARY CLASSIFIERS

Pavel Škrabánek, Petr Doležel

Abstract: *In this contribution, the question of reporting performance of binary classifiers is opened in context of the so called class imbalance problem. The class imbalance problem arises when a dataset with a highly imbalanced class distribution is used within the training or evaluation process. In such cases, only measures, which are not biased by distribution of classes in datasets, should be used; however, they cannot be chosen arbitrarily. They should be selected so that their outcomes provide desired information; and simultaneously, they should allow a full comparison of just evaluated classifier performance along, with performances of other solutions. As is shown in this article, the dilemma with reporting performance of binary classifiers can be solved using so called class balanced measures. The class balanced measures are generally applicable means, appropriate for reporting performance of binary classifiers on balanced as well as on imbalanced datasets. On the basis of the presented pieces of information, a suggestion for a generally applicable, fully-valued, reporting of binary classifiers performance is given.*

Keywords: *machine learning, binary classification, class imbalance problem, performance measures, reporting of results.*

JEL Classification: *C45, C83.*

Introduction

In general, classification is a process in which objects, either real or abstract, are recognized, differentiated, and understood. This issue is important in various fields such as by text classification (Nigam, et al., 2000), in medicine (Goeuriot et al., 2016), or within visual information retrieval (Lew, 2001). Naturally, economics is no exception. The relevance of classification in this field is obvious e.g. in applications related to machine learning (Qiao, et al., 2016) or data mining (Feelders, 2002).

From the perspective of machine learning or data mining, classification is the task of classifying elements of a given set into a predetermined number of groups, usually called **classes**. Although the number of classes might be any positive integer, just two classes are considered in many real-world applications. Such classification tasks are known as **binary classification**. Considering the status of the binary classification, let us focus on this issue in this contribution.

The process of the classification is carried out by a **classifier**. The classifier assigns each element into one of the considered classes. The assignment is accomplished on the basis of a **classification rule**. The classification rule is formed both by selection of a **classification method** and on the basis of **training data**. To this day, a number of supervised classification methods have been introduced, such as *k*-nearest neighbour, neural networks, support vector machine, random forest, and many others (Murphy, 2012). Selection of an appropriate classification method is carried out by an expert. Such a formed classifier is then trained on the training data.

The previous description of classifier development might give the wrong notion that design of classifiers is a simple task. The opposite is true. Depending on the used classification method, several parameters are usually needed to be set, in order to obtain a classifier of a desirable performance. However, the performance of the classifier is also affected by other factors, such as generality of the training data, or appropriateness of the selected methods for a particular task. It is obvious that information about performance of the classifier is highly desirable in order to fulfil the practical need to perform comparisons across various classifiers, settings and datasets.

Information about performance of a classifier can be acquired using a **performance measure**. In the case of binary classification, a variety of performance measures have been introduced, e.g. (Brodersen et al., 2010), (Garcia et al., 2010), (Hand, 2012), but not all of them are used in practice. To be honest, it is not so difficult to design a new performance measure; however, a successful measure needs to satisfy three basic criteria:

- it must coherently capture the aspect of performance of interest;
- it must be intuitive enough to become widely used, so that the same measure is consistently reported by a majority of researchers;
- it must be simple to report, preferably as a single number, for each method-setting-dataset combination.

As already implied, even if a measure meets all the stated out requirements, its universal acceptance is not guaranteed. It might be pointed here that different application areas have different preferences for measures due to different goals. Over the time, sets of measures, preferred within each particular area, have been naturally formed. A new measure, which might be succeeding in a particular area, must naturally fit to the appropriate set of widely accepted measures. In other words, outputs of such a measure should enable a comparison with other published results. This basic requirement will be further called **comparability requirement**. However, there are also other aspects influencing the probability of acceptance of a new measure in an application area. One important aspect is behaviour of the measure on data with a highly imbalanced class distribution.

Data with a highly imbalanced class distribution are said to suffer a **class imbalance problem**. Since class imbalanced datasets occur in many real-world applications, the class imbalance problem is a hot issue. This is evidenced by the long list of publications dealing with this topic. A large proportion of them deal with training of classifiers on imbalanced data; however, the class imbalance problem can also adversely affect the evaluation of classifiers.

The adverse influence of class distribution on some performance measures has been known for a long time and some works dealing with the evaluation on imbalanced data have been already published. Nevertheless, none of them brings an answer to one fundamental question: Which measures should be chosen so that a desired information value would be kept and the comparability requirement would be met? This question is opened and analysed in context of binary classifiers in this contribution. On the basis of the analysis, a suggestion for a fully-valued reporting performance of binary classifiers, which reflects all the above stated facts, is given. For this purpose, so called **class balanced measures** are presented as the appropriate means.

The rest of the article is organized in the following way. The class imbalance problem, and its impact on classification tasks, is considered in section 1. Basic variables used by evaluation of binary classifiers, and the most popular performance measures, are stated in section 2. The influence of imbalanced data on the performance measures is analysed in section 3. The class balanced measures are introduced in section 4. The opened question of reporting performance of binary classifiers is discussed in section 5. Finally, a conclusion is stated in section 6.

1 Impact of the class imbalance problem on classification related tasks

It is well known that a classifier trained on imbalanced data might be biased in favour of a major class. This issue has been widely studied and many related works have been published. A short summary about this issue is given in subsection 1.1. However, the class imbalance problem may become apparent also within an evaluation process. This issue is discussed in subsection 1.2.

1.1 Training on imbalanced data

As pointed out by (Garcia et al., 2007), two groups of approaches can be used to handle a class imbalance in data, by training of binary classifiers. Namely, a re-sampling method can be used, or measuring of a classifier's performance in imbalanced domains can be utilized within a classification method.

Generally, the re-sampling methods aim to form balanced datasets. Many different approaches belonging to this group have been presented, such as, random or focused over-sampling (Japkowicz et al., 2002); over-sampling with informed generation of new samples (Chawla at al., 2002); random under-sampling (Kotsiantis et al., 2003); or direct under-sampling (Mani et al, 2003).

The second group of approaches is aimed to deal with imbalanced datasets directly. At first, it might be pointed out that some performance measures are not influenced by the distribution of classes in datasets. (Garcia et al., 2007) pointed to this fact and they have logically inferred that these measures can be safely used on imbalanced data. It is worth mentioning that new measures, which are resistant to imbalances in data, are constantly developed (Huang et al., 2007), (Brodersen et al., 2010), (Garcia et al., 2010), (Koyejo et al., 2014). The essence of such measures was the inspiration of many classification methods which are designed for direct application on imbalanced datasets, e.g. (Barandela et al., 2003), (Rosenberg, 2012), (Koyejo et al., 2014).

1.2 Evaluation on imbalanced data

Although composition of datasets affects outcomes of some performance measures (Daskalaki et al., 2006), these measures are widely used due to their information value and comprehensibility (Hand, 2012). In order to keep the comparability, researchers usually report about performances of classifiers on datasets with nearly uniform distribution of classes. However, achievement of this precondition may not be always possible or advisable, such in the case of fraud detection (Phua et al., 2004), mining data streams (Zhao et al., 2012), or object detection (Škrabánek et al., 2016).

As has been already mentioned, there are a number of performance measures resistant to distribution of classes in datasets. These measures can be safely used on

imbalanced datasets. This fact is commonly used when facing the class imbalance problem within the evaluation process (Daskalaki et al., 2006), (Jeni et al., 2013), but this is not the adequate solution in each situation.

In summary, despite general awareness about this issue, one fundamental question has not yet been opened nor answered. The question is, which measures should be chosen so that a desired information value would be kept and the comparability requirement would be met? Search for a generally valid answer to this question is the scope of interest in this article.

2 Standard performance measure used by evaluation of binary classifiers

Two classes, **positive** or simply P, and **negative** or simply N, are considered by the binary classification. The aim of a classifier is to correctly assign a class label to each judged sample. For each sample, the decision-making process falls into one of four possible scenarios: the sample is positive and the classifier correctly recognizes it as such (**true positive** or simply TP); the sample is negative and the classifier correctly recognizes it as such (**true negative** or simply TN); the sample is positive but the classifier labels it as negative (**false negative** or simply FN); or the sample is negative but the classifier labels it as positive (**false positive** or simply FP).

On the basis of the presented scenarios, four fundamental quantities for performance measure are formulized: number of true positive $|TP|$; number of true negative $|TN|$; number of false negative $|FN|$; and number of false positive $|FP|$ samples. The quantities are usually summarized into a 2×2 matrix. The matrix is known as **confusion matrix** and it is traditionally expressed as in Tab. 1.

Tab. 1: The confusion matrix

		Assigned label	
		positive	negative
True label	positive	$|TP|$	$|FN|$
	negative	$|FP|$	$|TN|$

Source: Authors

A number of performance measures derived from the confusion matrix have been introduced up to the present (Choi et al., 2010). However, not all of them have been widely accepted. Moreover, different measures are preferred in various scientific fields. Thus, only the most frequently used measures are considered further. Namely, the following measures are considered: accuracy (acc), error rate (er), precision (pr), recall (re), specificity (sp), false negative rate (fnr), false positive rate (fpr), harmonic mean of precision and recall (Fscore), geometric mean of precision and recall (Gmean), and area under the ROC curve (AUC).

3 Influence of imbalanced data on performance measures

As was already mentioned, the class imbalance problem is caused by highly imbalanced distribution of classes in datasets. The unfavourable properties of some performance measures on imbalanced data are well known; however, the core of this issue is not visible at first glance. In this section, the relation between the measures

and proportions of the classes in datasets is analysed. On the basis of the analysis, all the considered measures are expressed in the terms used within the analysis.

3.1 Preliminary

Let us consider a dataset of M labelled samples where each sample belongs either to the class P or N then

$$M = |P| + |N|, \tag{1}$$

where $|P|$ is number of positive samples, and $|N|$ is number of negative samples in the dataset. Supposing the confusion matrix stated in Tab. 1, the numbers of samples belonging to the classes can be expressed as

$$|P| = |TP| + |FN|, \quad |N| = |TN| + |FP|, \tag{2}$$

which allow us to express (1) as

$$M = |TP| + |FN| + |TN| + |FP|. \tag{3}$$

Let us express the numbers of samples in the classes as

$$|P| = v_P M, \quad |N| = v_N M, \tag{4}$$

where v_P is the proportion of the positive samples in the dataset, and v_N is the proportion of the negative samples in the dataset. Furthermore, it holds that $v_P, v_N \in [0,1]$ and $v_P + v_N = 1$.

3.2 Analysis

Let us consider the objective of a binary classifier now. As was already stated, the aim of a binary classifier is to correctly assign a sample to one of the two classes, P or N, if possible. A well working classifier will correctly assign all the samples, i.e. $|TP| = |P|$, $|TN| = |N|$, $|FP| = 0$, and $|FN| = 0$. A classifier with a worse performance will correctly classify a smaller proportion of the samples. Thus, let us express the number of correctly classified samples as

$$|TP| = \xi_{TP} |P|, \quad |TN| = \xi_{TN} |N|, \tag{5}$$

where ξ_{TP} is the proportion of correctly classified samples from all positive samples in the dataset, ξ_{TN} is the proportion of correctly classified samples from all negative samples in the dataset, and $\xi_{TP}, \xi_{TN} \in [0,1]$.

On the basis of formulae (2) and (5), the numbers of miss-classified samples can be expressed as

$$|FN| = (1 - \xi_{TP})|P|, \quad |FP| = (1 - \xi_{TN})|N|. \tag{6}$$

It is obvious that performance of a binary classifier can be positively determined using just two quantities, ξ_{TP} and ξ_{TN}.

Let us express all the performance measures using the quantities ξ_{TP} and ξ_{TN}. The modification will be demonstrated on the accuracy. The accuracy is given by

$$\text{acc} = \frac{|TP| + |TN|}{|TP| + |FN| + |TN| + |FP|}. \tag{7}$$

Using formulae (3) and (5), the original formulation (7) can be expressed as

$$\text{acc} = \frac{\xi_{TP} |P| + \xi_{TN} |N|}{M}. \tag{8}$$

This formula can be further modified using (4), i.e.

$$\text{acc} = \frac{\xi_{TP} v_P M + \xi_{TN} v_N M}{M} = \xi_{TP} v_P + \xi_{TN} v_N. \tag{9}$$

Formula (9) clearly shows that the accuracy (7) does not depend only on the performance of a classifier (ξ_{TP} and ξ_{TN}); however, composition of dataset is also reflected in this measure (v_P and v_N). The same procedure, which has been used for the accuracy, can be applied on other measures. The most common measures are summarized in Tab. 2 (AUC is expressed for a threshold value 0.5). Acronyms of the measures are stated in the first column. Their usual expressions are listed in the second one. The last column contains their modified expressions. It is apparent from the modified expressions that accuracy, error rate, precision and Fscore are biased by the class distribution in datasets while the other measures are invariant.

4 Class balanced performance measures

The previous analysis has clearly indicated the biased measures in Tab. 2, as well as the underlying problem. Simultaneously, a way of dealing with the problem has been outlined by the analysis. Specifically, the biased measures can be extended by **class weights**. Once the weights are properly set, measures resistant to the class distribution in a dataset are acquired. Since distributions of classes in datasets are known within the evaluation process, the weights can be set according to the proportion of the classes v_P and v_N. This idea was used when developing the class balanced measures. For simplicity, let us call them balanced measures, but do not confuse them with already published metrics such as a balanced accuracy (Brodersen et al., 2010) or a balanced error rate (Chi-Yuan, 2011).

In the case of the balanced measures, the setting of the weights was based on common practice. As already mentioned, it is usual to report performance of classifiers on datasets with nearly symmetrical prior probabilities of classes, i.e. magnitude of the classes in the biased measures is nearly uniform. Thus, the magnitude of classes in the balanced measures should be also uniform in order to get comparable results. It means that the basic quantities related to the positive class, $|TP|$ and $|FN|$, have to be multiplied by the proportion of the negative class in the dataset v_N; and similarly, the basic quantities related to the negative class, $|TN|$ and $|FP|$, have to be multiplied by the proportion of the positive class v_P. Following this idea, a class balanced complement can be developed for each biased measure.

Tab. 2: The most popular performance measures in the binary classification

Acronym	Standard expression	Modified expression
acc	$\dfrac{|TP|+|TN|}{|TP|+|FN|+|TN|+|FP|}$	$\xi_{TP}\nu_P + \xi_{TN}\nu_N$
er	$\dfrac{|FP|+|FN|}{|TP|+|FN|+|TN|+|FP|}$	$(1-\xi_{TP})\nu_P + (1-\xi_{TN})\nu_N$
pr	$\dfrac{|TP|}{|TP|+|FP|}$	$\dfrac{\xi_{TP}\nu_P}{\xi_{TP}\nu_P + (1-\xi_{TN})\nu_N}$
re	$\dfrac{|TP|}{|TP|+|FN|}$	ξ_{TP}
sp	$\dfrac{|TN|}{|TN|+|FP|}$	ξ_{TN}
fnr	$\dfrac{|FN|}{|TP|+|FN|}$	$1-\xi_{TP}$
fpr	$\dfrac{|FP|}{|TN|+|FP|}$	$1-\xi_{TN}$
Fscore	$\dfrac{(\beta^2+1)|TP|}{(\beta^2+1)|TP|+\beta^2|FN|+|FP|}$	$\dfrac{(\beta^2+1)\xi_{TP}\nu_P}{\left[(\beta^2+1)\xi_{TP}+\beta^2(1-\xi_{TP})\right]\nu_P+(1-\xi_{TN})\nu_N}$
Gmean	$\sqrt{\dfrac{|TP|}{|TP|+|FN|}\times\dfrac{|TN|}{|TN|+|FP|}}$	$\sqrt{\xi_{TP}\times\xi_{TN}}$
AUC	$\dfrac{1}{2}\left(\dfrac{|TP|}{|TP|+|FN|}+\dfrac{|TN|}{|TN|+|FP|}\right)$	$\tfrac{1}{2}(\xi_{TP}+\xi_{TN})$

Source: Authors

In such a way, balanced accuracy (acc$_B$), balanced error rate (er$_B$), balanced precision (pr$_B$), and balanced harmonic mean of precision and recall (Fscore$_B$) have been established. All the class balanced complements of the biased measures in Tab. 2 are summarized in Tab. 3. Their acronyms are stated in the first column. Their usual expressions are listed in the second one while the modified expressions of these measures are stated in the last column.

Tab. 3: The class balanced performance measures

Acronym	Standard expression	Modified expression
acc$_B$	$\dfrac{\nu_N|TP|+\nu_P|TN|}{\nu_N(|TP|+|FN|)+\nu_P(|TN|+|FP|)}$	$\tfrac{1}{2}(\xi_{TP}+\xi_{TN})$
er$_B$	$\dfrac{\nu_P|FP|+\nu_N|FN|}{\nu_N(|TP|+|FN|)+\nu_P(|TN|+|FP|)}$	$\tfrac{1}{2}\left[(1-\xi_{TP})+(1-\xi_{TN})\right]$
pr$_B$	$\dfrac{\nu_N|TP|}{\nu_N|TP|+\nu_P|FP|}$	$\dfrac{\xi_{TP}}{\xi_{TP}+1-\xi_{TN}}$
Fscore$_B$	$\dfrac{(\beta^2+1)\nu_N|TP|}{\nu_N\left[(\beta^2+1)|TP|+\beta^2|FN|\right]+\nu_P|FP|}$	$\dfrac{(\beta^2+1)\xi_{TP}}{(\beta^2+1)\xi_{TP}+\beta^2(1-\xi_{TP})+(1-\xi_{TN})}$

Source: Authors

As follows from the previous text, the class balanced measures should provide results corresponding to evaluation on balanced datasets. Fulfilment of this requirement can be simply verified on benchmark datasets or analytically. The analytical approach takes into account the uniform distribution of classes in balanced datasets ($\nu_P = \nu_N = 0.5$). Inserting these values into the modified expressions of original measures, leads to the class balanced measures which confirms the above stated requirement (third columns of Tab. 2 and Tab. 3).

The verification using benchmark datasets consists of a systematic application of original and balanced measures in different scenarios, followed by a comparison of the results. The results obtained using the original measures on a balanced dataset are taken as the reference values. However, this approach leads to a huge amount of data which could not be summarized in this article due to limited space.

In order to offer an alternative verification approach, we developed a specialized visualization method. It is based on the idea to use gradients of a performance measure m in order to show its dependence on the real performance of a classifier (ξ_{TP}, ξ_{TN}) and the proportion of samples in datasets. Just as a reminder, the composition of a dataset can be expressed either as the proportion of positive ν_P or negative ν_N samples, where $\nu_P + \nu_N = 1$. In our approach, the gradient is defined as

$$\nabla m = \left(\frac{\partial m}{\partial \xi_{TN}}, \frac{\partial m}{\partial \xi_{TP}}, \frac{\partial m}{\partial \nu_P} \right). \tag{9}$$

The gradients are then represented as a 3D graph, where ξ_{TN}, ξ_{TP} and ν_P are shown on x, y and z axes, respectively. For each explored scenario, the gradient ∇m is symbolized using an arrow. While size of the gradient ∇m determines length of the arrow, orientation of the arrow reflects degree of influence of each independent variable. Thus, a non-zero angle, determined by the arrow and its base, indicates influence of the composition on the measure. The base of the arrow is a plane parallel with x and y axes, passing through the z axis at the level given by ν_P. The size of the angle is proportional to the degree of influence of the proportion of positive samples on the measure.

Application of this method on the original and balanced accuracy is shown in Fig. 1. Evaluation of the measure for $\xi_{TN}, \xi_{TP}, \nu_P \in \{0.00, 0.25, 0.50, 0.75, 1.00\}$ was carried out for the purpose of this article. While the original accuracy (acc) is strongly influenced by the proportion of positive samples ν_P (non-zero angles for a majority of the expected settings in Fig. 1 (a)), the balanced accuracy (acc$_B$) is resistant to the composition (zero angles for all the settings in Fig. 1 (b)). Similar results were achieved for all other biased measures and their balanced counterparts.

From this perspective, the class balanced measures seem to be the perfect solution. Unfortunately, it is not true. A miss-classified sample, which belongs to a minority class, has a different impact on the final value of a balanced measure, comparing with a miss-classified sample which belongs to a majority class. Naturally, the same holds for correctly classified samples. Impact of this issue will be discussed in the following section.

Fig. 1: Visualization of a dependence of the original accuracy acc (a), and the balanced accuracy accB (b) on the performance of a classifier and on the composition of a dataset. Non-zero angles, determined by the arrows and their bases in the left panel, indicate the influence of the dataset composition on acc
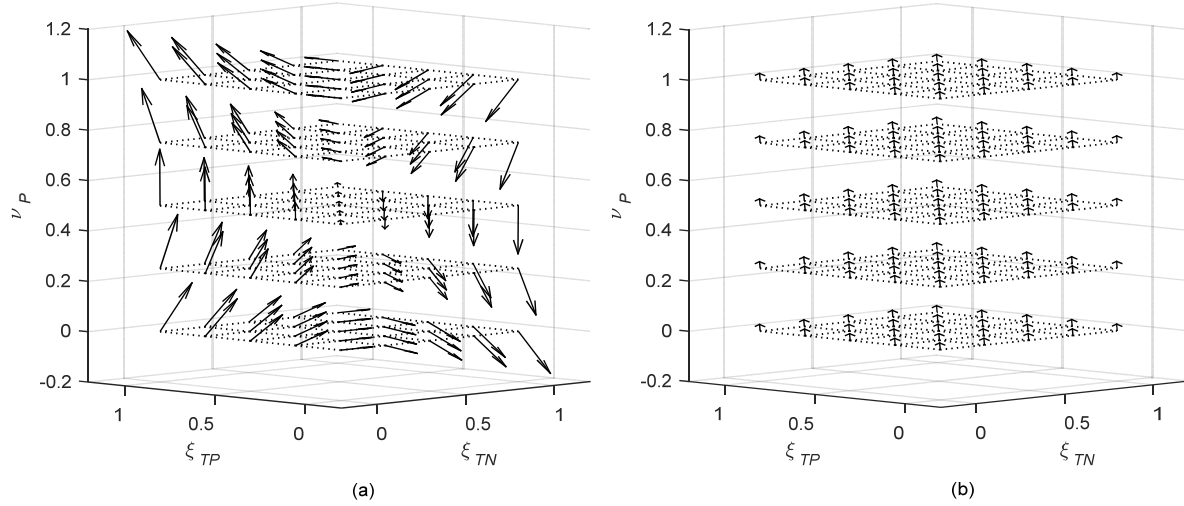
5 Discussion

The question of reporting performance of binary classifiers has been opened in the context of the class imbalance problem. As follows from the above stated facts, realization of an expressive evaluation of a binary classifier on a highly imbalanced dataset is not a simple task. Let us briefly summarize the nature of this issue.

Outcomes of an evaluation process are required to be comparable with results published by other researchers. In order to preserve the comparability, the evaluation should be accomplished using widely accepted performance measures. Nevertheless, some of the widely used measures are biased by class distribution in datasets. Once evaluation on imbalanced dataset has to be done, only unbiased measures should be used in order to obtain meaningful results. This poses the question of, which measures should be chosen so that a desired information value would be kept and the comparability requirement would be met?

In our opinion, requirements on eligible measures stated in the question, i.e. obtaining of the desired information value while keeping the comparability, are equally important. Of course, all three requirements on a successful measure, which were stated in the introduction, should be met in order to obtain eligible measures. As already said, eligible measures should be also unbiased. Keeping in mind all these requests, use of the class balanced performance measures seems to be the appropriate solution.

The class balanced measures, which are basically extensions of the widely used biased measures, are resistant to class distributions in datasets, i.e. they are unbiased. They are aimed to provide comparable results on datasets with an arbitrary distribution of classes. The balanced measures capture the same aspects of performance as their

original counterparts, i.e. meaning of the balanced measures is easy to understand for the majority of researchers.

As follows from the essence of the balanced measures, their outcomes should fully correspond to results, which would be obtained by evaluation of classifiers on balanced datasets, using appropriate original biased measures. The balanced measures emulate their originals, where the originals coherently capture aspects of performance of interest. From this perspective, the balanced measures coherently capture the aspect of performance of interest as well. On the other hand, a miss-classified sample belonging to a minority class has a different impact on a balanced measure compared to a miss-classified sample which belongs to a majority class. In this light, fulfilment of the first requirement of a successful measure (see introduction) is disputable.

Despite this drawback, the information value mediated by the class balanced measures is very high, as can be shown in real world data. For example, object detection in large-scale images using the sliding window, inherently leads to highly imbalanced datasets. This issue was demonstrated on a grape detector which was evaluated on real-life images (Škrabánek et al., 2016) where proportions of classes in datasets generated by the sliding window were $\nu_P = 0.001$ and $\nu_N = 0.999$.

Let us compare performance of the grape detector evaluated on these datasets using the balanced (Škrabánek et al., 2016) and imbalanced measures (Škrabánek et al., 2015). The average accuracy of the detector was 0.963 but its average balanced accuracy was 0.936. Its average precision was 0.027 but its average balanced precision was 0.966. For comparison, its average accuracy by a 10-fold cross-validation on balanced datasets was 0.982 and its average precision was 0.980 (Škrabánek et al., 2015). It is evident that the balanced measures provide meaningful results with a high information value, even on highly imbalanced datasets. Thus, at least, the class balanced measures allow a rough comparison with other results.

Moreover, there are two solid facts which strongly support using of the class balanced measures by evaluation of classifiers on imbalanced data. First, the meaning of these measures is evident to a broad community of researchers. Second, the balanced measures can be safely used both on balanced and on imbalanced datasets. In short, the class balanced measures are universal, intuitive, and simple to report. Thus, the second and the third requirement on a successful measure are fully met. Considering all these facts, the class balanced measures have a high probability of the broad acceptance by researchers across the majority of application areas.

The above stated facts lead us to a following conclusion: "When reporting performance of binary classifiers, the balanced measures should be used primarily on balanced as well as on imbalanced datasets." A merit of the class balanced measures is the fact that the selection of appropriate measures does not differ from the current practice. Moreover, once the balanced measures are applied on datasets with a balanced distribution of classes, they provide identical results to the original biased measures. Thus, the balanced measures can be also safely used when training or tuning classifiers on balanced datasets which we also positively recommend as the best practice. This suggestion is aimed to keep uniformity and clarity within every single report, paper or article.

6 Conclusion

In this article, the question of reporting performance of binary classifiers has been discussed. This issue is fundamental in many areas of economics; especially when machine learning or data mining methods are applied on datasets with imbalance distribution of classes. However, the discussed topic is not limited on the economics. It is relevant in many other fields such as medicine or computer vision.

In order to solve the discussed issue, the class balanced measures were suggested as a new standard while reporting performance of binary classifiers. The class balanced measures are basically extensions of the widely used biased measures. They capture the same aspects of performance as their counterparts. Results provided by these measures on balanced datasets do not differ from the original biased measures. The class balanced measures provide also meaningful results with high information value on imbalanced datasets. Since the meaning of these measures does not differ from the original ones, their acceptation by a broad professional community is expected.

As the next step, generalization of the introduced concept for multiclass classification problem is considered. However, less emphasis should not be placed on the presented class balanced measures. In the work (Brodersen et al., 2010), posterior distribution of a measure within the cross-validation has been considered. The way of looking at measures provided by Brodersen et al. might be applied to all the class balanced measures in order to obtain more detail information about their features.

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KRAJSKÉ MESTÁ SLOVENSKA A ICH FINANČNÉ ZDRAVIE

REGIONAL CAPITOLS IN SLOVAKIA AND THEIR FINANCIAL HEALTH

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Abstract: This paper focuses on the comparison of the financial health of regional capitols in Slovakia. The theoretical part of the paper offers insight into the current understanding of the financial health of cities. The main focus is on differences in the understanding of this concept and the definition of basic financial indicators to be used to evaluate the financial health of cities. Subsequently, the selected 13 financial indicators that we used in creating their own comprehensive indicator of financial health. It is calculated separately for the regional capitols of Slovakia in the years 2011-2014. In this paper we present the outcome of the main causes of the financial health of the regional capitol. Designed a comprehensive indicator is then compared with the results of indicator Institute Ineko who engages in assessing the financial health of all cities in Slovakia.

Keywords: financial health, regional capitols, comprehensive indicator, indebtedness, rentability, liquidity.

JEL Classification: H 70, H 72, H 75.

Úvod

Finančné zdravie je nevyhnutným predpokladom pre dosiahnutie cieľov akejkoľvek inštitúcie. Podľa Valachovej definície finančného zdravia, ktorá sa vzťahuje na všetky druhy organizácií, za finančne zdravú považujeme takú jednotku, ktorá je momentálne schopná plniť svoje funkcie a poslanie bez ohľadu na sektorovú príslušnosť (Valach, 1999). V prípade podniku je teda finančné zdravie podmienené schopnosťou uhrádzať svoje splatné záväzky, rovnako je dôležité splniť aj podmienky primeranej likvidity a rentability (Bajus et al., 2015). Finančné zdravie obce vypovedá o jej stave, udržateľnosti hospodárenia a či jej vo všeobecnosti hospodárenie spôsobuje alebo nespôsobuje problémy (Valach, 1999). Za finančne zdravú obec možno považovať takú obec, ktorá dokáže generovať zdroje na rozvoj svojho územia a na uskutočňovanie potrieb svojich občanova a nemá problém so svojou schopnosťou včas uhrádzať splatné záväzky (Opluštilová, 2012). Takáto obec je schopná zabezpečovať všetky potrebné verejné statky pre svojich občanov bez potreby nadmerného zadlžovania (Maličká, 2010). Práve zabezpečovanie verejných služieb je základnou úlohou verejnej správy (Halásková, 2012). Slovenský inštitút Ineko uvádza podobnú definíciu, ktorá hovorí, že finančné zdravie mesta, obce alebo vyššieho územného celku (VÚC) vypovedá o tom, do akej miery je hospodárenie udržateľné a či príslušnému mestu, obci alebo VÚC hospodárenie spôsobuje, alebo nespôsobuje problémy (Ineko, 2016).

V zahraničnej literatúre sa pojem finančného zdravia obcí objavuje častejšie. Nenájdeme tu však jednotné vnímanie tohto pojmu, ktoré je viditeľné predovšetkým v používaní odlišného súboru ukazovateľov hodnotenia finančného zdravia. V literatúre sa stretávame aj s termínom fiškálne zdravie obcí. Hendrick (2004) vo svojej štúdii zameranej práve na fiškálne zdravie municipalít poukazuje na to, že je možné použiť

rôzne indikátory založené na konceptoch fiškálnej krízy, daňovej záťaže, finančnej kondície, či fiškálnej tiesne. Holandle et al. (2004) sa prikláňajú k názoru Govesa et al. (1981), že termín, ktorý najviac vystihuje finančné zdravie je finančná kondícia, ktorá sa hodnotí na základe bežnej likvidity, dlhodobej platobnej schopnosti, rozpočtového hospodárenia a schopnosti úhrady výdavkov na danú úroveň služieb. Goves et al. (2003) neskôr uvádzajú, že je potrebné vziať do úvahy aj environmentálne faktory. Berne (1992) považuje za finančnú kondíciu schopnosť obce splniť záväzky voči veriteľom, zamestnancom, daňovým poplatníkom a ďalším zúčastneným stranám, povinnosť poskytovať im služby v súčasnosti aj budúcnosti. Chaney et al. (2002) vidia finančnú kondíciu ako schopnosť adekvátne poskytovať služby a spĺňať súčasné a budúce záväzky. Wang et al. (2007) tvrdia, že ide o schopnosť plniť si včas svoje finančné povinnosti.

1 Formulácia problematiky

Vzhľadom k tomu, že vnímanie finančného zdravia obcí môže byť pomerne široké, vyvoláva to otázku ako je vhodné toto finančné zdravie merať. Základom je stanovenie cieľa, s akým ideme finančné zdravie obce určiť. Prvou možnosťou je zistenie finančného zdravia samotného mesta s možnosťou hlbšej charakteristiky a vyvodenia opatrení na jeho zlepšenie. Druhou možnosťou je hodnotenie finančného zdravia obcí pre účely porovnania obcí medzi sebou (Cabaleiro et al., 2012). V literatúre sa najčastejšie stretávame s hodnotením finančného zdravia pomocou ukazovateľov výnosov, nákladov a dlhu. V niektorých štúdiách je kladený dôraz iba na finančné aspekty, avšak stretávame sa aj s prípadmi hodnotenia finančného zdravia obcí pomocou sociálno-ekonomických ukazovateľov. Rovnako existujú aj rozdiely v počte ukazovateľov, ktoré reprezentujú finančné zdravie. Niektorí autori uvádzajú viacero pomerových ukazovateľov ako napríklad Clark (1977) a Zafra et al. (2009), zatiaľ čo iní vytvárajú súhrnný index hodnotenia finančného zdravia, ktorý môžeme nájsť v štúdiách Browna (1993), Cohena et al. (2012), Kloha et al. (2005) a napríklad aj v práci Mercera a Gilberta (1996).

Prvopočiatky hodnotenia finančnej situácie organizácií verejnej správy nájdeme v práci Grovesa, Godseya a Shulmana (1981) , ktorí sledovali po vzore korporátnej sféry hodnotenie finančnej situácie v organizáciách verejnej správy. Sledované ukazovatele vychádzali z finančnej, demografickej a ekonomickej oblasti. Brown (1993) vychádza z podobného hodnotenia ukazovateľov, avšak na príklade finančného zdravia 750 menších miest a obcí v USA. Brown upozorňuje, že interpretácia finančného zdravia za pomoci súhrnných ukazovateľov je možná len v prípade, ak porovnávame obce z hľadiska veľkosti. Používa pritom údaje z účtovných závierok, ktoré priraďuje do jedného z 10 indikátorov, za pomoci ktorých je vytvorený jediný indikátor finančného zdravia. V roku 1998 bol Brownov test použitý v štúdii Honadla a Lloyd-Jonesa (1998), ktorí za hlavné podmienky ukazovateľa finančného zdravia považujú jednoduchosť, zrozumiteľnosť, schopnosť zaujať širokú verejnosť a včasnú zverejniteľnosť. Subjekty sú porovnávané opäť podľa počtu obyvateľov, pričom sa na základe ukazovateľa vyvodzujú aj ďalšie kroky vedúce k zlepšeniu finančného zdravia obce.

Finančnej výkonnosti municipalít sa venoval aj Carmeli (2007), ktorý ju hodnotí z dvoch strán, a to z finančnej a ako rozvoj municipality. Podľa Wanga, Dennisa a Tua (2007) je pri sledovaní finančného zdravia municipality potrebné sledovať štyri oblasti, a to peňažnú likviditu, rozpočtovú solventnosť, dlhodobú solventnosť a solventnosť

v poskytovaní služieb. Svoboda (2015) uvádza syntézu oblastí, ktoré by mali byť predmetom skúmania finančného zdravia municipalít. Ide o peňažnú likviditu, rozpočtovú likviditu, solventnosť, kvalitu a rozsah verejných služieb, ekonomickú flexibilitu a nezávislosť na cudzích zdrojoch.

Opluštilová (2012) v svojej práci navrhuje komplexný ukazovateľ finančného zdravia pre hodnotenie českých miest, ktorý by bolo možné použiť bez ohľadu na veľkosť, či rozsah pôsobenia mesta. Sleduje 5 ukazovateľov z oblasti rozpočtového hospodárenia (váha 40%), 3 ukazovatele likvidity (20%), 4 ukazovatele zadlženosti (40%), pričom zohľadňuje veľkosť mesta.

Na Slovensku sa hodnotením finančného zdravia zaoberá inštitút INEKO , ktorý každoročne hodnotí finančné zdravie 2930 slovenských obcí a ôsmych vyšších územných celkov. Jediným zdrojom údajov o finančných ukazovateľoch pre inštitút INEKO je Datacentrum, ktoré je v pôsobnosti Ministerstva financií SR. Nevýhodou tohto zdroja údajov je to, že sa nemusia zhodovať so skutočnými údajmi v účtovníctve obcí, a teda Ineko negarantuje správnosť prezentovaných údajov. Medzi najdôležitejšie ukazovatele finančného zdravia patria ukazovatele ako celkový dlh, dlhová služba, záväzky aspoň 60 dní po splatnosti, okamžitá likvidita a základná bilancia. Výsledné skóre vznikne ako vážený aritmetický priemer parciálnych skóre z týchto uvedených oblastí. Váhy pre tento výpočet sú 1/3 – celkový dlh (vyššia váha z dôvodu vyššieho potenciálneho rizika), 1/6 – dlhová služba, záväzky aspoň 60 dní po splatnosti, okamžitá likvidita, základná bilancia. Podľa metodiky vyššie opísanej mestá môžu dosahovať celkové skóre od 0 po +6 . Hodnoty vyššie alebo rovné +3 poukazujú na zdravosť mesta, pričom čím je vyššia hodnota tým je mesto zdravšie a odolnejšie voči finančným výkyvom. Ak je mesto v škále od 0 po +3 naznačuje to problémy s finančnou stabilitou a s plnením zákonných kritérií. Je potrebné spomenúť, že pre údaje potrebné na výpočet finančného zdravia danej obce sa nepoužívajú len dáta z jedného roka ale ide o priemer hodnôt za posledné tri roky (Ineko, 2016).

2 Metódy

Príspevok sa zameriava na tvorbu súhrnného indikátora finančného zdravia krajských miest na Slovensku, pričom cieľom indikátora je zostaviť poradie týchto miest. Sledovaných bolo osem krajských miest, konkrétne Košice (KE), Banská Bystrica (BB), Trnava (TT), Žilina (ZA), Nitra (NR), Prešov (PO), Trenčín (TN) a Bratislava (BA). Skupiny sledovaných ukazovateľov boli vyberané predovšetkým na základe odborných štúdií. Dátovým zdrojom boli záverečné účty krajských miest za roky 2011-2014. V čase písania príspevku neboli dostupné všetky potrebné údaje za rok 2015. Pre potreby zostavenia súhrnného indikátora finančného zdravia každého krajského mesta v každom roku bolo potrebné vytvoriť vlastnú databázu vstupných finančných ukazovateľov, medzi ktoré patrili príjmy bežného rozpočtu, príjmy kapitálového rozpočtu, výdavky bežného rozpočtu, výdavky kapitálového rozpočtu, úvery od štátneho fondu rozvoja bývania, záväzky po lehote splatnosti, záväzky neuhradené 60 a viac dní po lehote splatnosti, neobežný majetok, krátkodobé pohľadávky, finančné účty, dlhodobé záväzky, krátkodobé záväzky, bankové úvery a výpomoci, počet obyvateľov k začiatku roka, výdavky na splácanie istiny, úrokové splátky, výsledok hospodárenia za bežné a predchádzajúce účtovné obdobie, miestne dane, podielové dane a celkové dotácie. Z týchto 21 vstupných finančných ukazovateľom bolo vytvorených trinásť

indikátorov finančnej stability. Vzťahy na výpočet použitých indikátorov sú uvedené v Tab. 1.

Tab. 1 Vzťahy pre výpočet indikátorov finančnej stability

Indikátor finančnej stability	Vzťah na výpočet
Celkový dlh (%)	$$\frac{bankové\ úvery\ a\ výpomoci\ +\ dlhodobé\ záväzky\ -\ úvery\ od\ ŠFRB\ -\ záväzky\ z\ PE}{bežné\ príjmy\ za\ predchádzajúci\ rok}$$
Dlhová služba (%)	$$\frac{výdavky\ na\ splácanie\ istiny\ +\ úrokové\ splátky}{bežné\ príjmy\ za\ predchádzajúci\ rok}$$
Záväzky aspoň 60 dní po splatnosti (%)	$$\frac{záväzky\ neuhradené\ 60\ a\ viac\ dní\ po\ lehote\ splatnosti}{bežné\ príjmy\ za\ predchádzajúci\ rok}$$
Okamžitá likvidita (%)	$$\frac{finančné\ účty}{krátkodobé\ záväzky}$$
Pohotová likvidita (%)	$$\frac{finančné\ účty\ +\ krátkodobé\ pohľadávky}{krátkodobé\ záväzky}$$
Bilancia bežného účtu (%)	$$\frac{bežné\ príjmy\ -\ bežné\ výdavky}{bežné\ príjmy}$$
Bilancia kapitálového účtu (%)	$$\frac{kapitálové\ príjmy\ -\ kapitálové\ výdavky}{kapitálové\ príjmy}$$
Základná bilancia (%)	$$\frac{bežné\ príjmy\ +\ kapitálové\ prímy\ -\ bežné\ výdavky\ -\ kapitálové\ výdavky}{bežné\ príjmy\ +\ kapitálové\ prímy}$$
Výsledok hospodárenia na jedného obyvateľa (eur)	$$\frac{saldo\ bežného\ rozpočtu\ +\ saldo\ kapitálového\ rozpočtu\ +\ saldo\ finančných\ operácií}{počet\ obyvateľov}$$
Daňová sila obce (eur)	$$\frac{mietsne\ dane\ +\ podielové\ dane}{počet\ obyvateľov}$$
Finančná sila obce (eur)	$$\frac{mietsne\ dane\ +\ podielové\ dane\ +\ dotácie}{počet\ obyvateľov}$$
Miera samofinancovania (%)	$$\frac{vlastné\ príjmy}{bežné\ výdavky}$$
Miera sebestačnosti (%)	$$\frac{vlastné\ príjmy\ +\ daňové\ príjmy}{celkové\ príjmy}$$

Poznámka: ŠFRB- štátny fond rozvoja bývania, PE – predfinancovanie eurofondov
Zdroj: Šebová, 2012, Ineko, 2016, Zákon č. 583/2004, 2004.
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Medzi často používané skupiny ukazovateľov pre hodnotenie finančného zdravia obcí patria ukazovatele zadlženosti, likvidity a hospodárenia (Ineko, 2016, Opluštilová, 2012). Keďže v definícii finančného zdravia sa hovorí aj o nezávislosti od cudzích zdrojov (Svoboda, 2015) do súhrnného indikátora finančného zdravia boli zahrnuté aj ukazovatele samofinancovania. Pomerne nové pri hodnotení finančného zdravia sú ukazovatele finančnej a daňovej sily, ktoré hovoria o sume daní a dotácií na jedného obyvateľa, čo má vplyv na schopnosť obce zabezpečovať verejné služby v primeranej

kvalite, čo rovnako autori považujú za dôležité (Dugasová, 2012, Holande, Lloyd-Jones, 1998).

Pre každý z 13 ukazovateľ finančnej stability bolo použité skóre hodnotenia od 1 (najlepšie) po 5 (najhoršie), teda opačne ako používa inštitút Ineko, pričom hraničné hodnoty ukazovateľa priradené k danému skóre boli vytvorené čiastočne podľa inštitútu INEKO ale veľkou mierou podľa vlastnej metodiky, resp. jednotlivých výsledkov krajských miest. Ako prvé boli vypočítané hodnoty stanovených indikátorov pre každé mesto v období rokov 2010-2014. Následne bol vypočítaný priemer týchto hodnôt pre daný indikátor, ktorý bol porovnaný s priemernou hodnotou vykazovanou inštitúciou Ineko. Tieto dve hodnoty boli opäť spriemerované a predstavovali stred intervalu pre dosiahnutie troch bodov v hodnotiacej škále. Krajná hranica pre skóre 1 a 5 bola stanovená ako priemer maximálnych, resp. minimálnych hodnôt pre daný indikátor za roky 2011-2014. Rozhodujúce bolo, či je žiaduce dosiahnuť čo najnižšiu, resp. čo najvyššiu hodnotu daného ukazovateľa v obci. Pri ukazovateľoch zadlženosti a hospodárenia bol postup stanovenia skóre iný, keďže bolo nutné zohľadniť zákonné kritériá, ktoré sú bližšie popísané v Zákone č. 583/2004 Z. z. o rozpočtových pravidlách územnej samosprávy. Pre ukazovateľ celkového dlhu predstavovalo hraničnú hodnotu 60%, pri ukazovateli záväzky po lehote splatnosti viac ako 60 dní bola hranica 15% a pre dlhovú službu to bolo 25%. Rovnako boli rešpektované aj podmienky kladené na výsledné saldo bežného, kapitálového a celkového rozpočtu obce. Skóre pre jednotlivé indikátory finančnej stability uvádza Tab. 2

Tab 2. Skóre finančného zdravia jednotlivých ukazovateľov finančnej stability

Skóre FZ	1	2	3	4	5
CD	0-15	15,1-30	30,1-45	45,1-60	60,1 a viac
DS	0-5	5,1-10	10,1-20	20,1-25	25,1 a viac
Z	0-1	1,1-5	5,1-10	10,1-15	15,1 a viac
OL	101 a viac	76-100	51-75	26-50	0-25
PL	121 a viac	101-120	81-100	61-80	0-60
BBÚ	10,1 a viac	6,1-10	3,6-6	0,1-3,5	0 a menej
BKÚ	20,1 a viac	10,1-20	0,1-10	-14,9-0	-15 a menej
VH	40,1 a viac	25,1-40	10,1-25	0-10	0 a menej
ZB	10,1 a viac	5,1-10	0,1-5	- 15-0	-15 a menej
DSO	371 a viac	341-370	311-340	281-310	280 a menej
FSO	481 a viac	450-480	431-451	411-440	410 a menej
MST	0,75 a viac	0,67-0,74	0,59-0,66	0,51-0,58	0,5 a menej
MSF	0,81 a viac	0,71-0,8	0,61-0,7	0,51-0,6	0,5 a menej

Zdroj: vlastné spracovanie autormi

Finančné zdravie je počítané pre každý rok samostatne, to znamená že je možné ho každoročne vypočítať za posledné uzavreté obdobie, ktoré je nezávislé od roku pred posledným uzavretým obdobím. Jeho výsledné skóre je v rozmedzí hodnôt jeden až päť podľa hodnotenia jednotlivých finančných ukazovateľov, kde 1 je výborné finančné zdravie, 2 – dobré finančné zdravie, 3 – uspokojivé finančné zdravie, 4 – dostatočné finančné zdravie, 5 je nedostatočné finančné zdravie.

Po stanovení skóre pre dané indikátory finančnej stability bolo vytvorených päť sledovaných oblastí a určené váhy tak pre tieto oblasti, ako aj pre ukazovatele finančnej stability, ktoré sa v nich nachádzajú, čo znázorňuje Tab. 3. Váhy pre dané oblasti boli určené na základe analyzovaných štúdií, zákonných kritérií a váh stanovených

inštitúciou Ineko. Napríklad hraničné hodnoty pre ukazovatele zadlženosti sú stanovené zákonom, teda pri ich nedodržaní má obec obmedzené možnosti čerpania návratných zdrojov financovania, čerpania eurofondov, prípadne sa môže dostať do ozdravného režimu alebo nútenej správy. Z tohto dôvodu má táto oblasť až 50%-tnú váhu v celkovom indikátore finančného zdravia. Po 20%-tnú váhu majú ukazovatele likvidity a hospodárenia. Likvidita je pre obec dôležitá z hľadiska dostatku financií na krytie svojich krátkodobých záväzkov. Problémy s dostatočnou likviditou môžu mať za následok existenciu záväzkov po lehote splatnosti nad 60 dní, čo upravuje zákon. Vysoká váha ukazovateľov hospodárenia je spôsobená rovnako zákonnými kritériami, keďže zákon upravuje aké saldo daného rozpočtu musí byť v obci plánované. Problémy s hospodárením obce sa priamo odrazia na zabezpečovaní verejných statkov (Halásková, 2013), ktorých kvalita je odrazom finančného zdravia obce. 15%-tná váha bola pridelená ukazovateľom sebestačnosti a samofinancovania, keďže hovoria o finančnej kondícii obce vzhľadom na jej rozvojové možnosti. Tieto indikátory sa výrazne posilnili po realizácii fiškálnej decentralizácie po roku 2005 (Šebová, 2012). Ukazovatele daňovej a finančnej sily získali váhu 10%, keďže patria medzi pomerne nové ukazovatele, ktoré sú zahrnuté do hodnotenia finančného zdravia. Hovoria o objeme miestnych a podielových daní, prípadne aj dotácii na jedného obyvateľa, čo predstavuje množstvo peňazí, ktoré má obec vyčlenené na zabezpečenie originálnych a prenesených kompetencií na jedného obyvateľa. To má priamy vplyv na kvalitu ponúkaných verejných statkov v obci.

Tab. 3 Prehľad indikátorov finančnej stability použitých pri tvorbe súhrnného indexu finančného zdravia krajských miest a ich váhy

Sledované oblasti	Ukazovatele finančnej stability
Ukazovatele zadlženosti (35%)	Celkový dlh (CD),(50%)
	Dlhová služba (DS) (25%)
	Záväzky aspoň 60 dní po splatnosti (Z), (25%)
Ukazovatele likvidity (20%)	Okamžitá likvidita (OL), (50%)
	Pohotová likvidita (PL), (50%)
Ukazovatele hospodárenia (20%)	Bilancia bežného účtu (BBÚ), (25%)
	Bilancia kapitálového účtu (BKÚ), (15%)
	Základná bilancia (ZB), (35%)
	Výsledok hospodárenia na jedného obyvateľa (VH), (25%)
Ukazovatele daňovej a finančnej sily (10%)	Daňová sila obce (DS), (50%)
	Finančná sila obce (FS), (50%)
Ukazovatele samofinancovania (15%)	Miera samofinancovania (MSF), (50%)
	Miera sebestačnosti (MST), (50%)

Poz: percentá v zátvorke predstavujú podiel sledovaných oblastí v súhrnnom indexe finančného zdravia a podiel vstupných ukazovateľov v sledovaných oblastiach.

Zdroj: vlastné spracovanie autormi

Výsledný vzťah na výpočet súhrnného ukazovateľa finančného zdravia obce má tvar:

Súhnný index finančného zdravia obcí $= 0,35 * uk. zadlženosti + 0,2 *$
uk. likvidity $+ 0,2 * uk. hospodárenia + 0,15 * uk. samofinancovania + 0,1 *$
uk. finančnej a daňovej sily (1)

Daný vzťah umožňuje určiť hodnotu súhrnného indexu finančného zdravia pre každé mesto v stanovenom roku. Čím je hodnota bližšia k jednej hovoríme o lepšom finančnom zdraví obce. Obec tak môže zistiť aké je jej celkové finančné zdravie, prípadne ktorá oblasť alebo konkrétny indikátor je pre obec problémový. Pri sledovaní viacerých obcí je možné zostaviť poradie, prípadne sledovať zlepšenie, resp. zhoršenie finančného zdravia obce v čase.

3 Rozbor problému

Podľa zvolenej metodiky sme stanovili skóre pre každý ukazovateľ finančnej stability, vypočítali skóre pre každú skupinu ukazovateľov a následne podľa vzorca určili konečné skóre finančného zdravia, ktoré slúži na vzájomné porovnanie medzi sledovanými mestami a reprezentuje finančné zdravie obce. Na základe uvedených výpočtov je možné obce hodnotiť podľa jednotlivých ukazovateľov, napr. podľa celkového dlhu, podľa skupiny ukazovateľov napr. ukazovatele zadlženosti a samozrejme aj cez súhrnný index finančného zdravia, čo možno v každom prípade zhodnotiť aj v čase od roku 2011-2014. Ako príklad uvádzame Tab. 4 s ohodnoteným skóre pre 13 sledovaných ukazovateľov mesta Košice v rokoch 2011-2014.

Tab 4. Hodnotenie jednotlivých ukazovateľov finančného zdravia mesta Košice

Rok	CD	DS	Z	OL	PL	BBÚ	BKÚ	VH	ZB	FS	DS	MS	MST
2011	2	3	2	4	3	4	1	2	2	2	3	1	3
2012	2	2	2	5	4	4	5	4	3	3	2	2	2
2013	2	1	2	3	2	4	5	2	3	1	1	2	4
2014	2	2	2	1	1	3	1	1	2	1	1	1	2

Zdroj: vlastné spracovanie autormi

V Tab. 4 je možné vidieť, problémové boli ukazovatele likvidity a hospodárenia v rokoch 2011-2013, pričom v roku 2014 došlo k zlepšeniu situácie.

Rovnakým spôsobom boli hodnotené všetky krajské mestá a z nich bolo zostavené hodnotenie miest v piatich oblastiach a celkové hodnotenie finančného zdravia. Za rok 2014 je toho hodnotenie a celkové skóre uvedené v Tab. 5.

Tab. 5 Skóre finančného zdravia krajských miest v daných oblastiach za rok 2014

Skupiny ukazovateľov	KE	BB	TT	TN	ZA	PO	NR	BA
Ukazovatele zadlženosti	2	1,75	1,25	1,75	2,25	2,25	1,75	3
Ukazovatele likvidity	1	1	1	3,5	2	2,5	2	2,5
Ukazovatele hospodárenia	1,85	2,5	2,55	3,4	2,2	3,7	3,15	3,65
Ukazovatele daňovej a finanč. sily	1	1	2,5	1	1	1,5	1,5	2,5
Ukazovatele samofinancovania	1,5	2,5	1	2,5	1,5	1,5	2	2
Celkové skóre za rok 2014	1,59	1,78	1,54	2,46	1,95	2,40	2,09	2,83

Zdroj: vlastné spracovanie autormi

Výsledné hodnoty jednotlivých ukazovateľov finančného zdravia majú svoje príčiny. V prípade Žiliny bola napríklad vysoká úroveň ukazovateľa celkového dlhu zapríčinená úverom od štátu, ktorý mesto získalo za účelom výkupu pozemkov v súvislosti s investíciou automobilky KIA. V roku 2014 sa hodnota celkového dlhu pohybovala na úrovni 59,66%, čo je tesne pod zákonným limitom 60%. V Bratislave bol v roku 2014 problematický ukazovateľ dlhovej služby, ktorý presiahol zákonných 25% a dostal sa na úroveň 34,43%, čo zhoršilo hodnotenie Bratislavy v ukazovateľoch zadlženosti.

Náhly nárast tohto ukazovateľa bol pravdepodobne spôsobený v dôsledku zarátania predčasného jednorazového splatenia návratných zdrojov financovania. Naopak stabilne nízku dlhovú službu si udržiava Trnava a Prešov. V prípade záväzkov po lehote splatnosti 60 a viac dní v pomere k bežným príjmom dosahoval najvyššiu hodnotu Prešov (2%), čím naplnil jednu zo zákonných podmienok na zavedenie ozdravného režimu. Tento stav bol v roku 2014 zapríčinený predovšetkým nízkou hodnotou ukazovateľov likvidity, kde v prípade okamžitej likvidity pripadá na 1 euro záväzkov iba 0,8 eura likvidných aktív, v prípade pohotovej likvidity to je 0,9 eura, pričom priemer obcí na Slovensku je za rok 2014 na úrovni 1,4 eura. Najlepšie na tom bola Trnava, kde pohotová likvidita predstavovala 261%, čo znamená, že na 1 euro záväzkov pripadá 2,61 eura likvidných aktív. Pri tejto úrovni okamžitej likvidity by však mesto malo uvažovať aj nad investovaním „voľného" kapitálu v prospech mesta. V prípade ukazovateľov hospodárenia je hodnotenie krajských miest najhoršie. Bilancia bežného účtu je nad priemerom obcí počas celého sledovaného obdobia v Žiline a Trenčíne. V Prešove však v roku 2014 dosahovala bilancia bežného účtu -1,7%, čo môže pre mesto predstavovať potenciálnu hrozbu neschopnosti plnohodnotne zabezpečiť chod samosprávy. V prípade základnej bilancie mali slovenské mestá problémy v pokrízovom období, kde v roku 2010 bol celoslovenský priemer na úrovni -12%. Postupom času sa tento stav zlepšil, aj keď v roku 2014 to je len 0,1%. Košice majú v prípade tohto ukazovateľa kladný vývoj a v roku 2014 je jeho hodnota 8,1%. Trenčín, Nitra a Bratislava majú záporné hodnoty základnej bilancie, čo je však spôsobené vysokou úrovňou kapitálových výdavkov, ktoré sú pre veľké mestá typické.

V Tab. 5 uvádzame výsledné poradie krajských miest Slovenska aj s prideleným skóre v rokoch 2011-2014. Pri tomto komplexnom hodnotení finančného zdravia sme zistili, že podľa nami zvoleného indikátora má najlepšie finančné zdravie Trnava, a to počas celého sledovaného obdobia. Okrem prvej priečky sme u nej zaznamenali aj zlepšenie samotného skóre za posledné tri sledované roky. Mesto nemá problémy so zadlženosťou a disponuje vysokou okamžitou likviditou aj vďaka vlastným príjmom z priemyselného parku. Na druhej mieste v hodnotení finančného zdravia sa v rokoch 2011-2013 umiestnila Nitra, ktorú v roku 2014 nahradili Košice s lepším skóre aké mala Nitra v minulosti. Dôvodom toho, že sa Nitra posunula v rebríčku nižšie, bolo medziročné zvýšenie záväzkov o 6,7 mil. eur v dôsledku financovania projektu obnovy a modernizácie mestských komunikácií prostredníctvom súkromnej spoločnosti. Košice si svoje finančné zdravie zlepšili a v roku 2014 hlavne tým, že nemajú problémy so splácaním záväzkov, dosahujú nadpriemerné hodnoty likvidity a mesto disponuje stabilnými príjmami. Banská Bystrica si za posledné obdobie zlepšila hodnotenie finančného zdravia a v roku 2014 bola už na treťom mieste. Na jej dobré umiestnenie nemalo vplyv ani rozpočtové provizórium, v ktorom bolo mesto začiatkom roka 2014. Naopak najhoršie finančné zdravie spomedzi krajských miest mala v roku 2011 Žilina, v roku 2012 to bola Banská Bystrica, ktorá sa však v roku 2014 dostala až na druhé miesto a v roku 2013 a 2014 mala najhoršie finančné zdravie Bratislava. V Žiline to bolo zapríčinené už spomínaným úverom v súvislosti s automobilkou KIA. V Bratislave bol dôvodom hlavne úver, ktorý si muselo mesto zobrať na úhradu svojich starých dlžôb.

Tab. 6 Vývoj skóre finančného zdravia krajských miest v rokoch 2011-2014

Poradie	2011	2012	2013	2014
1.	Trnava (1,68)	Trnava (1,84)	Trnava (1,74)	Trnava (1,54)
2.	Nitra (1,88)	Nitra (1,9)	Nitra (1,98)	Košice (1,59)
3.	Košice (2,51)	Bratislava (2,41)	Trenčín (2,34)	Ban. Bystrica (1,72)
4.	Trenčín (2,59)	Žilina (2,63)	Košice (2,37)	Žilina (1,95)
5.	Prešov (2,76)	Prešov (2,73)	Žilina (2,38)	Nitra (2,09)
6.	Ban. Bystrica (2,86)	Trenčín (2,78)	Ban. Bystrica (2,5)	Prešov (2,40)
7.	Bratislava (3,12)	Košice (2,88)	Prešov (2,59)	Trenčín (2,46)
8.	Žilina (3,36)	Ban. Bystrica (2,91)	Bratislava (2,61)	Bratislava (2,83)

Zdroj: vlastné spracovanie autormi

Pre porovnanie výsledkov nášho hodnotenia finančného zdravia s hodnotením inštitútu Ineko uvádzame nasledujúcu Tab.6 a Tab7.

V Tab. 7 uvádzame porovnanie výsledkov v prvom sledovanom roku t.j. v roku 2011. V prípade Ineka však ide v danom roku o ukazovatele počítané z rokov 2008-2011 a Ineko negarantuje ich správnosť, vzhľadom k tomu, že údaje sú čerpané z Datacentra a nie zo záverečných účtov. Naopak v prípade našich výsledkov bol ukazovateľ počítaný zo záverečných účtov, ktoré boli dostupné pre mestá za rok 2011, teda ide o korektný zdroj. Z výsledkov vidíme zhodu na prvom mieste, kde sa umiestnila Trnava a na poslednom mieste, kde skončila v roku 2011 Bratislava. Rovnako druhé miesto patrí v oboch prípadoch Trnave a piate Prešovu. Najväčší rozdiel bol pri Trenčíne, kde podľa nášho hodnotenia skončilo ako štvrté a podľa Ineka ako siedme.

Tab. 7 Porovnanie skóre finančného zdravia nami skonštruovaného indexu finančného zdravia a inštitútu Ineko za rok 2011

Mesto	Vlastný indikátor	INEKO (2008-2011)
Trnava	1,68 (1.)	4,5 (1.)
Nitra	1,88 (2.)	4,4 (2.-3.)
Košice	2,51 (3.)	3,2 (4.)
Trenčín	2,59 (4.)	2,5 (7.)
Prešov	2,76 (5.)	3,1 (5.)
Banská Bystrica	2,86 (6.)	4,4 (2.-3.)
Bratislava	3,12 (7.)	2,7 (6.)
Žilina	3,36 (8.)	2,3 (8.)

Zdroj: vlastné spracovanie autormi

Tab. 8 porovnáva výsledky finančného zdravia v roku 2014, pričom Ineko tu robí výpočet z údajov za roky 2011-2014.

Tab. 8 Porovnanie skóre finančného zdravia nami skonštruovaného indexu finančného zdravia a inštitútu Ineko za rok 2014

Mesto	Vlastný indikátor	INEKO (2011-2014)
Trnava	1,54 (1.)	5,0 (1.)
Košice	1,59 (2.)	4,0 (4-5.)
Banská Bystrica	1,72 (3.)	4,5 (2.)
Žilina	1,95 (4.)	4,0 (4-5.)
Nitra	2,09 (5.)	4,3 (3.)
Prešov	2,40 (6)	3,6 (7.)
Trenčín	2,40 (7.)	3,9 (6.)
Bratislava	2,83 (8.)	3,5 (8.)

Zdroj: vlastné spracovanie autormi

Z Tab. 8 vidíme, že výsledky sa odlišujú hlavne z dôvodu, že Ineko pracuje s ukazovateľmi zadlženosti a likvidity, zatiaľ čo my sme pridali aj ukazovatele hospodárenia, samofinancovania, daňovej a finančnej sily. Avšak totožné je umiestnenie na prvom mieste, kde sa umiestnila Trnava a na poslednom miestne, kde sa za opäť aj za rok 2014 umiestnila Bratislava.

4 Diskusia

Na základe nami zvolených 13 ukazovateľov bol vytvorený súhrnný indikátor finančného zdravia, ktorý bol použitý na porovnanie ôsmych krajských miest na Slovensku. Postupný proces tvorby indikátora umožnil priebežne hodnotiť jednotlivé ukazovatele aj skupiny ukazovateľov a porovnávať ich medzi mestami ako aj v čase. Na základe výsledkov, ktoré sme dosiahli je možné konštatovať, že dlhodobo má najlepšie finančné zdravie spomedzi krajských miest Trnava, ktorá rovnako skončila aj v hodnotení inštitútu Ineko. Okrem Bratislavy mali ostatné mestá odlišné poradie v prípade našich výsledkov a výsledkov Ineka. Je to samozrejme spôsobené odlišnou skupinou použitých ukazovateľov, resp. ukazovatele Ineka tvorili podmnožinu nami sledovaných ukazovateľov. Rovnako je použitý aj iný systém stanovenia váh, z čoho vyplýva výsledný vzťah na výpočet komplexného ukazovateľa finančného zdravia. Na druhej strane je nutné spomenúť aj to, že Ineko negarantuje úplnú správnosť výsledkov vzhľadom k tomu, že využíva Datacentrum a nie samotné účtovné výkazy obcí. Z časového hľadiska totiž nie je možné zvládnuť analýzu výkazov pre všetky obce na Slovensku. V danom príspevku sú použité konkrétne záverečné účty krajských miest za každý z rokov 2011 až 2014 a tým by mala byť zabezpečené správnosť výpočtov. Skonštruovaný indikátor finančného zdravia by mal komplexnejšie a pravdivejšie sledovať a hodnotiť finančné zdravie krajských miest, čo by mohlo byť považované za jeho výhodu. Na druhej strane väčší počet ukazovateľov vedie k časovo náročnejšiemu výpočtu a možnosti horšieho prístupu k všetkým ukazovateľom potrebným na výpočet skonštruovaného indikátora. Vo všeobecnosti je však aj uvedený ukazovateľ možné použiť na hodnotenie finančného zdravia akejkoľvek obce na Slovensku. Jeho pridanou hodnotou je aj to, že umožňuje hodnotiť finančné zdravie aj po vybraných skupinách indikátorov a môže slúžiť aj na porovnanie medzi zvolenými obcami napr. v kraji alebo regióne. V praxi by mala obec na detekciu finančného zdravia využiť ako prvé výsledky Ineka, ktoré poskytujú kvalitné odhady finančného stavu obce. Následne obec môže využiť metodiku popísanú v príspevku, ktorá určí finančné zdravie obce presnejšie z konkrétnych účtovných závierok.

Záver

Hodnoteniu finančného zdravia obcí sa venuje v zahraniční ale už aj na Slovensku dostatočná pozornosť. Aj napriek tomu však absentuje jednoznačná definícia tohto pojmu, ktorá by presne určila oblasti hodnotenia. Z tohto dôvodu sa stretávame so štúdiami, kde si autori sami volia podobné, aj keď nie totožné skupiny ukazovateľov, ktoré následne považujú za nosné pre určenie finančného zdravia obce. Pri každom hodnotení finančného zdravia obce je teda potrebné určiť, aký je cieľ daného ukazovateľa finančného zdravia a pre koho sú výsledky určené. Príspevok sa zameriava na tvorbu súhrnného indikátora finančného zdravia, ktorý je určený na zhodnotenie a komparáciu finančného zdravia krajských miest na Slovensku. Priebežné a celkové výsledky hodnotenia môžu byť prínosné pre predstaviteľov krajských miest, ktorí na ich základe dokážu detekovať problémové oblasti v meste. Rovnako sú v príspevku

uvedené pomerne jednoduchý návod ako súhrnný indikátor vypočítať. Jeho interpretácia po častiach samozrejme vyžaduje znalosť interpretácie jednotlivých čiastkových indikátorov, čo však nebolo predmetom nášho príspevku.

Na základe skonštruovaného indikátora finančného zdravia je možné konštatovať, že v rokoch 2011-2014 má najlepšie finančné zdravie Trnava v dôsledku nízkej hodnoty celkového dlhu, dobrej schopnosti splácať svoje záväzky a dostatočnej likvidite. Košiciam sa za posledné roky podarilo zlepšiť si svoje finančné zdravie a za rok 2014 sa umiestnili na druhom mieste. Nasleduje Banská Bystrica a Žilina, ktorej zhoršenie finančného zdravia zapríčinili záväzky v súvislosti s príchodom automobilky KIA. Žiline však táto investícia prinesie mnoho benefitov, pričom hlavným z nich je rast zamestnanosti. Nitra sa v rebríčku posunula nižšie aj v dôsledku financovania projektu obnovy a modernizácie mestských komunikácií prostredníctvom súkromnej spoločnosti. Na šiestom mieste bol Prešov, ktorý mal v posledných rokoch problém z likviditou a následne s uhrádzaním záväzkov nad 60 dní. Na siedmom mieste skončil Trenčín a za ním Bratislava, ktorá v dôsledku vysokých kapitálových výdavkov a potrebe úveru na splatenie starých dlhov skončila na poslednom mieste.

Hodnotenie finančného zdravia na základe uvedených ukazovateľov by mohlo byť základom finančného hodnotenia mesta. Pri celkovom hodnotení mesta je však potrebné brať do úvahy aj príčiny zhoršujúceho sa finančných ukazovateľov. Vysoké kapitálové investície totiž negatívne pôsobia na dané ukazovatele, na druhej strane však mestu prinášajú benefity v podobe lepšej infraštruktúry, kvalitnejších verejných služieb, či rast zamestnanosti v danom meste a okolí.

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EVROPSKÉ FONDY – MANAGEMENT RIZIK V OBLASTI VEŘEJNÉHO ŠKOLSTVÍ

EUROPEAN FUNDS – MANAGEMENT OF RISKS IN PUBLIC EDUCATION

Kamila Turečková, Jan Nevima

Abstract: *In the programming period 2007-2013, the Czech Republic was allowed to draw 26,7 billion euros from European funds. After joining the European Union in 2004, the Czech Republic gained an access to European funds by means of submitting individual or simplified projects within individual operational programmes. In the period 2007-2013, drawing funds from the European Union expanded to a great extent, but due to the initial project boom a great amount of projects failed to be successful as they were overwhelmed by the risks of project management. In the first part, risks of project management are introduced in general perspective which is universal for any other project. In the second part of the article, examples of risks in European funds are published. The last part of article deals "bad practices" in case of public education. Despite certain imperfections that can occur when drawing funds from the European Union, these funds represent an important financial tool for further growth of competitiveness of schools. The contribution is not only hypothetical, but also presents us with some relevant real-life examples from the sphere of public education in the Czech Republic.*

Keywords: *Programming period, Project, European funds, Risks.*

JEL Classification: *O22, H43, G32.*

Úvod

České republice se vstupem do Evropské unie v roce 2004 naskytly příležitosti, u nichž nebylo možné předem odhadnout, jaké efekty budou jednotlivým ekonomickým subjektům přinášet. Jednou z těchto příležitostí byl přístup k evropským fondům. Možnost získat finanční prostředky pro uskutečnění vlastního projektu se stala velmi lákavou. Mnozí žadatelé a posléze již samotní příjemci si často neuvědomovali rizika spojená s čerpáním těchto prostředků. Ačkoliv programovací období 2004-2006 znamenalo start čerpání pro ČR v roli řádného člena Evropské unie, teprve programovací období 2007-2013 plně otevřelo možnosti v přístupu k novým projektům.

V programovacím období 2007-2013 mohla Česká republika využít nabídku vyčerpat z evropských fondů 26,7 miliardy eur. Kromě toho si musela ještě ČR zajistit dofinancování těchto projektů ze státního rozpočtu. Česká republika si vytvořila pro získávání finančních prostředků z fondů EU – stejně jako ostatní členové Evropské unie - soustavu programových dokumentů a nezbytné institucionální zajištění. **Národní strategický referenční rámec** (MMR, 2007) představuje základní programový dokument České republiky pro využívání fondů Evropské unie v období 2007-2013. Ve většině případů byl totiž nastaven režim spolufinancování v poměru

85:15 (EU:ČR). Žadatelé, resp. příjemci, z řad zástupců veřejné sféry prakticky nikdy nemuseli řešit spolufinancování z vlastních prostředků, to se týkalo v převážné míře pouze soukromých subjektů.

Možná i tato skutečnost vedla k vytvoření určité iluze, že evropské fondy lze čerpat prakticky na cokoliv a to způsobilo mnohdy velmi laxní přístup zejména k finanční administraci projektů. Většina problémů, které příjemci při čerpání evropských dotací mají, je totiž finančního charakteru. Vyskytovaly se však i jiné problémy, které neukazovaly na chyby samotného systému evropských dotací, byly spíše způsobeny zbytečně přísnými pravidly, které si ČR nastavila na národní úrovni. Než si jednotlivé problémy a s nimi spojená rizika v další kapitole představíme, je nutno upozornit ještě na jeden velmi často opomíjený fakt.

Kontrolní orgány v ČR i v rámci institucí EU či řídící orgány jednotlivých operačních programů zpravidla nikdy nezajímalo, co se v rámci úspěšných projektů podařilo vytvořit či jaká pozitivní změna nastala. Vše se točilo pouze kolem mnohdy nešťastně nastavených monitorovacích indikátorů, které vše přepočítávaly na čísla, ne na kvalitu či vytvořenou přidanou hodnotu, ve srovnání se situací na začátku realizovaných projektů. Domníváme se, že je to velká škoda, protože se tím upozaďuje velké množství vykonané práce, která mnohdy nebyla na první pohled vidět.

Ačkoliv jsme nyní v dalším programovacím období 2014-2020, není možné objektivně konstatovat, zda se v tomto období změní portfolio rizik pro žadatele, resp. příjemce. I přes tuto skutečnost se však domníváme, že řada rizikových oblastí, kterou v článku představujeme, bude úzce propojena také se současným programovacím obdobím.

Pro zajištění objektivnosti příspěvku však chceme upozornit, že v současném programovacím období je již plně naplňován **Metodický pokyn** (MP) **pro řízení rizik ESI fondů v programovém období 2014–2020** (MMR, 2014), u něhož dochází k průběžné aktualizaci. Cílem tohoto pokynu je zavedení systematického přístupu k identifikaci, hodnocení, zvládání, monitorování a vykazování všech významných rizik systémovým, jednotným a integrovaným způsobem tak, aby tato rizika byla minimalizována a včas eliminována. Cílem MP pro řízení rizik 2014–2020 je také dosáhnout stavu, kdy rizika, která jsou komunikována s Národním orgánem pro koordinaci (MMR-NOK), mají srovnatelnou vypovídající hodnotu a je možné s nimi dále pracovat, předat návrhy na jejich minimalizaci na vyšší úroveň, například na úroveň vlády ČR, či následně přijímat nápravná opatření pro snížení významnosti rizika a to nejen z úrovně řídicího orgánu, MMR-NOK či Vlády ČR.

Cílem příspěvku je upozornit odbornou i laickou veřejnost a především samotné žadatele, resp. příjemce evropských dotací z řad zástupců veřejného školství na možnou hrozbu vzniku rizikových situací při řešení těchto projektů a nastínit cestu k jejich efektivnímu řešení.

1 Management rizik evropských dotací

V této kapitole si postupně ukážeme v obecné rovině základní skladbu rizik projektového managementu a to bez ohledu na to, zda jsou spojená s čerpáním evropských fondů či národních grantových schémat. Rizika mohou být v rovině příčin předvídatelných a ovlivnitelných nebo příčin neovlivnitelných (Němec, 2002). Při čerpání evropských fondů se setkáváme zpravidla s první skupinou rizik, ačkoliv se

objevovala rizika i z druhé skupiny. Riziko neovlivnitelné se týkalo například změny legislativy v oblasti daňových zákonů, konkrétně šlo o změnu DPH. Při přípravě projektu se počítalo s tím, že se sazba DPH měnit nebude.

Management rizik sehrává v projektovém řízení klíčovou úlohu. Je-li efektivně nastaven již od počátku realizace každého projektu, pak platí, že by měl každého příjemce finančních prostředků ochránit vnitřní kontrolní systém organizace. Při čerpání evropských fondů se však příjemce musí řídit i vlastní dokumentací příslušného operačního programu. Zpravidla se jedná o příručku pro příjemce, která nastavuje mechanismy finančního řízení ve vztahu k poskytovateli dotace.

Ani u dobře naplánovaného projektu nelze vyloučit rizika. Tlak na snížení nákladů, termíny realizace jednotlivých aktivit projektu či požadavky na kvalitu výsledku projektu komplikují schopnost dosáhnout zamýšleného cíle projektu. Charakteristickým rysem rizikové situace (Korecký, Trkovský, 2011) jsou neúplné informace a možnost, že původní očekávání nebudou naplněna. Hlavní úlohou řízení rizik je proto snaha zajistit co možná nejkompletnější informace a minimalizovat nejistoty v plánovacím a řídícím procesu.

Projektový management u veřejných projektů si sebou nese určité zvláštnosti (Ochrana, 2010). Ty jsou dány především formálními ustanoveními zákonů upravujících činnosti dotyčných subjektů ve veřejném sektoru či zákony a vyhláškami, které upravují způsoby financování veřejných projektů a to včetně veřejné kontroly veřejných projektů. Nyní si budeme klíčová rizika postupně představovat.

2 Portfolio rizik evropských dotací

Z pohledu příjemců patří mezi nejzávažnější rizika ta, která jsou spojena s realizací veřejných zakázek. V této souvislosti je základním rizikem **problém se specifikací zakázky** v rámci vyhlášeného výběrového řízení na dodavatele zboží či služeb. V drtivé většině zaznamenaných případů se jedná o chybně stanovenou specifikaci při dodávkách výpočetní a prezentační techniky, což je ve školách velmi často předmětem výběrového řízení, a vzniká tímto problém s transparentností výběrového řízení. Pro osoby bez příslušného technického vzdělání, nejlépe v oblasti ICT, může dojít zcela neúmyslně k uvedení výrobce požadovaného komponentu [viz Příloha 2]. Základním doporučením, které se zde nabízí, je kompletní posouzení specifikace veřejné zakázky ze strany poskytovatele dotace a upozornění na případné nesrovnalosti ve veřejné zakázce ještě před jejím zveřejněním. To samozřejmě povede k časové prodlevě, ale může se tak snáze předejít problémům v budoucnu.

Naprosto odlišná je situace, pokud příjemce uzavře nezákonnou dohodu s některými soutěžiteli u veřejné zakázky na dodávky ICT. To je situace, kdy dochází k tzv. dělení trhu či předkládání fiktivních nabídek. Což se projevuje především tím, že specifikaci zakázky připravili místo zadavatele samotní dodavatelé a zadavatel „pouze" podepsal.

Návazným rizikem pro příjemce je při odhalení chybně zadané veřejné zakázky následná veřejnosprávní kontrola. Ta začíná vyslovením podezření na nesrovnalost. **Nesrovnalostí** se přitom rozumí porušení právních předpisů EU nebo ČR v důsledku **jednání nebo opomenutí hospodářského subjektu**, které vede nebo by mohlo vést ke ztrátě v souhrnném rozpočtu EU (resp. ESI fondů) nebo ve veřejném rozpočtu ČR či k **započtení neoprávněného výdaje**. Za nesrovnalost se nepokládá provedení neoprávněného výdaje na úrovni příjemce v případě dotace poskytované v režimu ex-

ante a zároveň za předpokladu, kdy dojde k odhalení tohoto neoprávněného výdaje a provedení dostatečné finanční opravy před schválením žádosti o platbu, v opačném případě následuje předání podnětu na místně příslušný Finanční úřad (FÚ), aby toto podezření na nesrovnalost prošetřil – jedná se o **podezření na porušení rozpočtové kázně**. K samotnému kontrolnímu mechanismu, který je nastaven platnými právními předpisy v ČR, samozřejmě nemáme žádné připomínky. Problém nastává především v tom, kdy místně příslušný FÚ má prošetřovat třeba kvalitu vytvořených výsledků/výstupů v projektu a tato činnost je vysoce odborná a bez znaleckých posudků jí nelze kvalifikovaně provést. K určitým absurditám při provádění veřejnosprávní kontroly dochází například v situaci, kdy finanční manažer či účetní projektu chybně zaúčtuje na vrub projektu fakturovanou částku za zboží či služby, která je ze své podstaty způsobilým výdajem. Velmi často je to způsobeno chybou v řádu haléřů či korun, kdy fakturovaná částka obsahuje zaokrouhlení na celé koruny a z prostředků projektového účtu je uhrazena nezaokrouhlená částka včetně haléřového rozdílu. I v tomto případě dochází ze strany řídícího orgánu příslušného operačního programu k podání podnětu na místně příslušný FÚ k prošetření.

Výsledkem tohoto kroku je pak absurdní situace, kdy je sestavena kontrolní skupina na FÚ a ta prošetřuje například „újmu" ve výši 0,66 Kč [viz Příloha 1], ačkoliv příjemce situaci napravil a poskytovateli dotace objasnil. Čistě z ekonomického pohledu jsou náklady, které musí FÚ vynaložit, aby tuto záležitost prošetřil, mnohonásobně vyšší než samotná částka, která je předmětem této kontroly. Do budoucna se tedy jednoznačně nabízí přesně specifikovat finanční hranici, od které je i pro kontrolní orgány vůbec efektivní veřejnosprávní kontrolu uskutečnit, to si sebou samozřejmě nese i nutnost změnit příslušné předpisy v této oblasti, zejména Zákon č. 320/2001 Sb., o finanční kontrole ve veřejné správě ve znění pozdějších předpisů (Zákon 320/2001 Sb., 2001).

Určitým multiplikátorem problémů v této oblasti je pak **nařízený odvod finančních prostředků** v případě, kdy výsledek veřejnoprávní kontroly prokáže pochybení na straně příjemce evropské dotace. Tehdy FÚ nařídí odvod a to včetně lhůty pro uhrazení nezpůsobilé částky dotace. Většina veřejných škol se musí s touto situací vypořádat sama a to bez ohledu na to, kdo je zřizovatelem této školy. Škola v každém případě při vzniku této škodní události musí informovat podle Zásad hospodaření příspěvkové organizace svého zřizovatele. Pomoc ze strany zřizovatele však v drtivé většině případů očekávat nemůže. Škola tak musí hradit částku z vlastních prostředků, což může vést k následnému omezení výdajů na platy či běžné provozní prostředky. Naprosto ideální situace nastane v případě, kdy škola může nařízený odvod uhradit z výnosů z doplňkové činnosti a není tak postižena její hlavní činnost. V tomto smyslu lze jedině na zřizovatele apelovat, aby každý případ takového jednání řešil individuálně, změnu Zásad hospodaření pro příspěvkové organizace očekávat nelze.

Prakticky každá škola musela v průběhu realizace svých projektů rovněž řešit **problém se zajištěním průběžného financování** při realizaci svého projektu. Toto riziko přitom vzniká nejen u finančně náročných projektů. Příjemce si musí zajistit z vlastních finančních prostředků krytí aktivit, na které už nemá prostředky ze získané dotace, neboť zálohovou platbu, kterou na počátku řešení projektu obdržel, již stačil v mezičase vyčerpat. Zejména menší příspěvkové organizace tak mnohdy stály před problémem, zda si vzít na krytí finanční potřebnosti úvěr či požádat o mimořádný příspěvek zřizovatele. V případě úvěru je však rizik hned několik. První riziko souvisí

se splácením úroků z úvěru, kdy škola toto břemeno musí nést plně, nejde jej totiž následně refinancovat z evropské dotace. Druhé riziko souvisí se situací, kdy škole jako příjemci dotace nebudou ze strany poskytovatele všechny náklady uznány jako způsobilé a kromě úroků bude muset škola finančně pokrýt i částku nezpůsobilých výdajů, resp. nařízený odvod.

Naprosto analogickým rizikem je kromě průběžného financování ještě **riziko opožděných plateb ze strany poskytovatele dotace**. K zajištění lepšího finančního krytí by tak úroky z úvěru na krytí průběžného či opožděného financování mohly být hrazeny přímo z poskytnuté dotace. Toto řešení by muselo být nejen předem projednáno v Evropské komisi, ale také by každý projekt musel mít v rozpočtu tuto položku uvedenu, což je v současné situaci jen složitě realizovatelným řešením. Navíc by bylo velmi obtížně předem odhadnout výši úrokové sazby z úvěru a odhadnout, z jaké jistiny se bude úrok počítat.

Do ostatní kategorie rizik – ovšem rovněž úzce spojenou s financováním, patří **riziko zajištění udržitelnosti projektu po jeho skončení**. Programovací období 2007-2013 bylo charakteristické tím, že většina podpořených projektů musela po skončení financování z evropských fondů zajistit z vlastních prostředků ještě 5leté období tzv. **udržitelnosti**. V průběhu tohoto 5letého období musí každý příjemce zajistit udržitelnost vybraných aktivit, ke kterým se zavázal a je součástí příslušného článku Rozhodnutí o poskytnutí dotace. Náklady na financování těchto aktivit hradí plně příjemce. Některé školy nevěnovaly udržitelnosti adekvátní pozornosti již ve fázi přípravy projektu a neošetřily si rozsah aktivit takovým způsobem, aby jej byly schopny pokrýt z provozních prostředků příspěvkové organizace. V okamžiku, kdy poskytovatel dotace zjistil při kontrole udržitelnosti, že aktivity projektu nejsou realizovány, nahlásil tuto skutečnost místně příslušnému FÚ k prošetření. Následoval postup obdobný při podezření na porušení rozpočtové kázně. Někteří příjemci tak museli i několik let po ukončení projektu vracet určitou procentuální část dotace. V současném programovacím období 2014-2020 již udržitelnost zpravidla vyžadována není.

3 Příklady špatné praxe

V předchozí kapitole jsme si vysvětlili možná rizika plynoucí z čerpání evropských dotací v obecné rovině, v této kapitole chceme proto ukázat na konkrétní **příklady tzv. špatné praxe**, kdy byly instituce veřejného školství při čerpání evropských fondů neúspěšné, neboť se dopustily jednání, které zakládalo vznik rizikové situace. Uvádíme konkrétní případy z dotčených veřejných škol a konkrétní problém, který při kontrole projektů nastal.

Zásady transparentnosti byly porušeny při výběrovém řízení „Škola na druhou" v rámci projektu „EU peníze školám", kde Masarykova základní a mateřská škola v Hnojníku uvedla hodnotící kritéria projektu bez popisu metody jejich hodnocení. Kontrola Finančního úřadu Moravskoslezského kraje pak zjistila, že došlo k **porušení rozpočtové kázně**, protože zadavatel má povinnost veškeré úkony při zadávání zakázky činit jednoznačným, průhledným a srozumitelným způsobem (Kraus-Žurová, 2015). Škola musela nakonec vrátit pouze 25 % z 686tisícové částky a stejně velké penále, protože kontrola Finančního úřadu proběhla během trvání projektu, a nikoli až na jejím konci, kdy by hrozila škole povinnost vracet celou částku.

Řada problémových projektů také vděčí svému neúspěchu **netransparentnímu zpracování projektové dokumentace**, kdy si řada škol prokazatelně nechala zpracovat podmínky výběrového řízení od firmy, která se následně sama tohoto výběrového řízení aktivně účastnila. Školy, potažmo jejich zřizovatelé, se tak samy ochudily o možnost vybrat tu nejlepší nabídku, protože podmínky zakázky již byly „šité na míru" firmě, jež s přípravou projektu té či oné škole pomáhala. Školy tím porušily vnitřní pravidla poskytování evropských dotací (ČTK, 2011). Chybám ve výběrovém řízení se měl tímto způsobem dopustit Ústecký a Karlovarský kraj při rozdělování dotací z ROP Severozápad v projektu výstavby nové budovy Integrované střední školy technické a ekonomické v Sokolově. Kraj hodnotil nabídky nejen podle ceny, ale i podle způsobu, jakým jednotlivé firmy skloubí stavbu s běžným provozem školy, čímž bylo kritérium výběru dle systému hodnocení výběrového řízení výrazně subjektivně ovlivněno a nebylo dostatečně v projektu popsáno. Ze strany Evropské komise byla provedena finanční korekce a částka poskytnuté dotace byla snížena (Zeman, 2013).

Korekcí evropské dotace ve výši přibližně 12 milionů korun byla také dotčena výstavba nové školky v Poběžovicích na Domažlicku, protože město jakožto zřizovatel pochybilo při zadávání výběrového řízení na dodavatele stavby, kdy stanovilo kritérium, které mohlo být při výběrovém řízení diskriminační. Nesprávně nastaveným kritériem v tomto případě je myšlen tzv. **index důvěryhodnosti pro firmy**, které se o zakázku ucházejí. Zde měly Poběžovice stanovit výši indexu příliš vysoko, a tudíž měly diskriminovat firmy, které na něj nedosáhly. Také je zde ještě potřeba připomenout, že korekci vyměřil radnici úřad Regionální rady regionu soudržnosti Jihozápad. Problémem se také zabýval Úřad pro ochranu hospodářské soutěže, který v dané věci pochybení nezjistil. Závěry Úřadu pro ochranu hospodářské soutěže však úřad Regionální rady nemusí brát v potaz, a v tomto případně ani nevzal (ČTK, 2014).

Diskriminační chování při stanovení kritérií výběrového řízení se rovněž měla dopustit Základní škola ve Veřovicích na Novojičínsku při čerpání dotace na nákup moderních učebních pomůcek z operačního programu Vzdělávání pro konkurenceschopnost. Kontrola MŠMT zjistila chyby ve výběrovém řízení na dodavatele techniky. Finanční úřad tak škole nařídil vrátit dotaci ve výši 420 tisíc korun i dvousettisícové penále (ČTK, 2012b; Česká televize, 2012b).

Chybného vyúčtování evropské dotace se měla dopustit Základní škola Nerudova v obci Říčany, kdy špatně zaokrouhlila částku při závěrečném vyúčtování uskutečněného projektu za zhruba jeden milion korun určeného na vybavení učebny pracovních činností. Absurdní i v tomto případě je, že se jednalo o pochybení v hodnotě pouze 40 haléřů, kdy Středočeský kraj, jež přerozděloval evropské dotace, poslal při závěrečném vyúčtování na projektový účet do obce o 40 haléřů méně, než měl. Ty pak logicky při celkovém zúčtování projektu chyběly (Havránková, 2013).

Kvůli **pochybení ve vedení účetnictví** vzdělávacího projektu musela vrátit Integrovaná střední škola v Chebu zhruba 3,4 milionu korun z evropské dotace. Nesrovnalosti v hospodaření odhalila kontrola Karlovarského kraje, kdy z vyšetřování vyplynulo, že v účetnictví docházelo k nestandardním operacím a část finančních prostředků byla použita v rozporu s projektovou dokumentací (ČTK, 2012a).

Dalším častým rizikem neúspěšnosti evropských projektů je rovněž **porušení nastaveného období udržitelnosti**, na což několikrát upozornil i Nejvyšší kontrolní úřad (NKÚ, 2016). Například podkrkonošská Základní škola Pecka se zaručila k udržitelnosti projektu, kdy z evropského grantu byla škola upravena na bezbariérovou a rovněž proběhla rekonstrukce odborných učeben. Problémem v tomto konkrétním případě je, že díky nízkému počtu žáků musela škola uzavřít 2. stupeň, na jehož vybavení právě finanční prostředky z evropských fondů dostala (Česká televize, 2012a). Riziko „neudržitelnosti" je tak obecnou hrozbou pro malé školy v obcích, kde klesá počet obyvatel či porodnost a školy tak nejsou schopny dostát nastaveným závazkům v oblasti udržitelnosti.

Dalším příkladem **porušení podmínek udržitelnosti** je projekt MŠMT na zřízení center podpory inkluzívního vzdělávání na základních školách za více jak 133 milionů korun. V rámci tohoto projektu 9 regionálních center na podporu inkluzívního vzdělávání po ukončení projektu bez náhrady zaniklo. Jiným problémem je financování projektů v období udržitelnosti, které je zajišťováno obvykle veřejným subjektem (zřizovatelem), a není již přímo dotováno z evropských fondů. Toto riziko je například mediálně diskutováno v kontextu některých vědecko-výzkumných center dotovaných z nákladných projektů operačního programu Výzkum a vývoj pro inovace. Podle provedené kontroly Nejvyššího kontrolního úřadu u pěti z jedenácti center hrozí nesplnění podmínky udržitelnosti, protože se jim nedaří získat další zdroje financování, zejména v aplikační sféře. Pozornost je tedy potřeba věnovat praktickému a efektivnímu využití výsledků projektů i po jejich ukončení, kdy samotné dotace EU nemají jen financovat samotný projekt, ale také pomáhat k dlouhodobému zlepšení v dané oblasti, a toto bylo při předložení projektů opomenuto (NKÚ, 2016).

Pochybení při výběru dodavatele mělo udělat Nymburské gymnázium, které v rámci Operačního programu Vzdělávání pro konkurenceschopnost pořádalo pro učitele ze základních a středních škol z Nymburska jazykové kurzy včetně jazykového pobytu v Anglii. Pochybení při výběru dodavatele kurzu v Anglii bylo způsobeno v obeslání 4 namísto 5 potenciálních dodavatelů, čímž byla porušena povinnost oslovit více uchazečů. Jednalo se tak víceméně o formální pochybení, a nikoli o nedovolené využití evropské dotace. Rada Středočeského kraje škole odpustila vrácení 75 % částky (kraj je zřizovatelem gymnázia), škola musela vrátit z vlastních příjmů zbylých 25 % hodnoty dotace (Trejbal, 2013).

Chybu při čerpání evropských peněz udělala též obec Dymokury na Nymbursku, kdy místní Masarykova základní škola obdržela z projektu „EU peníze školám" celkem přibližně milion korun, ale část vynaložených prostředků (asi 347 tisíc korun) jim nebyla kontrolou uznána **z důvodu úpravy původní oboustranné smlouvy o dílo** s firmou zajišťující nákup interaktivních tabulí a vybavení počítačové učebny. Změna smlouvy, byť s dobrým úmyslem, je také proti pravidlům nastaveným při realizování evropského projektu. Důvodem pro úpravy smlouvy s dodavatelem byla snaha školy uhradit závazek firmě ve smluveném termínu z důvodu vyhnutí se sankce z nezaplacení, a to z vlastních zdrojů, protože peníze z MŠMT nebyly ještě na projektový účet připsány včas (Havránková, 2013).

Velmi zrádné je, pokud se na fondech EU chtějí obohatit třetí osoby. Tato situace byla příčinou neúspěchu projektu „EU peníze školám" v Ploskovicích na Litoměřicku v Ústeckém kraji. Místní základní škola si za zhruba 700 tisíc pořídila velmi drahé počítače a díky dalšímu projektu „Krok za krokem" měla vybavit učebny pro přírodní

vědy za dalších skoro pět milionů korun. Nové vedení školy se snažilo ukončit druhý jmenovaný projekt dohodou vědomo si nesmyslné předraženosti sjednaného vybavení a služeb, ale neúspěšně. Projekt nakonec neměl žádného projektového manažera, nebyla odevzdána monitorovací zpráva, kvůli čemuž kraj odstoupil od smlouvy pro porušení smluvních povinností a škola byla tak nucena vrátit zálohu necelý milion korun a uhradit uloženou sankci. V souvislosti s touto kauzou a podle zjištění evropských kontrolorů si na projektech podobně „přivydělávali" také někteří radní a regionální politici napříč politickým spektrem (Pelgrel, 2013).

4 Komplexní řešení neexistuje

Nekoordinovaná snaha o eliminaci výše představených rizik mnohdy paradoxně vede k jejich prohlubování a vytváření nových rizikových situací. Je to způsobeno tím, že v ČR neexistuje v oblasti čerpání evropských dotací **komplexní systém pro management rizik** spojených s realizací projektů. S odstupem času nám praxe ukazuje, že tato skutečnost má za následek nárůst podezření na nesrovnalost, kterou musí následně prošetřit místně příslušný Finanční úřad.

Řídící orgány jednotlivých operačních programů však zatím nepřijaly žádná opatření, která by mohla vést **k eliminaci vzniku těchto rizikových situací**. Z pohledu samotné implementace metodického pokynu (European Commisssion, 2013) došlo k určitému posunu v podobě institucionálního vzniku **Výboru pro řízení rizik**, který byl ustanoven na Ministerstvu pro místní rozvoj v roce 2016. Výbor je zřízen za účelem eliminace zejména kritických rizik v implementaci ESI fondů v programovém období 2014-2020, a to prostřednictvím diskuze a navrhování opatření.

Evropská komise na konci roku 2013 připravila příručku pro odhalování podvodů a to včetně účinných nástrojů pro jejich identifikaci (European Commisssion, 2013). Příručka však neobsahuje preventivní opatření pro žadatele, resp. příjemce evropských fondů. Rovněž je třeba upozornit, že pro naplnění principu efektivního čerpání evropských dotací by bylo daleko vhodnější věnovat pozornost právě prevenci rizik!

Kromě zpracování příručky spustila Evropská komise **program Hercule III** 2014 – 2018 podporovaný **Evropským úřadem pro boj proti podvodům** (OLAF) (European Anti-Fraud Office, 2016). Tento program je zřízen pro prosazování aktivit v oblasti ochrany finančních zájmů Evropské unie a je zaměřen na odhalování podvodů při čerpání dotací. Konkrétně podporuje technickou asistenci při odhalování podvodného jednání a především se zaměřuje na osvětu v této oblasti formou vzdělávacích a konferenčních aktivit.

Podvody v ESI se rozumí každé úmyslné jednání nebo neúmyslné opomenutí týkající se použití nebo předložení nepravdivých, nesprávných nebo neúplných prohlášení či dokladů, které má za následek neoprávněné přisvojení nebo zadržování prostředků ze souhrnného rozpočtu EU vedoucí k použití těchto prostředků pro jiné účely, než pro které byly původně poskytnuty.

Ačkoliv máme v řešení rizik ještě značené rezervy, nabízí se určitá řešení, která mohou významně přispět k jejich efektivní eliminaci. Mohou to být kupříkladu čestná prohlášení o neexistenci střetu zájmů u osob zapojených do tvorby zadávacích podmínek veřejné zakázky či průběžné vzdělávání zaměstnanců zapojených do realizace projektu. Další cestou je zavést si nad rámec běžných standardů vlastní projektový kontrolní mechanismus spočívající na jednoduché zásadě – neponechat vše

na projektovém či finančním manažerovi. Nastane-li již nějaký problém v procesní či finanční stránce projektu, pak je vždy nejlepší kontaktovat poskytovatele dotace a informovat jej neprodleně o vzniklé situaci. Tímto jednoduchým krokem je možné elegantně předejít vzniku mnoha problémových situací v budoucnu.

Závěr

Čerpání evropských dotací otevřelo českému školství přístup k novým horizontům. Některé školy však mnohdy z neznalosti či z vlastní laxnosti nevěnovaly pozornost možných hrozbám, které jsou se získáváním dotačních titulů spojeny. Minulé programovací období v plném rozsahu ukázalo široké spektrum možných rizikových situací. Z těchto rizik a případně i vlastních chyb by se měly poučit především školské příspěvkové organizace, které hodlají využít nabídku čerpat evropské fondy i v současném programovacím období 2014-2020.

Článek usiloval o deskripci těchto rizik a upozornil na nutnost věnovat zvýšenou pozornost kvalitnímu řízení projektu, které bude vždy respektovat zásady managementu rizik.

Poděkování

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Přílohy

1) Kontrola ukončeného projektu VŠ v Moravskoslezském kraji v roce 2012

7. Přehled kontrol po ukončení projektu

Kontrola po ukončení projektu:	Ne
Název subjektu, který provádí/provedl kontrolu:	Ministerstvo školství, mládeže a tělovýchovy ČR, Odbor kontrol na místě Finanční úřad pro MS kraj
Číslo kontroly:	
Název kontroly:	Veřejnosprávní kontrola
Datum zahájení kontroly:	10.10.2012 **Datum kontroly do:** 10.10.2012
Nápravná opatření splněna:	Ano
Lhůta ke splnění nápravných opatření:	
Popis nápravných opatření:	Na základě zjištění byly vyčísleny nezpůsobilé výdaje ve výši 0,66 Kč vč. DPH. Toto bylo po ukončení kontroly řešeno jako podezření na nesrovnalost a předáno na příslušný FÚ pod interním číslem [ ]. Zpráva o daňové kontrole č.j. [ ] z Finančního úřadu pro MS kraj doložena přílohou.

Zdroj: Vlastní úpravy a zpracování: Aplikace Benefit 7 (cit. 2016-09-07)

2) Nález kontrolní skupiny u projektu ZŠ v Moravskoslezském kraji v roce 2013

Provedenou kontrolou bylo zjištěno, že v rámci základních požadavků na sestavu PC byl daňovým subjektem požadován procesor AMD Athlon™ Dual-Core/Triple-Core, tedy procesor konkrétního výrobce a konkrétního typu.

Vzhledem k přesné specifikaci uvedené u sestavy PC daňový subjekt nepostupoval v souladu s čl. 7.5.3. Veřejné zakázky, část Základní vymezení oblasti zadávání veřejných zakázek Příručky pro žadatele a příjemce 1.4 OP VK, ve kterém je stanoveno, že při určení předmětu zakázky není přípustné uvádět v oznámení o zahájení výběrového řízení, resp. Výzvě k podání nabídky nebo v zadávací dokumentaci požadavky nebo odkazy na obchodní firmy, názvy nebo jména a příjmení, specifická označení zboží a služeb, které platí pro určitou osobu, popř. její organizační složku za příznačné, patenty na vynálezy, užitné vzory, průmyslové vzory, ochranné známky nebo označení původu, pokud by to vedlo ke zvýhodnění nebo vyloučení určitých uchazečů nebo určitých výrobků.

Daňový subjekt tímto nedodržel ustanovení části II – Povinnosti příjemce dotace, bodu 1 a 5 rozhodnutí – při zadávání zakázek v rámci projektu je příjemce povinen dodržovat pravidla zadávání veřejných zakázek stanovená v Příručce pro žadatele a příjemce 1.4 OP VK. Odvod za porušení rozpočtové kázně je stanoven dle části IV – Sankce a odvody, bodu 2, odst. 4 rozhodnutí ve výši hodnoty veřejné zakázky, k níž se porušení rozpočtové kázně vztahuje, tedy **ve výši 399 906,00 Kč.**

Zdroj: Vlastní úpravy a zpracování: Protokol o seznámení daňového subjektu s výsledkem kontrolního zjištění (cit. 2016-09-07)

MANAGEMENT OF EMISSIONS PERMITS: THREATS OF THE EUROPEAN EMISSIONS TRADING SYSTEM

Frantisek Zapletal, Jan Ministr, Petr Řeháček

Abstract: *Since the beginning of the millennium, heavy industrial companies in the EU must face the threat related to duty of emissions trading. The aim of this paper is to assess an impact of selected indicators of the emissions trading system (EU ETS) – number of grandfathered permits (allowances) to a company for free and emissions price for different type of permits. That is enabled by the parameterization and sensitivity analysis of the simple linear programming model which maximizes the total profit margin of the company. Analyses in this paper are performed using the data of one real iron and steel producing company in the Czech Republic. The influence of the chosen factors is explored for the second and the available part of the third trading phase of the EU ETS.*

Introduction

The aim of this paper is to analyze an influence of selected factors of the European emissions trading system (EU ETS) on profit of participating companies. Companies must face many constraints on their production. Except of traditional economical and legislative restrictions, European industrial companies are also affected by legislative constraints protecting the environment. Thus, decision-making on production of these companies is influenced by environmental factors headed by carbon emissions trading. All analyses will be performed for companies of so called carbon leakage sector. This sector involves selected industrial branches where an amount of emissions released to the atmosphere is extra large. This sector was established by (Directive EU, 2009). It is not necessary to involve also other companies to analysis of influence of an amount of freely allocated permits by the EU because these remaining installations either do not currently get any such free allowances or at least it will be so in very short term. An influence of emission permit price is the same for both carbon leakage company and non-carbon leakage company. All the analysis is performed using data of one Czech steel company. The steel sector is also involved in the carbon leakage sector, see (Directive EU, 2009).

Emissions trading within the European Union is a frequent object of many researches but most of them have analysed EU ETS' factors only as a whole (e.g. system efficiency analysis, econometrical analysis for forecasting the price of allowances etc.) and only few of them investigate their influence on companies. Some optimization models maximizing companies' outputs with respect to the EU ETS have been already designed, see e.g. (Rong and Landhelma, 2007; Tang and Song, 2012; Zapletal and Němec, 2012; Zapletal, 2014; Zhang and Xu, 2013). One of them (Zhang and Xu, 2013) is also used for analyses in this paper. The main benefit of this paper is the complex assessment of the EU ETS' influencing factors for the whole EU ETS system's lifetime till September 2014 (more recent data are not available for free).

The paper is organized as follows. After this short introduction, Chapter 1 containing basic principles of the EU ETS system follows. Legislative background and links between the system and companies are presented there briefly. Chapter 2 consists of the optimization model design and basic data on researched parameters of the EU ETS and their descriptive statistics. Results of the performed analysis and their critical discussion can be found in the Chapter 3. Finally, the paper is ended by conclusions and suggestions for future possible research topics related with this paper.

1 Emissions trading Scheme of the EU (EU ETS)

The EU ETS is the main tool of the EU's environmental policy which has been established in 2005 by (Directive EU, 2003). The core idea of the system is that each ton of the CO_2 released to the atmosphere by a company must be covered by one emission permit. That means that increase in production leads to increase in profit but, on the other hand, it will also cause an increase in need of emission allowances and thus increase in costs. Currently, the EU ETS involves more than 12 000 industrial installations inside the EU. A lifetime of the EU ETS is divided into phases – phase 1 (2005-2007), phase 2 (3018-2012) and current phase 3 (2013-2020). Conditions of emissions trading have been changing gradually, see e.g. (Zapletal and Moravcová, 2013).

Emission permit flows between a company and its environment are illustrated in Fig. 1.

Fig. 1: Emission permit flows between a company and its environment
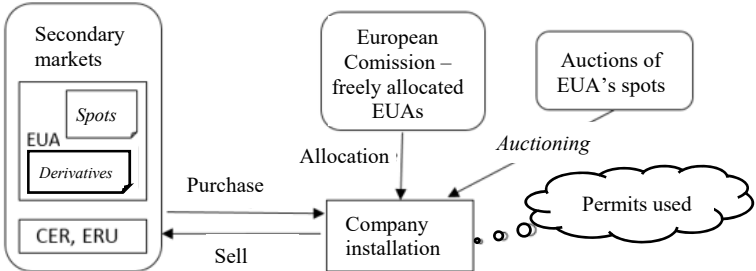
In Fig. 1, it can be seen that three possible sources of allowances exist for companies. The main source for companies from the already mentioned carbon leakage sector is a flow of freely allocated permits by the European Commission. Other two flows are common for all the companies in the EU ETS – additional permits can be purchased either on a secondary market or via emissions auctions for a market price. On the other hand, only one possibility to sell unused permits is accessible for all the companies – secondary market where permits are traded. All flows mentioned above refer to two main conditions affecting companies – market price of allowances and an amount of allowances granted to companies for free. These two parameters of the system are analysed further.

Allowances of the EUA type (European Union Allowance) in the form of a spot are the basic and the most traded financial instrument of the EU ETS system. Above that, derivatives of EUAs also exist, but they are of interest rather for speculators on the financial market. Except of EUA's, companies can also use allowances which have their origin in the Kyoto worldwide emissions trading system – CER's (Certified Emission

Reduction). These CER's are highly beneficial for European companies because their price is much cheaper than in case of EUAs. The EU has come with 10% quota for using CER's by European companies to prevent companies from over-using CER's which would lead to EUA's price drop, see (Directive EU, 2003).

The secondary market has been allowed to use since the very beginning of the EU ETS system in 2005. It consists of many stock exchanges all around Europe (e.g. SendeCO2 in Spain, EEX in Germany, ICE in Great Britain etc.). Analysis of EUA allowance price dependency among various stock exchanges was performed in (Zapletal and Moravcová, 2013) Almost perfect correlation (with the correlation coefficient greater than 99%) was proven there. That is why only prices from one chosen stock exchange (SendeCO2) where used for the analysis in this paper because this stock exchange (as one of few) enables also CER's trading.

Emissions auction is a new channel for purchasing the permits launched in 2013 (Directive EU, 2009). The reason for this change was the fact that conditions for allowances allocation had been changed for the third phase of the EU ETS system. The already mentioned research (Zapletal and Moravcová, 2013) proved that almost perfect correlation between prices at auctions and prices on the secondary market exists (with correlation coefficient exceeding 99%). That is why a possibility of emissions auctioning is not included in following analyses.

2 Optimization model and input data

In this chapter, the optimization model together with input data from the EU ETS system on allowance prices for further analyses are presented.

2.1 Optimization model maximizing the total profit of a company

The following deterministic optimization model is an aggregation of the models presented in (Zapletal and Němec, 2012) and (Zapletal, 2014). The model is deterministic like the one in (Zapletal and Němec, 2012), on the other hand it enables using the CER type of allowances like the one in (Zapletal, 2014).

Model presumptions are as follows:

- all the model parameters are considered to be deterministic;
- model is static, for only one period;
- decision is made at the beginning of the period and it cannot be changed further;
- the company always chooses a possibility of using the greatest possible amount of CER's (i.e. 10%) to cover its emissions.

The last presumption is supported by the fact that EUA's have never been cheaper than CER's so far. Currently, CER's are more than fifty times cheaper.

$$\max_{x,y}\{\boldsymbol{m}^T\boldsymbol{y} + (r - 0.9 \cdot \boldsymbol{e}^T\boldsymbol{x}) \cdot p^{EUA} - 0.1 \cdot \boldsymbol{e}^T\boldsymbol{x} \cdot p^{CER} - c\},$$

s. t. $\boldsymbol{y} = (\mathbf{E} - \mathbf{A})\boldsymbol{x},$

         $\boldsymbol{d}^c \leq \boldsymbol{y} \leq \boldsymbol{d}^e,$

         $\boldsymbol{x} \leq \boldsymbol{v},$

         $\boldsymbol{x} \geq 0, \boldsymbol{y} \geq 0,$

where:

$\boldsymbol{y} \in \mathrm{R}^n$ is a vector of product sales;

$\boldsymbol{x} \in \mathrm{R}^n$ is a vector of company's production;

$\boldsymbol{e} \in \mathrm{R}^n$ is a vector of carbon coefficients indicating an amount of CO2 released by production of a one unit of a particular product;

p^{EUA} is a price of the EUA allowance type;

p^{CER} is a price of the CER allowance type;

r is an amount of emissions permits granted to company for free;

$\boldsymbol{m} \in \mathrm{R}^n$ is a vector of company's margins;

c stands for total fixed costs of a company;

$\mathbf{E} \in \mathrm{R}^{n \times n}$ is a unit matrix;

$\mathbf{A} \in \mathrm{R}^{n \times n}$ is a matrix of technical emissions coefficients of a production;

$\boldsymbol{d}^c \in \mathrm{R}^n$ is a vector of lower bounds for sales (given by already signed contracts);

$\boldsymbol{d}^e \in \mathrm{R}^n$ is a vector of expected demands for the investigated period;

$\boldsymbol{v} \in \mathrm{R}^n$ is a vector of company's production capacities.

The reduction of model variables would be possible by substituting of y by x (in accordance with the first model constraint). The provided form was chosen in order to keep the clarity of the model. Fixed cost (c) is not dependent on any model variable and thus it does not affect the result of optimization. Therefore, it would be possible to optimize the model excluding c and then to decrease the optimal value by the value of fixed costs in the end.

2.2   Input data for analyses

To be able to perform the analysis declared in the introduction of this paper, many data are required like the data of some real industrial company on its production and data related with the EU ETS system (amounts of freely allocated allowances and allowance prices). Fig. 2 and Fig. 3 show a development of EUA's and CER's, respectively. In Fig. 4, it can be seen a development of amounts of allowances granted for free to the modelled company from the beginning of the EU ETS system (2005) till the end of the third phase of the system (in 2020). Basic descriptive statistics of the data sets mentioned above can be found in Tabs 1a-1c and 2. Many changes in EU ETS' conditions were realised between the second and the third phase so these statistics are also shown separately for these periods (the second phase is shown in Tab. 1b and the third phase in Tab. 1c). All the data were aggregated from the Spanish stock exchange SendeCO2[1]. Data on amounts of freely allocated allowances were gained from the CarbonMarketData database[2].

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[1] Sendeco2.com

[2] www.carbonmarketdata.com

Fig. 2: EUA price development on the SendeCO2 stock exchange in the second and third phase of the EU ETS
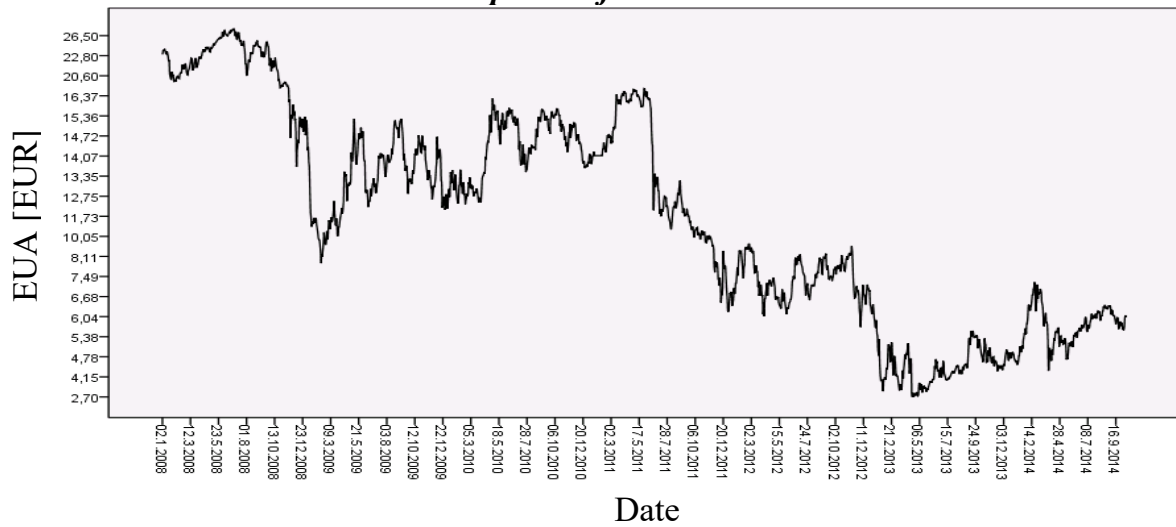
Fig. 3: CER price development on the SendeCO2 stock exchange in the second and third phase of the EU ETS
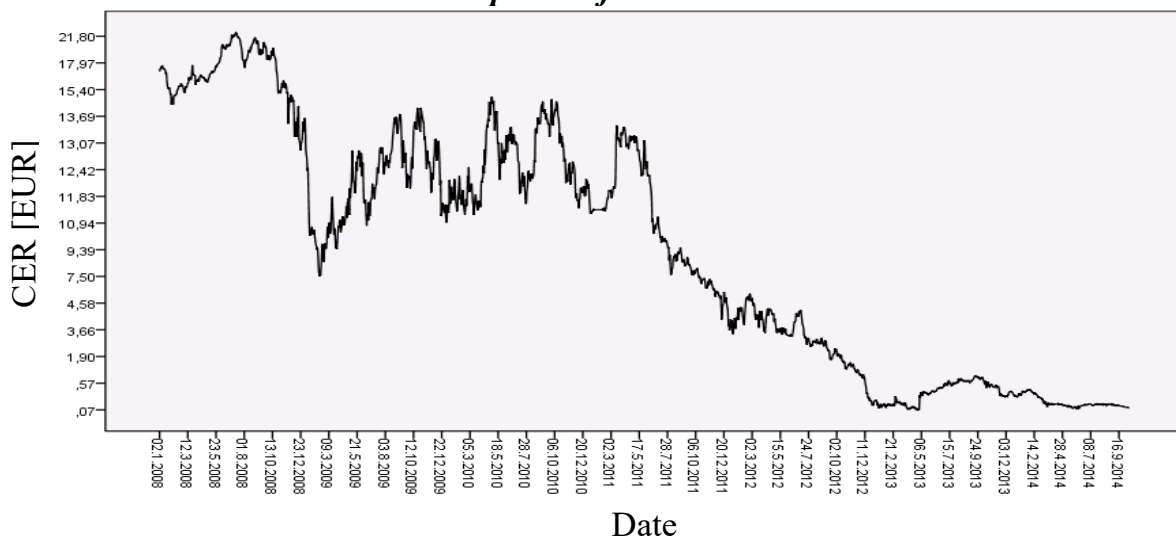
Fig. 4: Development of freely allocated amount of EUAs to the modelled company (2005-2014)
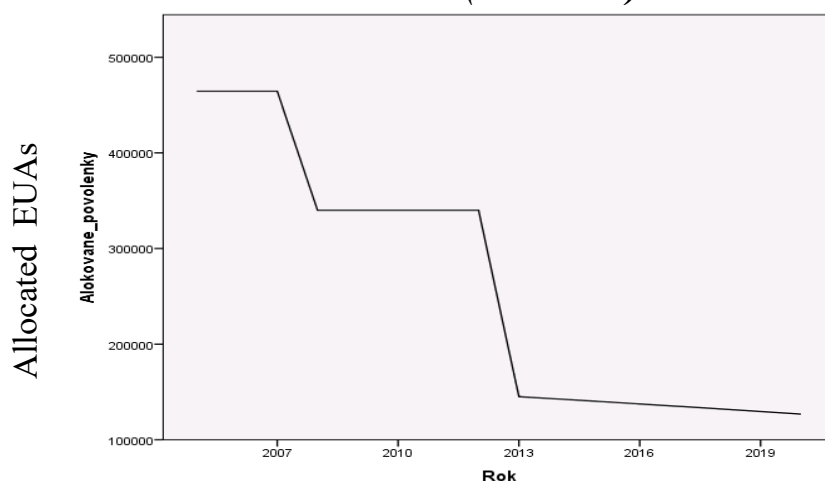
Source: authors

The main difference between prices and these amounts is the fact that amounts are determined directly by the central authority and prices are determined by the market. That is why data till the end of the third phase of the EU ETS are already known.

All the outputs mentioned above were processed using the SPSS 22 software.

The data on the modelled company were provided by one steel company in the Czech Republic. This company requires to be kept in anonymity because of the data privacy. However, this fact does not influence results of the analysis.

Tab. 1a: Descriptive statistics of allowance prices in the second and third EU ETS phases

	Observations	Range	Min	Max	Mean	Standard deviation
EUA	1721	25.60	2.70	28.3	11.57	5.965
CER	1721	22.53	0.07	22.6	8.16	6.412

Source: authors

Tab. 2b: Descriptive statistics of allowance prices in the second EU ETS phase

	Observations	Range	Min	Max	Mean	Standard deviation
EUA	1266	22.57	5.73	28.3	13.92	5.206
CER	1266	22.45	0.15	22.6	10.98	5.074

Source: authors

Tab. 3c: Descriptive statistics of allowance prices in the third EU ETS phase

	Observations	Range	Min	Max	Mean	Standard deviation
EUA	455	4.42	2.70	7.12	5.02	0.904
CER	455	0.65	0.07	0.72	0.31	0.181

Source: authors

Year

Tab. 2: Descriptive statistics of amounts of allowances granted to the modelled company for free

	Observation	Min	Max	Mean	Standard dev.
Granted EUA	16	12688	46450	261386.2	136764.008

3 Model verification and sensitivity analysis

Results of the optimization are shown in Tab. 3. It can be seen that the modelled company is currently in loss of about 4 mil. EUR where about 10% of this loss is caused by the emissions trading. These results correspond to values of input parameters current in September 2014 (EUA price equals to 6.2 EUR, CER price equals to 0.56 EUR and 145,098 permits granted to the company for free.

Now, sensitivity analyses of obtained results will be performed when the input data change in a range of historical data shown in Tabs. 1a-1c and 2.

A sensitivity analysis was performed using the parametrization in the MS Excel 2013 software.

Tab. 3: Results of the steel company's profit optimization

		V1	V2	V3	V4	V5
[tons]	Production	431451.3	576840.5	665365.6	120000	30000
[tons]	Sales	0	12000	620545.6	120000	30000
[EUR]	Objective function optimum:		-4013185	Costs induced by allowances:		-406903
[EUR]	Optimal value excluding fixed costs:			47638910.05		

As mentioned above, conditions of the EU ETS system have been changing very quickly during its phases which influenced a development of both analysed parameters – price of emissions permits and amounts of freely allocated permits to companies. That is why these factors are both analysed further for each phase individually and for the second and third phase together.

Figures 6a-8 show the results of the optimization. All these figures contain the visualization of dependency of optimal profit ("%UF" curve) and costs given by emissions trading on a change of chosen parameter (value ranges of parameters were determined on the base of value range from previous periods. In order to keep higher clarity of the figures, values of dependent variables are given in percentage change in comparison with the current state (the current state is indicated by dotted vertical lines). Mean values of probability distributions (μ) of explanatory variables are indicated by dashed vertical lines. Borders of blue rectangles correspond to bounds of intervals $[\mu - \sigma; \mu + \sigma]$, where σ stands for a standard deviation.

Figures 6a-6c show an influence of changes in EUA prices (Fig. 6a for values of parameters according to the variation range in the second and third EU ETS phase together, Fig. 6b for values of the second phase only and Fig. 6c of the third phase only).

Figures 7a-7c present an influence of changes in CER prices (Fig. 7a for values of parameters according to the variation range in the second and third EU ETS phase together, Fig. 7b for values of the second phase only and Fig. 7c of the third phase only). Finally, Fig. 8 demonstrates an influence of freely allocated allowances to the modelled company on the profit of this company.

Fig. 6a: Influence of EUA prices in the second and third EU ETS phase on chosen measures of the modelled company
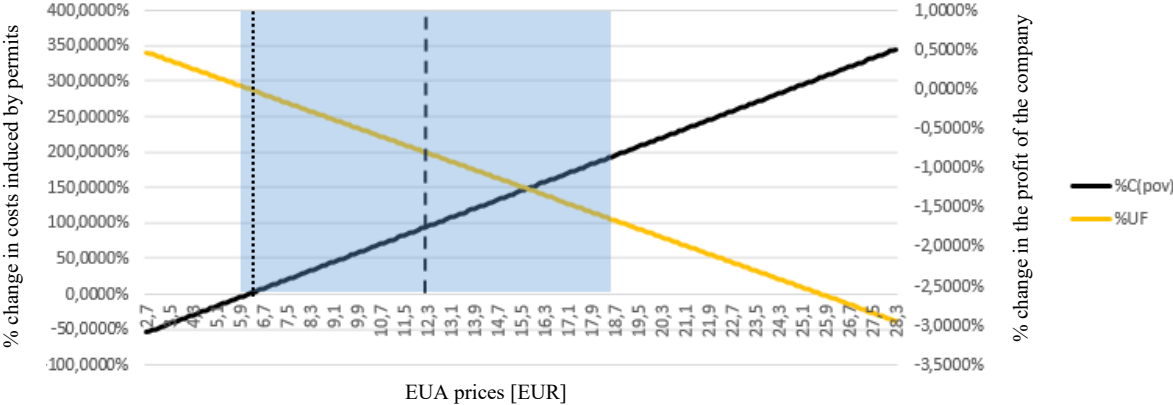
Fig. 6b: Influence of EUA prices in the second EU ETS phase on chosen measures of the modelled company
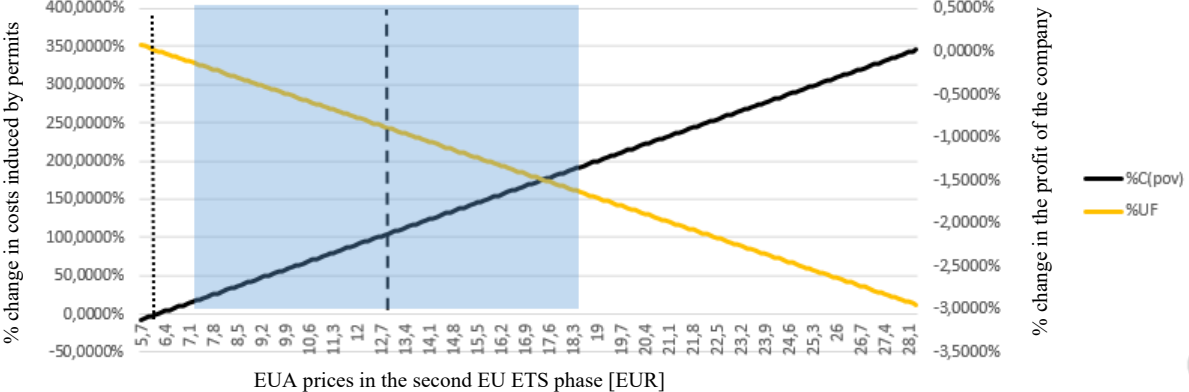
Fig. 6c: Influence of EUA prices in the third EU ETS phase on chosen measures of the modelled company
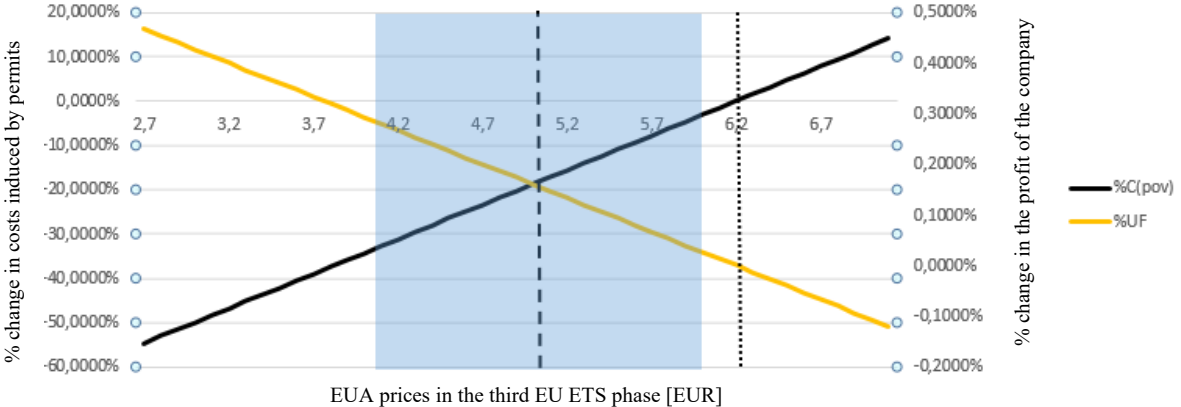
Fig. 7a: Influence of CER prices in the second and third EU ETS phase on chosen measures of the modelled company
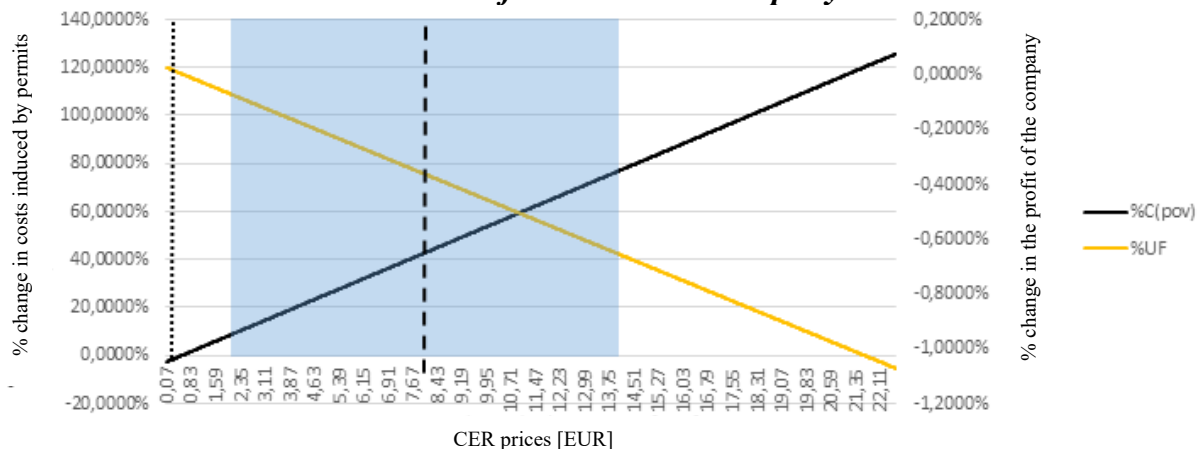
Fig. 7b: Influence of CER prices in the second EU ETS phase on chosen measures of the modelled company
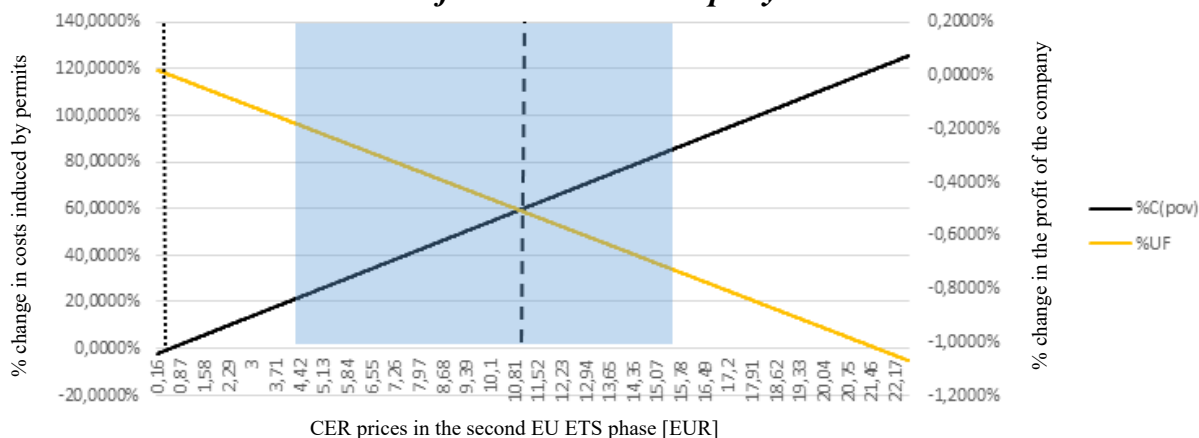
Fig. 7c: Influence of CER prices in the third EU ETS phase on chosen measures of the modelled company
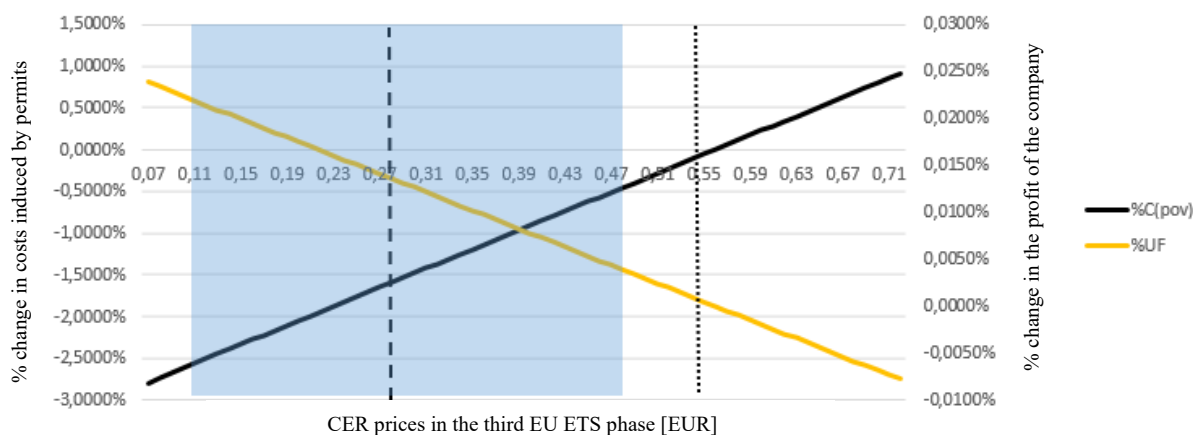
Fig. 8: An influence of the free allocated amount of allowances on selected measures of the modelled company
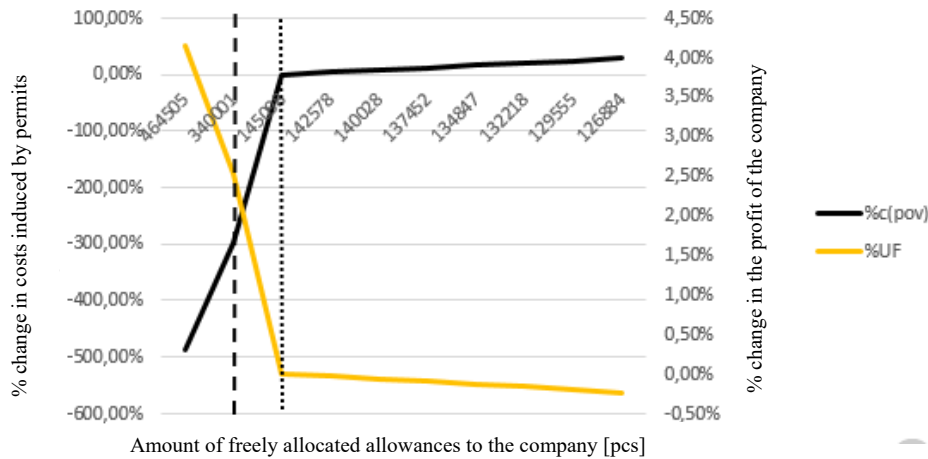
Figures 6a-8 demonstrate the dynamics of allowance prices' development. Analysis of individual EU ETS phases showed that current EUA and CER prices do not lie nearer than the standard deviation from the mean value (they lie out of blue rectangles in the figures above). In comparison with the second phase, current prices are lower, and in comparison with the whole third phase, prices are higher, on the contrary. This fact emphasises a need of further analysis of potential allowance prices' impacts on companies.

The analysis showed that a potential influence of EUA's is greater than in the case of CER's. An impact of EUA prices from both EU ETS phases on company's profit (without fixed costs) lies in [-3; 0.46]% in comparison with the current state. The same analysis but only taking variation range of values from the third EU ETS phase specified a shorter interval [-0.12; 0.46]%. An influence of EUA prices on costs induced by emissions trading can be expressed by the interval [-54; 345]% while taking into account values from both phases and by the interval [-57; 345]% for values only from the third phase. In financial terms, EUA prices can affect the profit by [-1,404; 222] thousand of EUR for values from both EU ETS phases and by [-57; 222] thousand of EUR for values from the third EU ETS phase only.

An influence of CER prices is weaker in comparison with EUA prices, especially due to the legislative restriction in the form of 10% limit for European companies which was already mentioned. Percentage change of company's profit (excluding fixed costs) in comparison with the current state taking into account values from both the second and third EU ETS phases lies in [-1.07; 0.024]%. The same analysis but only taking variation range of values from the third EU ETS phase specified a shorter interval [-0.078; 0.024]%. An influence of CER prices on costs induced by emissions trading can be expressed by the interval [-2.79; 125.56]% while taking into account values from both phases and by the interval [-2.79; 0.912]% for values only from the third phase. In financial terms, EUA prices can affect the profit by [-510; 11] thousand of EUR for

values from both EU ETS phases and by [3.8; 11] thousand of EUR for values from the third EU ETS phase only.

The last analyzed factor was an amount of freely allocated permits and it turned out to be the most influencing EU ETS system's parameter. The data collected for all available years were used (that means the data for the period 2005-2020). It was discovered that the involved variation range can cause the change in profit between [-0.24; 4.16]% (that means in [-112.9; 1980.3] thousand of EUR) considering no other changes. An influence of the same factor on costs induced by emissions trading lies in [- 487.7; 27.8]% or [-112.9; 1980.3] thousand of EUR, respectively.

Although an amount of freely allocated permits was identified as the most influencing factor for companies, another important fact should be taken into account. Too large amounts of allowances were granted to companies especially in the first EU ETS phase. Corresponding potential great increase in company's profit and decrease in costs induced by the emissions trading are caused by these high values for the first EU ETS phase. However, values of amounts are already known till the end of the third trading phase (till 2020) and these values are going to decrease slightly for each following year. That is the reason why emission prices can be considered as a greater threat for companies than freely allocated EUA amounts. Due to the fact that allocated amounts are known in advance, companies can adjust their decisions on production and investments also in advance. But emissions prices are very difficult to predict. Presented risks could be also investigated by some specialised risk assessing methods in the frame of risk management like the FMEA method, see e.g. (Řeháček, 2011).

Conclusion

The aim of this paper was to analyze a power of influence of selected EU ETS factors on companies. In particular, an influence of CER and EUA permit prices and amount of freely allocated permits has been investigated. The sensitivity analysis has been performed using the data of one steel company in the Czech Republic. Very similar effect for the whole steel sector and for other sectors listed in the carbon leakage group within the EU can also be expected. All three analyzed factors had a higher impact in the second EU ETS phase than in the third one. Currently, the weakest influence on companies can be observed for CER permit price, especially due to its low mean value, low volatility and because of legislative restriction of CER's use for European companies. An amount of freely allocated permits is the most influencing factor whose advantage is the fact that its values are known in advance. Therefore, EUA permit price is considered to be the most important factor for companies which are influenced by the high uncertainty. According to the historical EUA prices in the third EU ETS phase, an increase in costs induced by the emissions trading up to 14% can come. On the other hand, these costs can also be decreased down to 54% under the effect of EUA prices and down to 2.8% under the effect of CER prices.

The presented research can be extended further for example by involving also non-carbon-leakage companies. Statistical dependencies between particular factors could be also included into the analysis to make the results more precise.

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VISUAL EVALUATION OF CHANGES IN REGIONAL GROWTH AND DISPARITIES: USAGE OF A PARETO CHART

Pavel Zdražil, Petra Applová

Abstract: *This paper shows how to evaluate a development of regional disparities with the Pareto chart. Explanation of chart principles is followed by its application to the regions of Visegrad Group countries. To present the usability of Pareto chart, we applied it on three different situations – involving both convergence and divergence. In addition, to confirm the estimates resulted from charts, we used the σ-convergence approach as a benchmark. Our results found that the chart has very good predicative ability, since virtually all conclusions of its application have been confirmed by σ-convergence analysis. The benefit of Pareto chart is involvement of extra information about changes in some sample sections, growth and order. Based on this information one can find more comprehensive conclusions about changes in disparities over time. Besides, the Pareto chart has a very easy interpretation which calls for no special knowledge in methods for disparity measurement. This is a great advantage for other fields' researchers, political-bureaucratic apparatus and both expert and inexpert public. That is why we believe the Pareto chart is a very interesting tool to evaluate development of regional disparities, which can be used solely or in combination (complementary) with other approaches of disparity measurement.*

Keywords: *Pareto chart, Visegrad Group, disparity measurement, evaluation of regional policy, development.*

JEL Classification*: R12, Y10, O47.*

Introduction

The long-term existence of significant socio-economic disparities across societies led towards quite logical attempts of analytical quantification during the development of economically oriented disciplines, while the quantification is a prerequisite for disciplines' effective directing (Capello, Nijkamp, 2009). The reason for the interest in the issue of disparities is obvious, since economic systems burdened by high inequality are seriously limited by this handicap, and cannot fully realize their growth potential, thus effectively facing a significant obstacle to their own development (Alesina, Rodrik, 1994; Temple, 1999; Stiglitz, 2012). Restrictions on economic performance is then also, of course, reflected in other related, and for society, highly sensitive areas, one of which the level of living standards of the population may be mentioned in particular (Zdražil, 2016). In this context, however, we cannot completely forget some positive effects generated by disparities - but just because of the existence of certain, however "reasonable" differences, can be regarded as a stimulus and factual condition for progress (Hirschman, 1958; Myrdal, 1957). In other words, socio-economic disparities should only be regulated, not entirely eliminated in order to the growth and development of any territorial unit burdened with them. Knowledge of the extent and development of disparities can literally be described in the best way as a cardinal prerequisite for development, as the realization of any activity with the aim of their

influencing may not be desirable for growth and development, and moreover these activities are usually associated with spending a considerable amount of economic resources, whose economic efficiency and effectiveness is necessary to systematically evaluate (König, 2009; Applová, 2015).

1 Statement of a problem

Since regional disparities refer to spatial variability in economic performance and welfare, they are manifested in unequal distribution of both potential of development and the level of population's standards of living. Although the issue of disparities is a long-term and global problem at the general level, an important impulse, which in the development of their studies in the last decades has significantly been contributing, is the effort to achieve solidarity across EU countries and regions (Kraftová, Matěja, 2015). The availability of a sophisticated analytical apparatus for estimating regional disparities is an essential prerequisite for the formulation of successful regional policy, as well as an evaluation of its application capabilities, and necessary continuous correction. Within the theoretical and practical applications, and over time, some basic directions came into existence, through which we can approach regional disparities for evaluation. The methods used under these directions share a single goal (i.e. to quantify the disparities development) and neoclassical postulates (i.e. particularly the natural tendency of economies to a state of their long-term equilibrium), as well as they often agree in results; however, the ways of their implementation substantially differ. In terms of the most common approaches to economic disparities evaluation it would probably be possible to indicate the following directions:

- β-convergence, which is based on the assumption of the inverse relationship between the level of production and long-term growth, while generally using estimations through various forms of linear, or linearized, regression models (Mankiw et al, 1992; Baumol, 1986; Barro, Sala-i-Martin, 2004)

- σ-convergence, which is also based on the assumption of the neoclassical natural tendency of economies to a common long-term equilibrium, while generally lying in the evaluation of dispersion or variability across a reference sample (Barro, Sala-i-Martin, 2004; Baumol, 1986);

- data distribution analysis by means of using non-parametric estimations of the shape of density function, usually based on the description of Markov chains, or transition probability matrix (Quah, 1996; Ezcurra et al, 2005);

- econometric approaches based on the analysis of deterministic and stochastic trends' components of time series through cointegration analysis (Bernard, Durlauf, 1995; Pesaran, 2007)

Methodological variability, on the one hand, allows selection procedures due to a different extent of the accentuation of relevant variables more suitable to the specific objective evaluation; on the other hand, this freedom attributes a certain degree of entropy to the results of the evaluation, because the choice of specific methods is subjective to a large extent, while the analogy of their results is not universal. Concerning the abovementioned theoretical measurement directions of disparities development, it can be generally stated that, in principle, it is not about the approaches that would have mutually substituted, but it is rather about the complements, since the advantages of one group of methods can be generally considered as the disadvantages

of another one, and vice versa. For example, in β-convergence and σ-convergence concepts, we may mark as crucial advantages the lower knowledge requirements of mathematical and statistical apparatus, the calculation (un)demanding and easy interpretation of results. On the other hand, the results of these methods are basically just summary characteristics describing a given territorial unit, which completely abandons the provision of detailed information about their own composition, and thus about causes of the development in terms of changes within the sample regions. Analogously opposite conclusions can then be developed towards methods for disparities evaluation by means of analyzing the data distribution and econometric models, which usually provide "complete" information that is possible to de-compose to the level of individual regions, or pairs, and therefore identify the partial causes of development tendencies. These methods are then logically more demanding, particularly when their interpretation requires a deeper methodological knowledge of both the presenter and the recipient's side.

Given approaches may also be considered in certain exaggeration as opposite poles however, lacking the "middle way" between them, which would offer simplicity and easy interpretation, yet maintain sufficient information for a basic partial analysis. The method, which would have offered the usability potential not only in the context of empirical studies, but the results would have been, without necessity of more detailed study of partial steps, clear enough also for inexpert audiences from other fields, like the political-bureaucratic apparatus, but also the wider public. The authors of this paper assume that the so-called "Pareto analysis" or "the Pareto chart" could be an instrument suitable for the number of the abovementioned points, as well as serving as a suitable form of evaluation of the development of regional disparities.

Considering the abovementioned, the aim of this paper is to demonstrate the usability of an alternative approach to the evaluation of the development of regional disparities, specifically of the application of the Pareto chart, and assess its usefulness as a tool which through graphic expression to some extent is able to combine the advantages of the undemanding and simple interpretability, as well as preserving information useful for a more detailed evaluation of specific causes of development for the disparities of the whole unit.

2 Methods

As already indicated, this paper orients its focus on the evaluation of the advantages of regional disparities by using the Pareto chart, so it is certainly quite appropriate to specify this tool. Generally, the Pareto chart is designed as one of the seven basic tools of quality improvement defined by Kaoru Ishikawa (1985). In the Juran defined concepts (Juran, Godfrey, 1999) Ishikawa used, a diagram is essentially an application of the famous Pareto 80/20 rule, which has been interpreted by using a combination of column and line graphs simultaneously capturing the sequence, frequency and cumulative relative frequency within a given sample. In the field of quality management, this diagram is often used as a tool for simple error analysis. Its application, however, downright offers itself in the regional disparities evaluation since the used cumulative relative frequency (line graph) is nothing else than the inverse expression of the notoriously known Lorenz curve (1905), commonly used in economics to demonstrate wealth distribution in society. In combination with a (column) graph of aligned absolute frequencies, or when applying weighted values in

the field of regional development (e.g. per capita), it can then be easily read from the graph how individual parts of the sample, or even specific regions, diverge from one another.

The disparities development evaluation through the Pareto chart then lies in the visual comparison of two or more periods. This crucial advantage of the approach is, however, its most significant drawback to some extent. Although the Pareto chart can be described as clear for comparing a single, two perhaps even three periods, its clarity undoubtedly decreases with a growing number of the compared periods within a single field of the graph. Other apparent disadvantages arising from the principle of visual comparison is a limited ability to estimate the extent of disparities, as well as the evaluation of their development in the case that in terms of the partial convergence and divergence tendencies, the individual parts of the sample are fundamentally differentiated. In addition, one may found limitation in selection process of periods for comparison or evaluation based on selected reference points of time which are up to the researcher to choose. Of course, selection of periods that are burden for specific deviations can significantly bias the conclusions about development of regional disparities. However, such a limitation is common also for many other methods of disparities measurement - the β-convergence approach in particular. On the contrary, a great advantage of diagram application while comparing can undoubtedly mark the information content not only concerning the changes in disparities, but also the values of the monitored indicator and their changes, or extreme values, growth, etc., which other methods of disparities evaluation usually do not provide directly.

For the purposes of achieving the defined targets, the usability of the Pareto chart will be demonstrated on the disparities development indicator of GDP per capita (in purchasing power parity) between the NUTS II regions of the Visegrad Group countries, a total of 35 regions, of which 8 are Czech, 7 Hungarian, 16 Polish and 4 Slovak. The development was evaluated between 2000 and 2014, using source data from the Eurostat database (2016). Since we want to show that our results are not random but instead the Pareto chart is truly applicable tool to evaluate development of regional disparities, we extend the analysis beyond the period of 2000-2014 and provide two particular periods as well: 2000-2007 and 2007-2014. The fracture year 2007 not only splits the period of 2000-2014 to two symmetric sub-periods, but also is a year where the largest range of disparities among the Visegrad Group regions has been measured (the coefficient of variation at 49.94%) between 2000 and 2014, see Tab. 1. Moreover, as Tab. 1 shows, 2007 is a peak, which is followed by a downturn; hence, one can interpret the disparity process during sub-period of 2000-2007 as a divergence while the sub-period of 2007-2014 as a convergence. Well, we will be able to check whether the diagram is usable for examination of both regional convergence and divergence.

Tab. 1: Disparities in GDP of the Visegrad Group regions based on σ-convergence

	2000	2001	2002	2003	2004	2005	2006	2007
CV	41.42%	43.93%	44.62%	45.94%	45.86%	48.37%	48.66%	49.94%
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	
CV	48.70%	48.09%	47.12%	45.87%	44.80%	45.36%	44.36%	

Source: own calculations based on Eurostat (2016)

In order to evaluate the usability of the Pareto chart method for evaluating the development of regional disparities, the findings will be confronted with the results of

the disparities measurement through σ-convergence, namely by monitoring the development of the coefficient of variation. For the purposes of this paper there appears from the four abovementioned directions, the use of σ-convergence, as the "benchmark" method, seeming the most suitable because β-convergence is a formally necessary, but not sufficient, condition for σ-convergence (Monfort, 2008; Islam, 2003), while in comparison to the analysis of the distribution by using non-parametric estimates and econometric methods, it is a very simple and easily interpretable method, not necessary to extensively delimit now. The coefficient of variation is then chosen because of its good information value, comparability and customary use in solving disparities development by using the variability in many relevant studies (Zdražil, Applová, 2016; Monastiriotis, 2013; Marzinotto, 2012; Monfort, 2008).

In addition, we have to point out that since the evaluation of regional disparity based on Pareto chart is new and not yet known idea, no other similar studies of regional disparities were found in the literature. Hence, we are not able to provide any broader discussion of alternative methodological approaches and results gained by other Pareto chart applications.

3 Results and discussion

Disparities development in GDP per capita of regions in the Visegrad Group (V4) countries in the period 2000-2014 is shown in Fig. 1. Already at first sight it is clear, that thanks to the lines expressing distribution through the cumulative relative GDP per capita, the extent of regional disparities when comparing the years 2000 and 2014 has not change so much, when their deviation from the line of equal (uniform) distribution (black dashed) remained approximately at the same level. The area between the lines of equal distribution and real distribution can be marked as the range of disparities, or it is equal to the Gini coefficient, which can also be used as one of the methods of evaluating disparities in terms of σ-convergence approaches. The differences in regions disparities located between individual quartiles (Q) can be easily read from the curves and these differences are mostly very similar in both years being compared. There is a higher deflection of the curves between the most developed region and Q_3, as well as clear evidence of a relatively higher range of disparities among the regions with higher GDP per capita between Q_3 and Q_2. Furthermore, there is a convergence of both lines to the line of equal distribution in the Q_2 and Q_1 range, as well as in the lower quartile (between Q_1 and the least developed region) which is the sign of a relatively lower range of disparities between the less developed regions.

From the comparison of lines in the real distribution of GDP per capita, it can then be easily deduced that while the disparities ranging in the lower half of the sample remains unchanged because of the practically identical shape of the curves in both reference years, there were some changes in half of the developed regions (between the most developed region and Q_2) that are rather obvious even though they are based on visual inspection. Specifically, due to higher deflection (black dotted) line, which expresses disparity in 2014, it being clear that the disparities range between the most developed regions is higher in comparison with 2000 (full black line). Likewise, it is obvious that this trend is then reversed when the curve of the year 2014 converges to the curve of the equal distribution and is closer than the curve of the year 2000, while this reduction in the range of disparities is most noticeable between Q_3 and Q_2. In addition, we can even thing about another reversion in this trend since it seems that the

2014 line crossed (slightly) the 2000 line for the bottom of our sample which indicates (very low) increase in the range of disparities among the least developed regions.

The absolute values of regional GDP per capita, shown in the diagram in columns, confirm these findings. The differences between the values of (colorless) columns that represent 2014 as compared to the (grey) columns in 2000 are more pronounced at first glance among the most advanced regions. Likewise, it can be concluded that disparities among regions in the Q_3 and Q_2 range relatively decreased due to GDP growth while the distribution changes are barely visible in the regions located between the median (Q_2) and the least developed region. Although it is possible to assume from visual comparison in this case that the absolute differences are slightly higher, when considering the growth factor, which is also evident from the diagram, it is obvious that the change of disparities range will be practically minimal in a relative statement. Just the information about changes in the GDP values is such a major benefit, which allows the inferring of more complex conclusions from a Pareto chart about regional development, not only of changes in disparities, but also in terms of changes in economic performance, or lost growth. The diagram also shows that the deviation of the four most developed (metropolitan) regions significantly grew from other ones.

Fig. 1: The Pareto chart of disparities in GDP of the V4 regions (2000 and 2014)
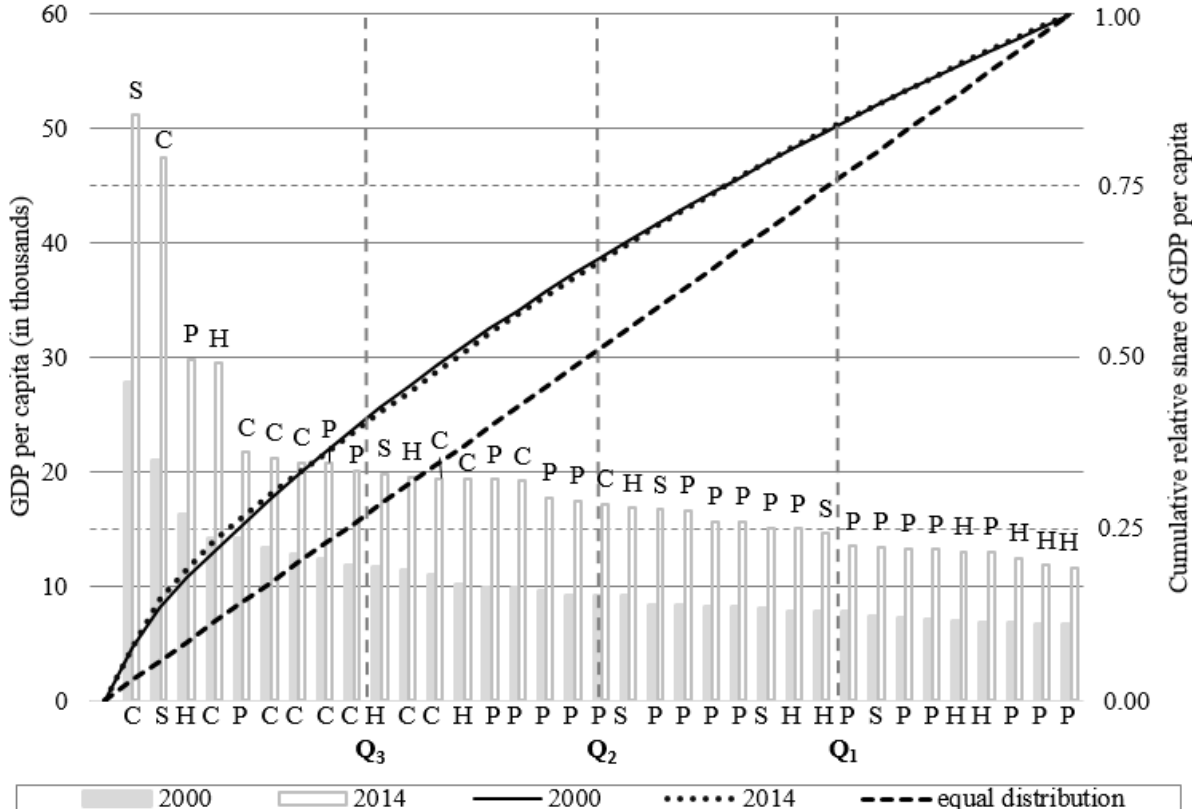
Notes: columns express the GDP per capita in 2000 and 2014 (C – Czech, H – Hungarian, P – Polish, S – Slovak regions; lower letters refer to 2000, upper letters to 2014); full line indicates the cumulative relative share of GDP per capita in 2000; dotted line analogically for 2014; dot-dashed line represents an equal distribution of GDP per capita among all regions; Q_1, Q_2 and Q_3 indicate quartile borders.

Source: own calculations based on Eurostat (2016)

As shown in Fig. 1, it is clear when evaluating a lower number of regions, that it is possible to monitor changes in disparities within the partial groups to a certain extent. For this issue the color resolution of columns is most appropriate. However, due to the

black and white color scheme that is available for figures in this journal, we provide only letter descriptions in our diagrams which is less appropriate because it does not allow to utilize the full potential of visualization capability. In terms of the development of regional disparities within each country, it is possible, due to significantly diversified growth, to quite safely state that between 2000 and 2014 there was a divergence between the regions of Slovakia (S). The changes in position within the sample and acquisitions of different size are less obvious for other countries, and therefore it is not possible to derive reliable conclusions for the development of their internal disparities. Furthermore, it is possible to see that Slovak regions are associated more with higher growth, causing their movement to the left in the diagram, or towards the developed regions. Similar tendencies are also evident with Polish regions (P). The opposite tendencies, or the fall in ranking, are again visible in Hungarian regions (H), four of them located among five of the least developed regions in 2014. Downward tendencies are also visible in some Czech regions (C), even though they all were located in the middle of more developed regions in 2014.

In two following sub-sections we will split our interval and focus on two sub-periods i.e. 2000-2007 and 2007-2014. This is due to confirm that Pareto chart is a valuable tool to monitor the changes in regional disparities. Since we provided detailed description of Pareto chart in this section, we will comment the following sub-periods only in brief. Of course, conclusions changes but the principles remain the same. In addition, one should assume that results of the late period would be different, since regions experienced economic crisis during that time. We welcome this fact, because it allows us to show applicability of Pareto chart on various periods of economic cycle. However, our objective is to demonstrate the applicability of chart, not to examine the reasons for development of regional disparities patterns. Hence we will focus on the aim and not to discuss the impacts of economic crisis or other factors on our results.

3.1 Application of Pareto chart on sub-period of 2000-2007

The Pareto chart applied on the sub-period of 2000-2007 is shown in Fig. 2. In this case again, thanks to the lines expressing distribution through the cumulative relative GDP per capita, increase in regional disparities is seen at the first sight. This is due to higher deflection of (black dotted) line which expresses disparity in 2007 vis-a-vis the line of 2000 (full black). Based on the course of 2007 line one can suggests that disparities increased rapidly between the most developed region and Q_3. This change is followed by a convergence between the lines in their following course. This development indicates decrease in GDP per capita disparities among the other regions of Visegrad Group countries, i.e. between Q_3 and the least developed region.

The interpretation of change in columns between 2000 and 2007 confirms the results based on the line graphs, i.e. largest increase in disparities is obvious among the most developed regions (between that most developed and Q_3). In particular, the capital regions of the Czech Republic, Slovakia and Hungary experienced pretty large growth (three highest columns in 2007). In the following sample sections, the changes in the range of disparities are less visible and hence hard to interpret. In the terms of disparities within particular countries, we can assume that Slovak regions (S) seem to diverged since it is possible to see that the gaps in per capita GDP between Slovak regions are larger. Besides, Slovak regions are associated more with higher growth, causing their movement to the left in the diagram, or towards the

developed regions (which is similar to conclusions about changes between 2000 and 2014). The disparities between the Czech regions (C) seem to remain more or less similar except one (capital region) which grew largely. Based on this fact we can assume disparities between the Czech regions increased. By focusing on Hungarian regions (H) one can suppose some increases in range of disparities as well. This is due to slower growth of the less developed Hungarian regions for one side (4 of them were situated in the lower quartile of all Visegrad Group regions in 2007), and for the other side higher growth of remaining 3 regions. In the case of Polish regions (P), it is hard to develop any qualified conclusions based on their columns in Fig. 2.

Fig. 2: The Pareto chart of disparities in GDP of the V4 regions (2000 and 2007)
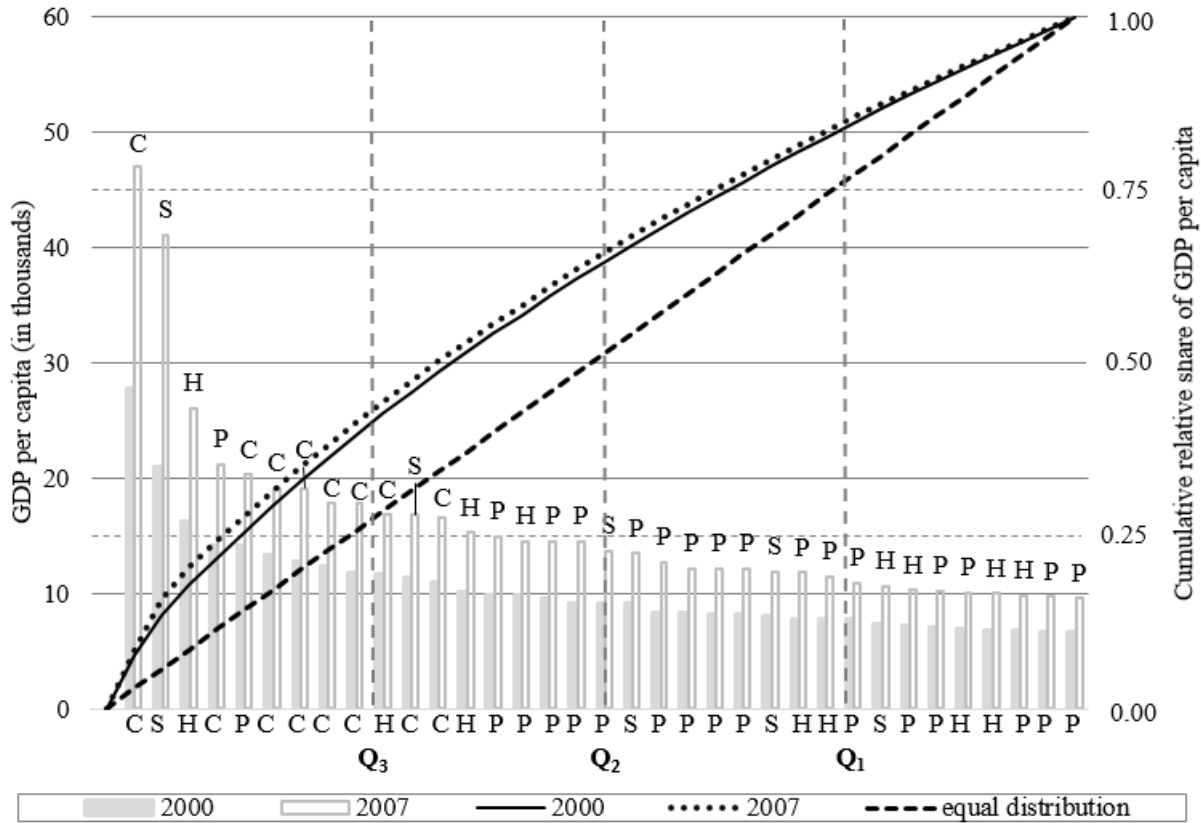
Notes: see notes below Fig. 1, symbols hold here analogically for 2000 and 2007.

Source: own calculations based on Eurostat (2016)

In a summary, based on the Pareto chart we can suggest the regions of Visegrad Group diverged in general between 2000 and 2007. This change has been caused due to divergence among the most developed regions while the diagram suggests that the rest of our sample (between Q_3 and the least developed region) rather converged. Besides the changes in columns graph seem that in the terms of particular countries the Czech Republic, Hungary and Slovakia experienced rather divergence as well.

3.2 Application of Pareto chart on sub-period of 2007-2014

Fig. 3 shows the application of Pareto chart on sub-period of 2007-2014. Over and over again, the first look is enough to draw some general conclusions about the change in range of disparities between examined years. The disparities in GDP per capita of the Visegrad Group regions decreased since the deflection of 2014 (dotted) line is lower than that of 2007 (full) line. Hence, we can suggest that regional disparities decreased in general. Nevertheless, by examining the sections delimited by quartiles

we can see that some signs of convergence are obvious among the more developed regions (upper half), nay but among the less developed (lower half). The evidence for this is found in courses of both lines since they rather diverge among the upper half regions (i.e. range of disparities decreases since the gap to the equal distribution line is lower) and rather converge among that lower (i.e. the dotted line diverges from the equal distribution line or converges to the full line, respectively; which means the range of disparities rather increases in this sub-sample).

Fig. 3: The Pareto chart of disparities in GDP of the V4 regions (2007 and 2014)
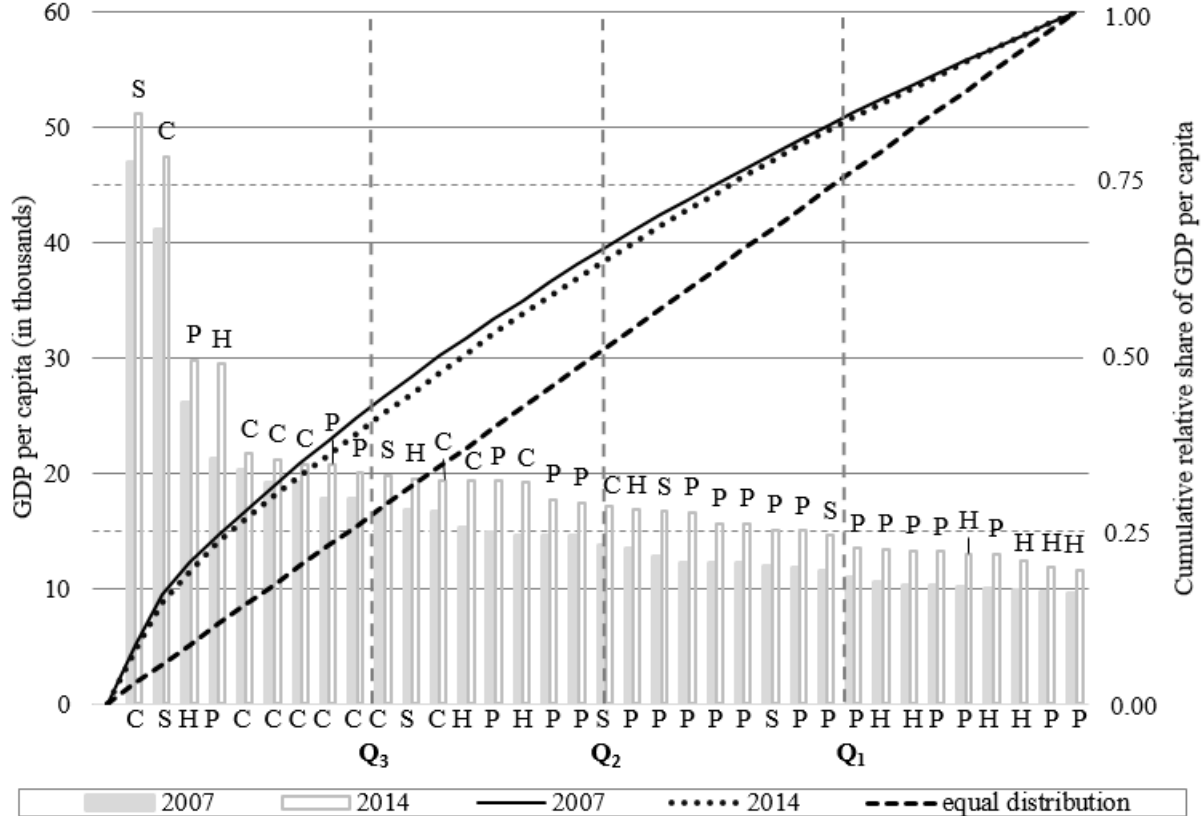
Notes: see notes below Fig. 1, symbols hold here analogically for 2007 and 2014.

Source: own calculations based on Eurostat (2016)

The columns graph shows convergence between the Q_3 and Q_2 since it is obvious that the relative gaps among the regions are lesser in 2014 vis-a-vis 2000. The changes in other particular sections of our sample are not predicative enough, so we cannot argue about changes in range of disparities for them. This is due to relative lower increase in the absolute GDP per capita values which result in low number of "well-visible" changes in our sample. From the last point of view, we can say that the gaps in GDP per capita among the Czech regions (C) seem relatively lower which indicates convergence among Czech regions. Furthermore, one can assume that range of disparities among the 3 regions of Slovakia (S) remained similar but, the capital region experienced higher growth which could result to change in the range of disparities among Slovak regions (one may guess the disparities increased but the outlyiness of capital region makes the interpretation harder).

3.3 Validation of results through σ-convergence

As mentioned before, to evaluate the relevance of the conclusions arising from the visual evaluation of the disparities development through the Pareto chart,

the coefficient of variation is used, which falls within the so-called σ-convergence approaches. The results of the analysis of regional disparities development of the Visegrad Group (V4) through this approach are presented in Tab. 2.

Tab. 2: σ-convergence - disparities in GDP of the V4 regions (2000, 2007 and 2014)

	2000	2007	2014		2000	2007	2014
V4	41.42%	49.94%	44.36%	**V4**	41.42%	49.94%	44.36%
Q_4 to Q_3	31.00%	40.33%	39.01%	**CZ**	36.28%	43.97%	39.71%
Q_3 to Q_2	8.93%	7.17%	5.10%	**HU**	32.85%	39.40%	36.73%
Q_2 to Q_1	5.51%	5.72%	5.52%	**PL**	20.87%	21.90%	24.58%
Q_1 to Q_0	4.68%	3.95%	5.17%	**SK**	49.41%	56.56%	58.30%

Source: own calculations based on Eurostat (2016)

Let us follow the paper structure and start with validation of our conclusion developed for the changes between 2000 and 2014. Within all regions of the Visegrad Group it is noticeable that actually there is only little change in the range of disparities (from 41.42% to 44.36%). In terms of development within individual sections bordered by quartiles it is then confirmed that indeed there was the most dramatic increase in disparities – 8 percentage points (pp) – among the most developed regions, while there was some decrease (by about 3.8 pp) in the regions between Q_3 to Q_2 vis-a-vis. At the same time, the conclusion of the same extent of disparities in the half of less developed regions has been confirmed since in the Q_3 to Q_2 range there was virtually no change recorded, and the change among the least developed regions reached only 0.5 pp. In the context of countries, the conclusion about a change in range of regional disparities among Slovak regions has been acknowledged by the σ-convergence. It is evident that the value of its variation coefficient increased from 49.41% to 58.30%. Changes in other countries are then indeed minimal, or up to 4 pp among regions of the Czech Republic, Hungary and Poland, which further confirms the presentation of the visual evaluation of disparities based on the Pareto chart.

Now we approach to the first sub-period i.e. 2000-2007. We can see there is higher change in the range of disparities (from 41.42% to 49.94%) by all the regions of Visegrad Group countries. In addition, the coefficients of variation confirm that disparities increased between the most developed region and Q_3 (by about 10 pp), while rather converged in the other ranges – Q_3 to Q_2 by about 1.8 pp; Q_1 to the least developed region by about 0.7 pp. For the range between Q_2 to Q_1 the measurement indicates virtually divergence (by about 0.2 pp) but, it is pretty clear that such a minimal difference cannot be tracked by the limits of human eyesight. Besides, we developed some conclusions about changes in ranges of disparities within particular countries as well. We assumed divergence in all countries except Poland, where we couldn't find unambiguous results. We found our estimates to be consistent with the results of σ-convergence measurements since the range of disparities increased as follows, according to the coefficients of variation: from 36.28% to 43.97% for the Czech Republic, 32.85% - 39.40% for Hungary and 49.41% - 56.56% for Slovakia.

The Pareto chart results of the sub-period 2007-2014 can be considered as confirmed as well. The disparities of whole sample decreased from 49.94% to 44.36%. The overall decrease in range of disparities happened due to convergence among the regions of upper half regions. The coefficients of variation found reduce in disparities between the most developed region and Q_3 (by about 1.3 pp) and in the range between Q_3 to Q_2 (by about 2.1 pp). At the same time, the results found virtually stable range of

disparities between the regions from Q_2 to Q_1 – decrease by about 0.2 pp, and increase of disparities in the lower quartile (by about 1.2 pp). In terms of countries, we can confirm reducing in range of disparities among the Czech regions – by about 4.3 pp. The ranges of disparities in other countries changed as well but by about half as much.

Conclusion

The intention of this article was to show the possibilities of the alternative evaluation of the development of regional disparities, whose credible quantification is the alpha and omega of every modern regional policy. As a possible contribution to the filling of a certain "vacuum" between nowadays conventionally used trivialities, but information-sparse attitudes, and vice versa highly sophisticated, but also demanding and more difficult to interpret approaches for measuring disparities, there was introduced the method called Pareto chart. The aim of the paper was to demonstrate and assess its usefulness for the evaluation of the development of regional disparities.

Due to the above-discussed facts it can probably be said that the comparison of the conclusions about the development of disparities based on the Pareto chart analysis and the results of the disparities analysis made with σ-convergence access clearly confirmed that a Pareto chart can be used as a sufficiently qualified tool to evaluate the development of regional disparities, which joins the advantages of simplicity and ease of interpretability, while retaining information useful for sub-base analysis of the causes of the development of these disparities in terms of changes within the sample of regions. The developed conclusions based on the Pareto chart was not in any way inconsistent with the results obtained through the σ-convergence approach. Even though we examined three different situations – including both convergence and divergence processes, we found the estimates based on Pareto charts confirmed in virtually every case. Moreover, the diagram displays other useful information such as growth, extreme values, and even changes in the positions of specific regions. Thanks to these parameters, it is possible on the base of this chart to attain a more comprehensive view of regional development within a particular territorial unit.

However, it must also be noted that the assessment of regional disparities using Pareto chart could mean certain difficulties arising from visual assessment. There can be designated opacity that is predictable while assessing multiple periods within a single field of the graph. Another limitation of interpretation, closely related to the imperfections of the human eye, is the very difficult identifiability, or non-identifiability, of very small changes. The question is how important are such relatively small changes when drawing conclusions about the development of disparities. However, it can be stated that larger changes are easier to catch and interpret via Pareto chart. Considering this, it would be usually better to apply the chart on larger period where one can expect some higher changes in development of examined indicators. Furthermore, we guess that the color resolution of columns is most appropriate for the presentation of Pareto chart. It should also be noted that the diagram is a tool for assessing the development of disparities, but not a tool to quantify its extent. In more complex analyses it would undoubtedly be appropriate to add one of the other methods, whose ambitions lie precisely in estimating values.

To conclude, it is a very interesting alternative assessment of regional disparities, which undoubtedly has, either individually or as a suitable complement to another technique, a potential usefulness not only in professional scientific studies, but may

with clarity via graphical interpretation be understandable enough to inexpert audiences from different disciplines, decision makers from within the political-bureaucratic apparatus, and also the broad professional and unprofessional public.

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THE MEDIATING ROLE OF BRAND REPUTATION: THE ANALYSIS OF DISCREPANCY BETWEEN THEORY AND FACT

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Abstract: *The aim of this research is to investigate the role of brand reputation as a mediating variable in the relationship between service quality and loyalty. The MRI's survey shows that there is a degradation in the ranking of the Oversea Chinese Bank Corporation-Nilai Inti Sari Penyimpan Bank (OCBC-NISP Bank) from 2009 to 2011, while the number of customers has increased over the same time frame. This indication highlighted the fact that although the quality of service decreased, the consumer's loyalty increased. This shows a contradiction in regard to previous research into the relationship between service and loyalty, such as* Al-Rousan and Mohamed (2010)*, and* Akbar *et al.*, (2010)*. The authors suggest the existence of a variable that mediates the relationship between service (service quality) and consumer loyalty, which is brand reputation. The sample size of this research was determined at 125 respondents. The data were collected by self-administered questionnaires. Results showed that a partial mediation, performed by brand reputation, occurred in the relationship between service quality and loyalty. This research shows that brand reputation is still deemed to be the cause of loyalty. The authors also made some recommendations.*

Introduction

Service quality can be interpreted as the effort expended to meet the needs and desires of consumers, and the delivery accuracy in meeting consumers' expectations (Zeithaml, 1988). Some studies show that service quality is related to loyalty of consumers (Al-Rousan and Mohamed, 2010; Akbar *et al.*, 2010). however, Caruana and Ewing (2010) study in the e-commerce consumers didn't find the relationship between service quality and consumer loyalty.

The difference between Caruana and Ewing (2010) finding and Al-Rousan and Mohamed (2010) and Akbar *et al.*, (2010) findings, thus supported by a condition which happened with the OCBC-NISP bank, raises the opportunity to replicate and extend the relationship between service quality and loyalty, especially in the field of banks' customers.

The contradiction above is reflected in the bank's condition, as shown in Tables 1,2 and 3, which describes a condition which happened with the OCBC-NISP bank, which gives an overview of the different investigation results with Al-Rousan and Mohamed (2010), and Akbar *et al.*, (2010).

1. Statement of a problem

The Marketing Research Indonesia (MRI) survey on Bank Service Excellence Monitor (BSEM) shows that OCBC-NISP bank ranking had declined in 2011 (see Table 1), but at the same time the total number of customers and the amount of money deposited were

continuously increasing, particularly into savings accounts, as the third-party funds at OCBC-NISP were dominated by savings accounts (Table 2 and Table 3). This phenomenon shows a discrepancy between the theory and the facts described. This highlighted the fact that the quality of service decreased, but the consumers' loyalty increased. Furthermore, this fact has allowed us to speculate that service quality has no relationship with consumer loyalty as described in Al-Rousan and Mohamed, (2010) and Akbar *et al.*, (2010) findings.

Table 1: List of BSEM (Bank Service Excellence Monitor) ranked based on MRI survey 2009-2011

Rank	2009	2010	2011
1	Bank Mandiri	Bank Mandiri	Bank Mandiri
2	Bank Internasional Indonesia	Bank Internasional Indonesia	Bank Permata
3	Bank CIMB Niaga	**Bank OCBC NISP**	Bank Internasional Indonesia
4	**Bank OCBC NISP**	Bank Permata	BNI
5	Bank Danamon	BNI	BRI
6	BCA	CIMB Niaga	**Bank OCBC NISP**
7	BNI	BRI	Bank CIMB NIAGA
8	PermataBank	BCA	Bank Danamon
9	Bank Bukopin	Bank Danamon	Bank BCA
10	Citibank.	Bank Bukopin	BTN

source: Infobank magazine 2009, 2010, 2011

Table 2: Number of Third Party Funding from 2009 – 2012 at OCBC-NISP, Cimahi Branch

(in million rupiah)

DESCRIPTION	2009	2010	2011	May-12
Giro	19,125	24,955	25,318	28,731
Saving	86,461	89,452	102,655	95,746
Total CASA (Saving)	**105,586**	**114,407**	**127,973**	**124,477**
Time Deposit (Deposito)	**56,772**	**70,025**	**59,306**	**54,184**
Total 3rd party fund	*162,358*	*184,432*	*187,279*	*178,661*

source: OCBC-NISP 2009, 2010, 2011

Table 3: Number of Saving Accounts from 2009 – 2012 at OCBC-NISP, Cimahi Branch

DESCRIPTION	2009	2010	2011	May-12
Number of accounts				
Giro	236	240	248	251
Saving	19,602	22,463	23,394	24,227
Time Deposit (Deposito)	791	771	714	681
Total Account (Rekening)	20,629	23,474	24,356	25,159

(source: OCBC-NISP)

Brown, S. W., and C. F. Gaulden, (1982) suggested that the replication and extension of research findings are the fundamentals for the development of theories into consumer behavior. This study replicates and extends Han et al. (2015) finding. Han et al. (2015) research is in the e-commerce consumers while this research examining their model using brand reputation as the mediating variable to Banking Consumers in Bandung, Indonesia.

MacKinnon and Dwyer (1993) stated that one of the objectives in analyzing mediating variables was to find out whether the independent variables affect the dependent variables directly or through other variables as intermediaries (mediating variables), so that the intermediate variables needed to be taken into account. Moreover, MacKinnon and Fairchild (2010) revealed that through their investigation of the role of mediating variables, the existing relationship would provide a more detailed picture of the relationship. In addition, several studies examined the relationship between service quality and loyalty through the use of some mediating variables, e.g., Osman and Sentosa (2013); Motlagh (2013); Dhandabani (2010); and Jeon (2009). All of these studies revealed that there was a mediation role of satisfaction in the service quality and loyalty relationship, although the studies were not into the same products.

Figure 1. Research Model
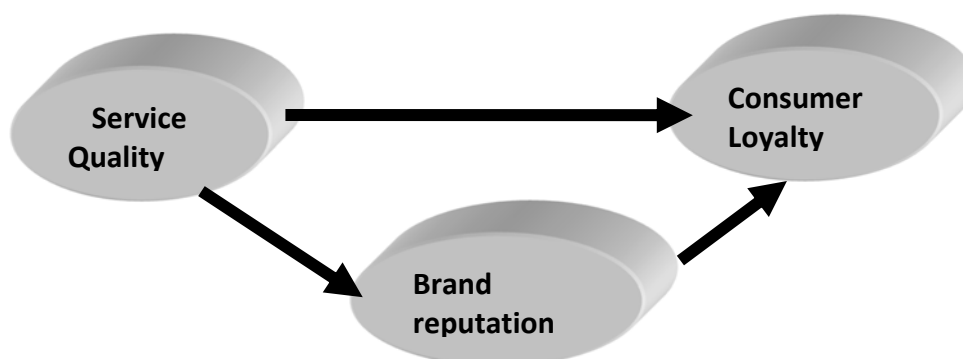
The aforementioned studies illustrated the direct and indirect relationship between perceived service quality and customer loyalty for tourism (Osman and Sentosa, 2013) , hotels (Motlagh et al., 2013), banking (Dhandabani, 2010), or e-businesses (Jeon, 2009). In addition, Han, et al. (2015) found that reputation partially mediates the relationship between

service quality and Loyalty, while Caruana and Ewing (2010) found that reputation fully mediates the relationship between customer service and loyalty. Those research show that in the field of service, the mediating role of a variable is an important thing to investigate, especially reputation as mediating variable. Based on the description above, authors investigate the relationsip among Service Quality, Reputation, and Loyalty as depict in figure 1.

2. Literature Review and Hypotheses

2.1. Service Quality and Loyalty

In the field of service, the importance of loyalty can be seen from some previous research which investigated the relationship between service quality and loyalty and found that the relationship is an antecedent of loyalty, for example Al-Rousan and Mohamed (2010) and Akbar *et al.* (2010). Al-Rousan and Mohamed (2010) research into a five star hotel in Jordan found that the dimensions of the service quality significantly predict customers' loyalty. Among the dimensions of tourism's service quality, tangibility is the most significant predictor of customers' loyalty.

All the above mentioned research clearly suggests that there is a relationsip between service quality and customer loyalty. On the other hand, Caruana and Ewing (2010) and the data described in Tables 1 to 3 shows that there is no relationship between service quality and customer loyalty. The authors see that the difference or gap between the research and the data in the three tables should be verified. Meanwhile, the authors' standpoint is that there is a relationship between service quality and customer loyalty, as suggested by the above mentioned research.

The hypotheses drawn in this study are meant to verify the difference between the results of the previous research and the data described.

H1 : There is a positive relationsip between service quality and customer loyalty for bank customers.

2.2. Brand Reputation and Loyalty

Fombrun and Van Riel (in Stenger, 2014) defined reputation as "The overall esteem in which a company is held by its constituents". Furthermore, Stenger (2014) suggested that reputation could also be considered as an intangible asset. The definition by Fomburn and Van Riel is in line with Kumbhar's (2012) investigation, which revealed that the reputation of the brand is part of the service quality dimensions evaluated by the services' consumers. This suggests that the reputation of the brand is also a part of the service attributes that should be taken into account in the management of a bank. Stenger (2014), through qualitative research, found five issues that should be paid attention to by online managers in managing reputation, namely monitoring, content suppression, right of reply, crisis communication, and claims management. Stenger (2014) findings expressed that reputation should be managed specifically and professionally, in terms of managing a business entity.

Based on the issues above, the author made an effort to verify Stenger's (2014) work. The second hypothesis of this research is developed through some research investigating the relationship between brand reputation and loyalty. These reseach had been conducted by Selnes (1993), Cretu and Brodie (2007), Casalo et al., (2008), (Dahlen et al. (2009), and Foroudi *et al.* (2016).

Selnes (1993) expressed that brand reputation was the strongest driver of customers' loyalty, compared to customers' satisfaction. In fact, when the intrinsic cues are ambiguous, it's found that customer satisfaction does not drive customer loyalty. Selnes' research (1993) revealed that the reputation of the brand can be a more important variable for influencing loyalty than satisfaction. This is consistent with the finding of Cretu and Brodie (2007) who reported that brand image had a more specific influence on customers' perceptions of product and service qualities, while the company's reputation had a broader influence on the customers' perceptions of value and loyalty.

Casalo et al., (2008), in the electronic commerce transaction research found that reputation and satisfaction have a positive effect on website loyalty, and usability has a positive effect on satisfaction. Additionally, (Caruana and Ewing, 2010) through four sequential stages of attitude by Oliver, found that corporate reputation has significant effect on online loyalty, and corporate reputation has a mediating role in the relationships between service quality and online loyalty. Dahlen, et al. (2009) found that non-traditional media enhanced consumer-perceived values. The effects were greater on brands with a poor reputation than on those with a higher or better reputation. High reputation brands were more sensitive to the appropriateness and expense of the marketing activities. Consumer-perceived value led to higher purchasing and word-of-mouth intentions.

Lai, et al. (2010) found that CSR and corporate reputation had positive effects on industrial brands' equities and brands' performance. In addition, corporate reputation and industrial brand equity partially mediate the relationship between CSR and brand performance. Abimbola anf Kocak (2007) suggested that branding and reputation building were key resources which allowed an organization to be successful over an extended period of time. In terms of research design and method, we found that an interdisciplinary approach was important for further exploration of the nexus between a brand's reputation and entrepreneurship. Because they are fuzzy concepts loaded with meaning and interpretations, they are better explored through qualitative data in the first instance. These findings are germane to paradigmatic development to distill the ideas, explanations and the reality that binds the concepts of brand reputation.

Corkindale and Belder (2009) found that there was a significant relationship between Corporate Brand (CB) strength and the respondents' likelihood in adopting the service. The CB construction was found to comprise of two factors: Conative and cognitive, where the former was more influential on the adoption probability. Omar et al. (2009) *findings* – identified that credibility and trust were significant elements which must be managed and communicated to maintain firms' corporate images and reputations.

On the basis of the previous research mentioned above, particularly Selnes' (1993), Cretu's and Brodie's (2007), and Dahlen et al. (2009), then the second and the third

hypotheses of this research can be formulated as follows:

H2: There is a positive relationship between brand reputation and customer loyalty for bank customers.

2.3. Service Quality and Brand Reputation

The Foroudi *et al.* (2016) research through complexity theory found that in the retail consumers environement, technical innovation capability operationalized as the development of new service, service operations, and technology has a significant effect on reputation. In line with Foroudi *et al.* (2016) works, Han et al. (2015) in the work of brand reputation as mediating variable between brand equity and brand trust, found that food and service quality had a positive effect on brand reputation. Caruana and Ewing (2010) study through four sequential theory of Oliver (1993) found that service quality has a significant effect on corporate reputation. Based on the previous research, this study hypothesizes that:

H3: There is a positive relationship between service quality and brand reputation for bank customers.

2.4. Mediating Role of Brand Reputation

The aim of this research is to investigate the role of brand reputation as a mediating variable in the relationship between service quality and loyalty. It is derived from the difference between the results of the MRI survey on bank services with the number of customers at OCBC-NISP bank's Cimahi branch. The phenomenon shows that there is indeed a decrease in OCBC-NISP's ranking; however, the number of customers increases.

The decrease in the bank's ranking shown in the BSEM, and the increasing number of loyal customers at its Cimahi branch, as proven by the increasing amount of savings or funds, indicates that there is no relationship between service quality and loyalty, as revealed in Al-Rousan et al. (2010) and Akbar et al. (2010) works. In addition, this study expects to examine whether the variable of service quality has a direct effect on loyalty, or goes through the other variable – reputation, so that the role of reputation in determining loyalty needs to be explored Lewis (1996: 57), and Caruana and Calleya (1998).

Han et al. (2015) expressed that in the chain restaurant consumer, brand reputation is a mediating variable between brand equity and brand trust. In their work they found that brand reputation partially mediates the relationships between food and service quality, brand affect, and brand awareness and brand trust. Except relationship between brand association and brand trust is fully mediated. Caruana and Ewing, (2010) beside found that Customer Service is associated with corporate reputation, they also found that corporate reputation mediates the relationship between customer service and online loyalty.

This motivated the authors to verify the role of brand reputation as a mediating variable between service quality and customer loyalty. This also drove us to suggest that brand reputation will certainly mediate the relationship between service quality and customer loyalty, since brand reputation is part of the service quality dimensions which are evaluated by e-service consumers (Kumbhar, 2012), and that brand reputation is the strongest driver of

customer loyalty (Selnes, 1993). Based on the explanation above, the fourth hypothesis of this research is formulated as follows:

H4: There is a mediating role by brand reputation in the relationship between service quality and customer loyalty.

3. Methods

The population of this study was the 4322 customers who owned an account at OCBC NISP's Cimahi branch. Cimahi is a small town near Bandung, the capital of West Java, Indonesia. The sample size was 200, determined by use of Slovin's formula. The data were collected through random sampling and self-administered questionnaires.

Reputation is operationalised based on Barnett et al. (2006) Barnett et al.(2006) and Fombrun and Shanley's definition in Stenger (2014). Loyalty is operationalised based on the study by Reichheld and Schefter (2000) and measured by 5 items. Service quality is operationalised through 5 dimensions of Parasuraman et al. (1988), and measured by 10 items, brand reputation construct is also measured by 10 items, in which all of the items use a Likert scale, and are then indexed by averaging the values.

This research used of three variables to analyzed, these are Service Quality, Brand Reputation, and Consumer Loyalty, consequently, there are three relationships which are analyzed (Baron and Kenny, 1986), those are the relationship between Service Quality and Consumer Loyalty, Service Quality and Brand Reputation, and Brand Reputation and Consumer Loyalty. The using of multivariate regression analysis in this study is only to explain the role of brand reputation as a mediating variable, as suggested by Baron and Kenny (1986), and not to explain the causality of the independent variable and the dependent variable. This research places more emphasis on the role of brand reputation as a mediating variable, rather than the influences among variables. Consequently the authors do not explain the influences between the independent variables and the dependent variable in this study in detail.

Furthermore, during the attempt to analyze the mediating effect of brand reputation, the authors referred to Wuensch (2009) who suggested that mediation occurs when the relation between the Independent Variable (IV) and the Dependent Variable (DV) is mediated by a Mediator (M). To test the mediating function of M in the relationship between IV and DV, the authors analyzed four regression models in a simultaneous manner.

3.1. Validity and Reliability

The validity test is done through confirmatory factor analysis (CFA), the result is depicted in Table 1. The 5 out of 10 variable items of service quality (SQ) not confirmed, those are SQ1,SQ6,SQ7,SQ9, and SQ10; 4 out of 10 Brand Reputation variable items are also not confirmed, these are BR4, BR8, BR9, and BR10; and 2 out of 5 variable items of Consumer Loyalty also were not confirmed, those are CL1, CL3. Then the 10 variables which not confirmed were dropped, not to be analyzed furtherly.

Table 1. Rotated Component Matrixᵃ

	Component		
	1	2	3
SQ2		.612	
SQ3		.770	
SQ4		.830	
SQ5		.763	
SQ8		.600	
BR1	.893		
BR2	.842		
BR3	.783		
BR5	.649		
BR6	.605		
BR7	.747		
CL2			.557
CL4			.709
CL5			.840

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Reliability testing is done through Cronbach's alpha, Table 2,3, and 4 are the results of a Cronbach's alpha value for each variable. All the variables value are exceed of 0.6, then all of them are appropriate for further analysis.

Table 2. Service Quality Reliability Statistics

Cronbach's Alpha	N of Items
.826	5

Table 3. Brand Reputation Reliability Statistics

Cronbach's Alpha	N of Items
.877	6

Table 4. Consumer Loyalty Reliability Statistics

Cronbach's Alpha	N of Items
.636	3

4. Results

Table 5. che coefficient of regression for brand reputation on service quality is 1.022 and the t-value is 30.625, and the p-value is 0.000, which is lower than 0.05, showing the relationship is significant. This means that service quality has an effect on brand reputation

and supported the first hypothesis of this research. The greater the service quality is, the greater the reputation will be.

Table 5. Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-0.185	0.112		-1.653	0.101
	SERVQUAL	1.022	0.033	0.940	30.625	0.000

a. Dependent Variable: BRAND_REP

The independent variable in Table 6 is brand reputation, and the dependent variable is loyalty. The coefficient of regression for loyalty on brand reputation is 0.688 and it is significant at $p = 0.000$ level ($p < 0.05$). This means that brand reputation has an effect on loyalty and supported the second hypothesis of this research. The greater the brand's reputation is, the greater the loyalty will be.

Table 6. Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.907	0.150		6.045	0.000
	BRAND_REP	0.688	0.046	0.803	14.964	0.000

a. Dependent Variable: LOYALTY

The independent variable in Table 7 is service quality, and the dependent varaible is loyalty. The coefficient of regression for loyalty on service quality is 0.758 and it is significant at $p = 0.000$ ($p < 0.05$) level. It means that service quality has an effect on loyalty and supported the third hypothesis of this research. The greater the service quality is, the greater the loyalty will be.

Table 7. Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.601	0.163		3.679	0.000
	SERVQUAL	0.758	0.049	0.814	15.556	0.000

a. Dependent Variable: LOYALTY

Table 8 illustrates the results of the two steps of regression which analyzed the mediating effect of brand reputation in the relationship between service quality and loyalty. Model 1 is the first step where service quality is the independent variable, and loyalty is the dependent variable. The result shows that the coefficient of regression is 0.758 and it is significant at $p = 0.000$ ($p < 0.05$) level. It means that service quality has a significant effect on loyalty. It also means that the greater service quality is, the greater the loyalty will be.

Model 2 is the second step, which shows the regression between the variables of service

quality and brand loyalty with the addition of the brand reputation variable as a control variable (Model 2). The result shows that the coeffcents of both the independent variable and mediating variable in Model 2 (control model) are significant, so it can be considered that the relationship between the variables of service quality and loyalty is partially mediated by brand reputation, since the regression coefficient of the independent variable (service quality) is significant and is increased (from 0.000 in Model 1 to 0.001 in Model 2), and the coefficient of the mediating variable (brand reputation) is also significant (0.033) **in both models**. This indication specifically shows that the fourth hypothesis is supported.

Table 8. Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.601	0.163		3.679	0.000
	SERVQUAL	0.758	0.049	0.814	15.556	0.000
2	(Constant)	0.653	0.163		4.009	0.000
	SERVQUAL	0.472	0.141	0.508	3.350	0.001
	BRAND_REP	0.279	0.130	0.326	2.153	0.033

a. Dependent Variable: LOYALTY

5. Discussion

The results of this study is align with Al-Rousan *et al.*(2010), Akbar *et al.*, (2010), which found that there is a relationship between service quality and loyalty and also align with Han et al.(2015) which found that reputation partially mediates the relationship between service quality and loyalty. These mean that there is indeed a relationship between service quality and customer loyalty at OCBC-NISP bank's Cimahi branch, which is partially mediated by brand reputation. This suggests that the OCBC-NISP bank's brand reputation plays an important role in increasing the number of loyal customers. So even though the quality of the bank's and branch's services declined, it didn't directly minimize the customers' loyalty. It was instead partially mediated by the reputation of the brand. Therefore it can be concluded that the reputation of the brand should also be taken into account when looking to increase customer loyalty, aside from the quality of the services offered. This is in line with the previous research that supported brand reputation as a mediating variable, such as Han et al. (2015), Kumbhar (2012), and Caruana and Ewing (2010).

This study also shows that the reputation requires appropriate management. One way to manage reputation is through five activities suggested by Stenger (2014), Those are monitoring, Content Suppression, Right of Reply, Crisis Communication, and Claim Management. Such five activities are employed to respond the challenge related to customer participation on Social Media. The five activities seem to be able to be performed by Bank Managers in managing Brand Reputation as a part of service dimensions as suggested by Kumbhar (2012) as afformentioned in the literature review at the subsection Brand Reputation of this paper.

Those five activities are:
1. Monitoring: Finding and monitoring what is said online (*in this case saving or*

deposti bank, ***authors***) by constituents (customers, employees, suppliers...) or any stakeholders (journalist, NGO...) about brands or firms organizations.

2. Content suppression: Dealing with content posted illegally and content that undermines the image and reputation of the brand
3. Right of Reply: Dealing with content that undermines the image and reputation of the brand company
4. Crisis Communication: Dealing with rumours, polemics, crisis communication
5. Claims management: Dealing with a large number of claims on social media (*in this case Bank,* ***auhors***) mainly coming from customers or Internet users (*in this case Bank customers,* ***authors***) which can be anonymous.

Maintaining a brand's reputation can also be done by managing the brand based on the Analyses of the average score for the brand's reputation in the questionnaire, the highest score was 625, which was derived from the number of respondents (125 respondens) x (5 (the highest score in a Likert scale), while the lowest score was 125 x 1 = 125:

a. The dimension of the brand's reputation or the items earning the highest average score are the emotional approach, with an average score of 412. This means that the customers felt emotionally connected to the brand, which in turn drove them to save their money at OCBC NISP bank's Cimahi branch. Consequently, a way of maintaining the OCBC-NISP brand's reputation is by maximizing its relationship marketing, which focuses on how to tighten the emotional bond with its customers, by providing programs which give emotional rewards (esteem rewards) to those who are willing to save their money and stay loyal to OCBC NISP's Cimahi branch. Such emotional rewards may be in the form of birthday presents or souvenirs for religious festivals. Also, to maintain such an emotional connection with its customers, the bank should provide training for its front-line staff (eg the tellers and customer service officers), to train them how to provide excellent personal service and to show empathy with their clients.

b. The items related to the variables of the brand's reputation which obtained the lowest scores were about the statements regarding the vision and the leadership of the bank, with an average score of 377. This means that the customers did not have a firm understanding of the vision and the leadership of the bank's Cimahi branch. The two are important in creating a brand's reputation, especially in triggering the consumers' trust for saving or managing their money in the respective bank or branch.

Conclusion

The role of brand reputation, which partially mediates the relationship between service quality and customer loyalty provides the following some conclusions:

1. The brand reputation is partially mediates the relationship between service quality and loyalty
2. The brand reputation of OCBC-NISP bank must be managed and maintained or even enhanced because it plays an important role in determining customers' loyalty.
3. To manage and Maintain the reputation, the manager could follows Stenger (2014) suggestion and/or the average score for the brand's reputation in the questionnaire

Acknowledgement

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ROZVOJ MIEST A JEHO FINANCOVANIE

DEVELOPMENT OF CITIES AND ITS FINANCING

Elena Žárska – Oliver Rafaj

Abstract: *The importance of cities in the economic system of the country is unquestionable. They group and attract a large number of economic actors and allow them to realize intense economic interactions between them. To offer long-term benefits for inhabitants and entrepreneurs and remain attractive for them, cities need to develop continuously. Ensuring the development of the city means to create and acquire resources to increase its capacity and use of the available potential. This article deals with the financial capacity of Slovak cities, which reflects their ability to ensure their development. The financial capacity of Slovak cities was investigated in time period 2009 – 2014. Investigated were all 138 Slovak cities and they were divided into three size groups: small cities with population up to 20 000 inhabitants, medium-sized cities with population between 20 001 and 50 000 inhabitants and large cities over 50 001 inhabitants. The evaluation of financial capacity was realized on six indicators: current account balance, capital account balance, total debt, debt service, immediate liquidity and net worth. The comparison of the calculated values of each group showed that the highest amount of resources allocate to their development the group of largest cities. On the other hand, that group has also the highest debt.*

Keywords: *Development of cities, financial capacity, current account, capital account, total debt.*
JEL Classification*: G 32, H 63, R 51.*

Úvod

Zabezpečovať rozvoj mesta znamená vytvárať a získavať zdroje pre rozvoj (zvyšovanie) svojich kapacít a využívanie disponibilného potenciálu (Hansen, 1965). Významnou súčasťou zdrojov sú finančné zdroje, ktorých objem predstavuje finančnú kapacitu. Tá predstavuje objem disponibilných finančných prostriedkov k určitému časovému momentu, ktoré mesto môže použiť na krytie bežných a kapitálových výdavkov vrátane svojich záväzkov (Peková, 2011). Je výsledkom, resp. prejavom schopnosti generovať finančné prostriedky v zmysle platnej legislatívy, existujúcich rozpočtových vzťahov, disponibilného majetku a manažovania voľných, grantových a úverových zdrojov. Táto schopnosť je vymedzenou kategóriou finančná kondícia mesta. Ide o stav, na akej úrovni je mesto schopné generovať príjmy a výdavky zodpovedajúce potrebám bežného výkonu a rozvojovej stratégii obce z hľadiska udržateľnosti rozvoja, stability vývoja základných finančných ukazovateľov a dlhovej schopnosti. Finančná kapacita sa meria sústavou podielových ukazovateľov, ktoré vypovedajú o finančných schopnostiach samospráv zabezpečiť svoj rozvoj (European center of Management, 2014). Cieľom príspevku je jednak na základe dostupných a porovnateľných údajov o hospodárení miestnych samospráv preskúmať finančnú kapacitu miest Slovenskej republiky pre generovanie svojho rozvoja a súčasne do akej miery je tento rozvoj zabezpečovaný dlhovým financovaním.

1 Formulácia problematiky

Mestá sú nosnou kostrou sídelného, administratívneho a ekonomického systému krajiny. Sú objektom skúmania viacerých disciplín – urbánnej ekonómie, územného plánovania, demografie, sociológie, geografie a tiež aj verejnej správy, pretože sú to samosprávne jednotky, ktorých úlohou je zvyšovanie kvality života svojich občanov pri udržateľnosti rozvoja. Viažu na seba niekoľko teoretických konceptov – od teórie centrálnych miest z 30.rokov minulého storočia (Christaller, 1933), cez City management a governance z 90.rokov a až po koncept kreatívnych miest zo začiatku tohto storočia (Landry, 2008). Mesto je v nich skúmané v kontexte mestských systémov, podľa funkcií a typov, na základe ich vzťahov so svojím zázemím, hierarchie a lokalizačného usporiadania, až po faktory dynamiky ich rastu. Súčasné verejné politiky akcentujú problematiku miest aj vo svojich prístupoch rozvoja regiónov a tvorbe koncepcií a dokumentov (v SR koncepcia mestského rozvoja).

Mestá zohrávajú v ekonomike mimoriadne dôležitú úlohu. Zoskupujú veľký počet obyvateľov a firiem na relatívne malom území, čím dokážu obyvateľom poskytnúť väčšie množstvo pracovných príležitostí ako aj pestrejšiu paletu profesií a firmám zasa väčšie a špecifickejšie zdroje pracovnej sily, dodávateľov, odberateľov. Mesto predstavuje dopravný a komunikačný uzol s vytvorenou sieťou obchodov a služieb (Cox, Mair, 1998). Mesto je často aj sídlom administratívnej jednotky, čo prináša efekt prítomnosti inštitúcií verejnej správy, toku peňazí pre jej výkon a pracovných miest byrokratického aj manažérskeho zamerania v nej (Halásková, Halásková, 2016). K mestu sa viaže spádové územie a viaže tým na seba zodpovednosť aj za svoje okolie. Mesto je súčasne aj samosprávna jednotka, kde v zmysle platnej legislatívy zabezpečuje kompetencie pre svojich obyvateľov (Nam, Parsche, 2001). V samosprávnej pôsobnosti má mesto jedinečnú úlohu – koordinovať záujmy a potreby svojich obyvateľov a subjektov pôsobiacich na svojom území. Význam miest spočíva predovšetkým v umožnení jednotlivým aktérom rýchlejšie a intenzívnejšie uskutočňovať ekonomické interakcie medzi sebou. V kontexte spravovania spoločného priestoru pre všetkých aktérov vystáva otázka, či mestá dokážu v otázke zabezpečenia vlastného rozvoja hospodáriť zodpovedne a či dokážu „rozumne" alokovať prostriedky do svojho rozvoja s cieľom zvyšovať atraktivitu pre podnikateľov a kvalitu prostredia pre obyvateľov (Cox, Mair, 1998), (Žárska, Ferčíková, 2015). Teda či rozvoj zabezpečujú dobrým hospodárením s finančnými prostriedkami, bez zvyšovania miery zadlžovania, pri znižovaní svojej dlhovej služby a efektívnom využívaní a zhodnocovaní svojho majetku (Balážová, 2011), (Flaška, Košta, Bolcárová, 2014).

Pre skúmanie daného problému boli formulované dve výskumné otázky:
1. *Financujú mestá svoj rozvoj zvyšovaním zadlženosti?*
2. *Ktorá veľkostná kategória miest má najlepšie hodnoty finančnej kapacity?*

1.1 Ukazovatele finančnej kapacity

Porovnávanie finančnej kapacity je realizované na základe 6 ukazovateľov[1], ktoré charakterizujú finančné hospodárenie, dlhovú politiku a majetkové zabezpečenie.

1. Bilancia bežného účtu (ďalej len BBÚ)
Ukazovateľ vypovedá o tom, či samospráva dokáže pokrývať svoje bežné výdavky, ktoré sú určené na bežný chod samosprávy zo svojich bežných príjmov. Ak je hodnota

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[1] údaje boli prevzaté z verejne prístupných databáz Inštitútu pre ekonomické a sociálne reformy - INEKO

ukazovateľa kladná, samospráva má k dispozícii zdroj pre financovanie svojich kapitálových potrieb. Ukazovateľ je počítaný:

$$BBÚ = (bežné\ príjmy – bežné\ výdavky) / bežné\ príjmy \qquad (1)$$

2. Bilancia kapitálového účtu (BKÚ)

Ukazovateľ informuje o tom, či samospráva hospodárila prebytkovo alebo deficitne z pohľadu kapitálového účtu. Vypovedá o tom, ako samospráva dokáže pokrývať svoje kapitálové výdavky (investície, ktorými zhodnocuje svoj majetok) zo svojich kapitálových príjmov (z predaja majetku, vlastnej podnikateľskej činnosti, presunom z rezervného fondu, prijatím úveru, resp. získaním grantu).Ukazovateľ je počítaný:

$$BKÚ =(kapitálové\ príjmy – kapitálové\ výdavky) / (kapitálové\ príjmy) \qquad (2)$$

3. Celkový dlh (CD)

Tento ukazovateľ má aj tzv. zákonné kritérium, ktoré samopsrávy nemôžu prekročiť, pokiaľ na plnenie svojich úloh chcú prijímať návratné zdroje financovania. Podľa Zákona NR SR č. 583/2004 Z. z. o rozpočtových pravidlách územnej samosprávy (Zákon NRSR č.583, 2004), ak celková suma dlhu samosprávy prekročí 60% skutočných bežných príjmov predchádzajúceho roka, samospráva sa nemôže uchádzať o návratné zdroje financovania. Ukazovateľ je počítaný:

$$CD = (bankové\ úvery\ a\ výpomoci + dlhodobé\ záväzky – úvery\ od\ ŠFRB) /$$
$$(bežné\ príjmy\ za\ predchádzajúci\ rok)^2 \qquad (3)$$

4. Dlhová služba (DS)

Vypovedá o výške výdavkov, ktoré samospráva vynakladá v súvislosti so splácaním svojho dlhu. Podľa Zákona NR SR č. 583/2004 Z. z. o rozpočtových pravidlách územnej samosprávy (Zákon NRSR č.583, 2004), ak suma ročných splátok návratných zdrojov financovania vrátane úhrady výnosov neprekročí 25 % skutočných bežných príjmov predchádzajúceho roka, obec na plnenie svojich úloh môže prijímať návratné zdroje financovania. Ukazovateľ je počítaný:

$$DS = (výdavky\ na\ splácanie\ istiny + úrokové\ splátky) / (bežné\ príjmy\ za$$
$$predchádzajúci\ rok) \qquad (4)$$

5. Okamžitá likvidita (OL)

Informuje o tom, do akej miery dostupné prostriedky na finančných účtoch samospráv postačujú na splatenie krátkodobých záväzkov. Má význam z hľadiska finančnej stability samosprávy a aj pri riešení krátkodobých krízových javov a havarijných situácií. Ukazovateľ je počítaný:

$$OL = (finančné\ účty) / (krátkodobé\ záväzky) \qquad (5)$$

6. Čistý majetok (ČM)

Tento ukazovateľ vyjadruje výšku majetku samosprávy (po očistení o zadlženie) v pomere k bežným príjmom. Nárast majetku a schopnosť jeho efektívneho využívania je prejavom dobrého manažovania a udržiavania si dobrej finančnej kondície, lebo majetok treba nielen spravovať, ale aj udržiavať a zhodnocovať. Ukazovateľ je počítaný:

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[2] od roku 2012 sú započítané aj záväzky na predfinancovanie eurofondov

$$\check{C}M = (neobe\check{z}n\acute{y}\ majetok + finan\check{c}n\acute{e}\ \acute{u}\check{c}ty - (bankov\acute{e}\ \acute{u}very\ a\ v\acute{y}pomoci + dlhodob\acute{e}$$
$$z\acute{a}v\ddot{a}zky - \acute{u}very\ od\ \check{S}FRB)) / (be\check{z}n\acute{e}\ pr\acute{i}jmy\ za\ predch\acute{a}dzaj\acute{u}ci\ rok)^{3}\ (6)$$

2 Metódy

Objektom skúmania sú všetky mestá Slovenskej republiky v časom rade rokov 2009 až 2014. Prvým rokom skúmania je rok 2009, ktorý predstavuje nástup (dopad) finančnej krízy na financovanie miest a ako sa prejavila v správaní sa miest v nasledujúcich rokoch z hľadiska toho, či ich investičná aktivita klesla, resp. sa zvýšilo úverové krytie kapitálových výdavkov. Dané relácie sú skúmané podľa veľkostných kategórií miest. Celý súbor predstavuje 138 miest, t. j. všetky samosprávy, ktoré v danom období disponovali štatútom mesta. Tieto boli pre potreby analýzy rozdelené podľa počtu obyvateľov do 3 veľkostných skupín:

1.skupina – malé mestá s počtom obyvateľov do 20 tisíc (98 miest),
2.skupina – stredné mestá s počtom obyvateľov od 20 001 do 50 tisíc (29 miest)
3.skupina –veľké mestá s počtom obyvateľov nad 50 001 (11 miest).

Na vyhodnotenie vývoja jednotlivých podielových ukazovateľov za jednotlivé stanovené skupiny miest, bola použitá metóda aritmetického priemeru (Rafaj, 2014). Pre zistenie priemernej hodnoty každého podielového ukazovateľa každej skupiny miest v sledovanom období, bol použitý nasledovný vzťah:

$$\text{Aritmetický priemer} = \frac{x1+x2+x3+\cdots xn}{n} \qquad (7)$$

v ktorom písmeno x je hodnota podielového ukazovateľa konkrétneho mesta a písmeno n počet všetkých miest danej skupiny obcí. Pre porovnanie vývoja každej skupiny miest z časového hľadiska, bola použitá metóda chronologického priemeru. Použitý bol nasledovný vzťah:

$$\text{Jednoduchý chronologický priemer} = \frac{\frac{y1+y2}{2}+\frac{y2+y3}{2}+\cdots+\frac{yt-1+yt}{2}}{t-1} \qquad (8)$$

v ktorom písmeno y je hodnota konkrétnej mesta v jednom roku a písmeno t znamená celkový počet rokov sledovaného obdobia. V tomto prípade t= 6.
Pre naplnenie cieľa a overenia hypotéz boli použité metóda komparatívnej analýzy a grafická metóda vývoja priemerných hodnôt ukazovateľov.

3 Rozbor problému

Skúmanie a hodnotenie výsledkov má tri roviny. Prvá predstavuje analýzu, ako sú mestá schopné generovať prostriedky pre rozvoj na základe prebytkov bežného účtu a vykrytia kapitálových výdavkov kapitálovými príjmami. Druhou rovinou je analýza zadlženosti, teda zapojenia úverových zdrojov do financovania rozvoja a jej odraz v dlhovej službe. Oba prístupy v analýze sa premietajú do likvidity a vývoja majetku miest. Skúmanie má aj tretiu súčasť a to je porovnanie podľa troch zvolených veľkostných skupín miest, vychádzajúc z predpokladu, že vývoj sledovaných ukazovateľov a správanie sa miest pri financovaní rozvoja môže mať rôzny prejav podľa ich veľkosti.

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[3] od roku 2012 sú započítané aj údaje o výške záväzkov na predfinancovanie eurofondov

Obr. 1 Vývoj bilancie bežného účtu miest
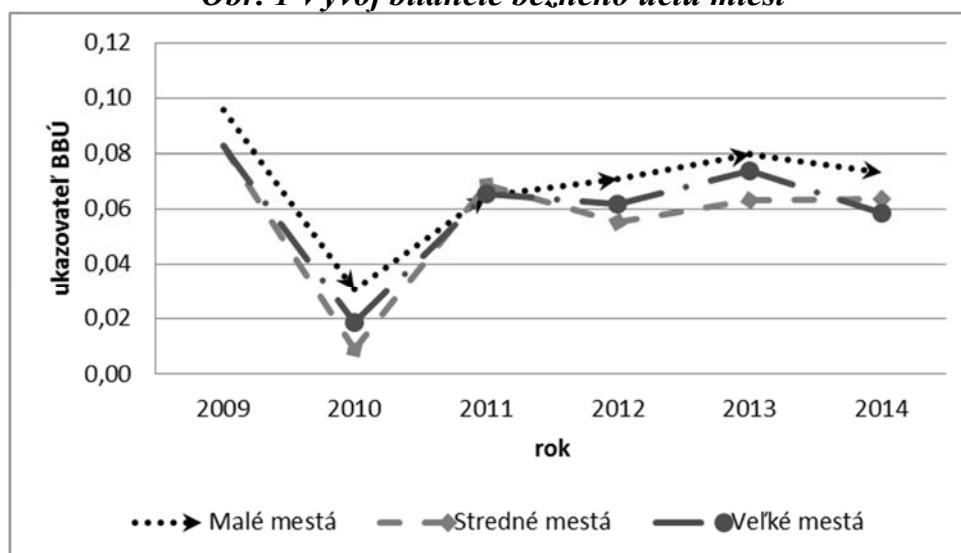
Mestá od roku 2010 hospodárili prebytkovo v bežnom rozpočte, a teda mohli si vytvárať zdroje napr. v rezervnom fonde alebo na inom účte pre investovanie. Prebytok je do 10% čo zodpovedá približne tvorbe rezervného fondu (Zákon NRSR č.583, 2004). Obr. 1 dokumentuje, že mestá vedia pomerne stabilne zabezpečiť bežný chod samosprávy a s najväčším prebytkom počas sledovaného obdobia na bežnom účte hospodárili malé mestá. Extrémne hodnoty dosiahli: Leopoldov (malé mesto) hospodárilo s najväčším prebytkom v bežnom rozpočte – s priemernou hodnotou ukazovateľa tohto + 0,25. Najvyšší schodok na bežnom účte vytváral Trebišov (stredné mesto) s hodnotou ukazovateľa -0,02.

Obr.2 Vývoj bilancie kapitálového účtu miest
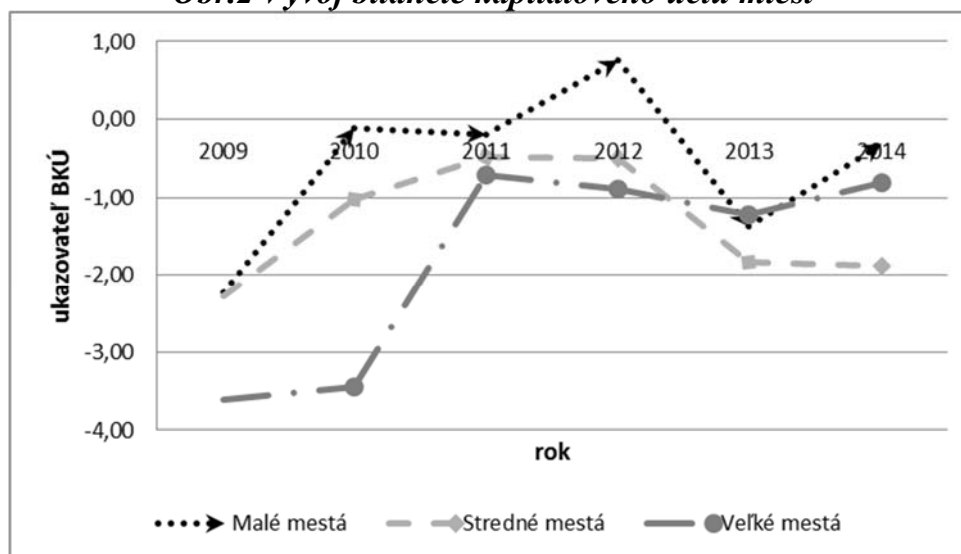
V porovnaní bilancií kapitálových účtov možno konštatovať, že vývoj je nerovnomernejší a určitú stabilitu od roku 2011 dokumentuje vývoj bilancie kapitálového účtu veľkých miest (obr. 2). U všetkých miest ide o deficitné hospodárenie na kapitálovom účte a najvýraznejšie je u veľkých miest, čo korešponduje s dlhovou službou, ktorá je najvyššia v roku 2011 (obr. 4). Najvyrovnanejší priebeh mal vývoj

kapitálového účtu u stredných miest, no najvyššie podiely vytvárali malé mestá. Najvyšší kapitálový schodok dosiahli Rajecké Teplice (malé mesto) -122,31 a najmenší kapitálový schodok mala Skalica (malé mesto) -0,04.

Obr. 3 Vývoj zadlženosti miest
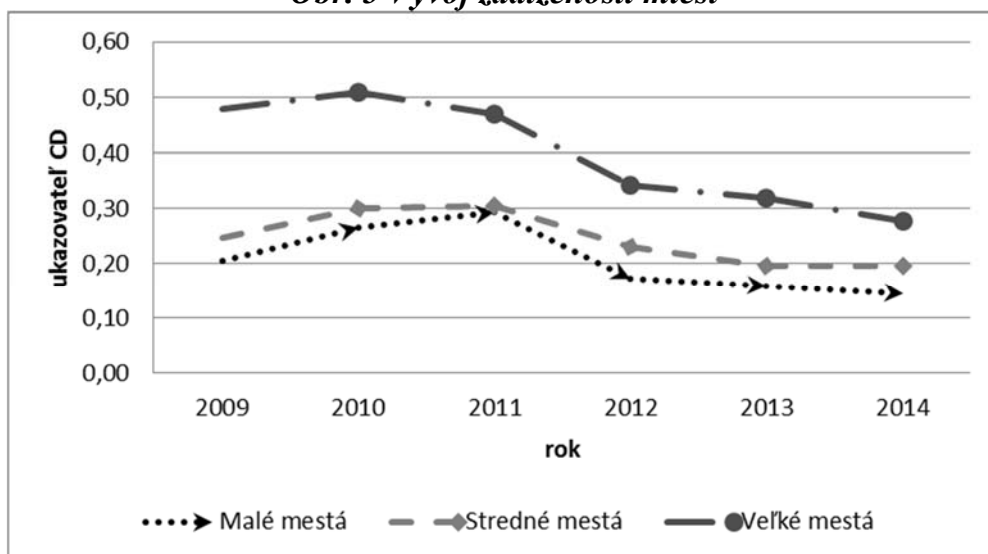
Z vývoja zadlženosti vyplýva (Obr. 3), že veľké mestá sú najzadlženejšie. To predstavuje obmedzenie pre možné ďalšie čerpanie návratných zdrojov financovania na plnenie svojich úloh vrátane prostriedkov na rozvoj (Žárska, 2015). Výšku zadlženosti treba vnímať v kontexte účelnosti jednotlivých úverov a jej veľkosť relativizovať vo vzťahu k veľkosti rozpočtu mesta a hlavne schopnosti uhrádzania dlhu. Obr. 4 dokumentuje u všetkých troch skupín miest výšku dlhovej služby pod 15%. Najviac zadlžené sú mestá nad 50 000 obyvateľov. Najzadlženejším mestom v skúmanom období bola Žilina (veľké mesto) s hodnotou 0,86 a najnižšiu zadlženosť mal Tvrdošín (malé mesto) s hodnotou 0,01.

Obr. 4 Vývoj dlhovej služby miest
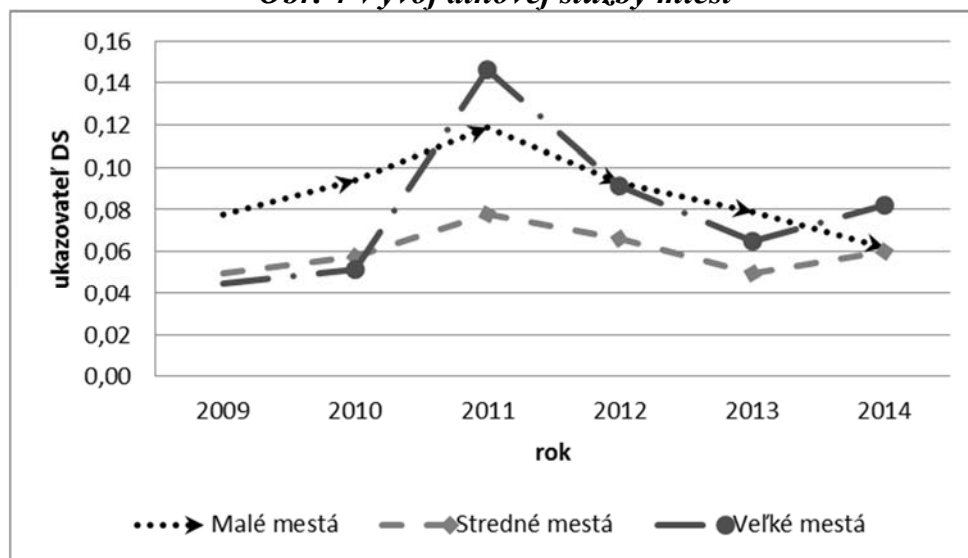
Výdavky na obsluhu svojich dlhov mali mestá porovnateľné. Významný je rok 2011 – mestá svoj chod financovali z kapitálového rozpočtu t.j. brali úvery na zabezpečenie bežných výdavkov. Je to reakcia na krízový vývoj, ktorý sa prejavil výrazným znížením výnosu podielovej dane z príjmu fyzických osôb, ktorá je najvyšším príjmom miest. Jej prepad v roku 2010 spôsobil prijímanie úverov aj do bežných výdavkov (Žárska, 2013). V sledovanom období mesto Svätý Jur (malé mesto) nemalo žiadne výdavky na dlhovú službu a najvyššie výdavky malo mesto Veľký Šariš (malé mesto) s hodnotou 0,38 – čiže jeho dlhová služba predstavovala 38 % bežných výdavkov.

Obr. 5 Vývoj okamžitej likvidity miest
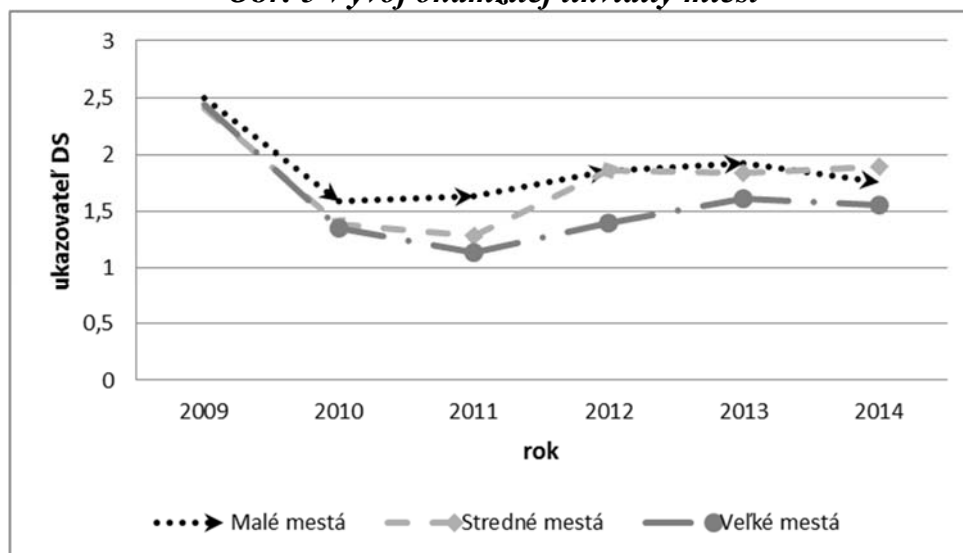
Z vývoja okamžitej likvidity vidieť (obr. 5), že mestá majú na svojich finančných účtoch dostatok financií na úhradu krátkodobých záväzkov (krátkodobých pôžičiek, úverov). Jednotlivé kategórie miest vykazujú porovnateľnú úroveň v úhrade krátkodobých záväzkov prostredníctvom financií, ktorými disponujú na finančných účtoch. Vývoj prezentuje výrazný vplyv krízy na mestá, ktoré vyčerpali svoje zdroje uložené na účtoch vrátane rezerv – pokles likvidity v rokoch 2010 a 2011. Spomedzi miest dosiahlo v sledovanom období najpriaznivejšie hodnoty ukazovateľa mesto Svätý Jur s priemernou hodnotou 16,15. Najnižšiu priemernú hodnotu zaznamenala Handlová (0,06) s kategórie malých miest.

Obr. 6 Vývoj čistého majetku miest
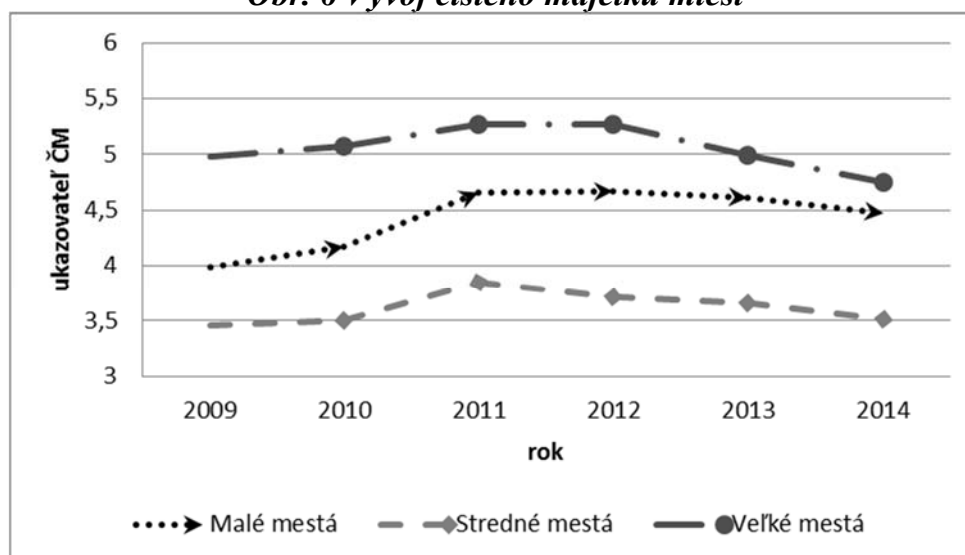
Zaujímavý je vývoj čistého majetku jednotlivých kategórií miest (obr. 6), kde najväčšími majetkami disponujú veľké mestá, potom malé mestá a najmenší čistý majetok majú stredné mestá. Tu sa tiež mohla prejaviť kríza tým, že mestá vyčerpali svoje zdroje uložené na finančných účtoch vrátane rezerv. V sledovanom období má najvyššiu hodnotu Banská Štiavnica (malé mesto) – 8,93 a najnižšiu priemernú hodnotu dosiahla Čierna nad Tisou (malé mesto) s hodnotou 1,04.

4 Diskusia

Hodnoty finančnej kapacity v sledovanom šesťročnom časovom rade dokumentujú výrazne najvyrovnanejší priebeh ukazovateľov u malých miest (do 10 tisíc obyvateľov). Vývoj kapitálového účtu a zadlženosti dokumentuje, že najlepšie hodnoty dosahovali malé mestá, čo môže byť prejavom stratégie opatrného zadlžovania sa a preferencie vytvárať zdroje pre financovanie zvyšovaním kapitálových príjmov. Je však otázkou, či za daným stavom nie je predaj majetku. Vývoj čistého majetku malých miest vykazuje len mierny nárast v rokoch 2009 a 2010 a v ďalších rokoch stabilitu (obr. 6), čo znamená, že pokiaľ malé mestá aj predávali svoj majetok, dokázali ho zhodnocovať investičnou činnosťou. Táto veľkostná kategória miest dosahovala najlepšie hodnoty financovania z vlastných príjmov pri dostatočnej kapacite nevyužitých potenciálnych zdrojov pre prijatie úverov, to však mohla znižovať celková hodnota objemu majetku ako záruka úverov a veľkosť (nízky objem) rozpočtu. Malé mestá spomedzi všetkých skúmaných miest dosahujú pri viacerých ukazovateľoch aj najväčšie extrémy hodnôt (bilancia kapitálových účtov, dlhová služba, okamžitá likvidita a čistý majetok).

Stredné mestá prezentujú najnižšie hodnoty dlhovej služby, ale aj hodnoty čistého majetku a bilancie bežného účtu, pričom ich zadlženosť zostáva v úrovni 20 až 30%. V tejto kategórií miest (od 20 do 50 tisíc obyvateľov) sa prejavuje určitá stabilita v zadlženosti, čo korešponduje, resp. je odrazom zápornej bilancie kapitálového účtu počas celého sledovaného obdobia s rastom po roku 2012 a najnižšou dlhovou službou. To môže byť dôsledkom minulého vývoja a prenosu zadlženosti aj dlhovej služby z minulých rokov, pretože tvorba čistého majetku je najnižšia oproti dvom ďalším skupinám miest.

Veľké mestá sú najzadlženejšie, čo predstavuje obmedzenie pre prijímanie návratných zdrojov financovania, ktoré by mohli použiť na investovanie do rozvoja, avšak hospodária vyrovnane (bilancie bežného účtu a kapitálového účtu). Generujú najväčšie objemy kapitálových výdavkov do rozvoja, s najvyššími hodnotami čistého majetku. Ich dlhová služba je pod 15%, čo nemusí predstavovať významnú zaťaženosť v schopnosti splácania dlhov a súčasne dokážu generovať dostatok prostriedkov na svoj rozvoj. Výsledky však treba vnímať v kontexte štruktúry a dĺžke splatnosti úverov.

Mestá financujú svoj rozvoj aj dlhovým financovaním. Prvé dva roky analýzy (2009 a 2010) zadlženosť miest rástla, no od roku 2011 postupne klesá vo všetkých troch veľkostných skupinách. Možno hypoteticky konštatovať, že finančná kríza bola medzníkom, kde mestá dokončovali financovanie investičných aktivít predchádzajúceho obdobia pred krízou, no ďalšie financovanie prijímaním úverov tlmili. Uvedené výsledky neumožňujú jednoznačne odpovedať na prvú výskumnú otázku, lebo v sledovanom časovom období mestá v prvých dvoch rokoch zvýšili svoju zadlženosť, no po kulminácii finančnej krízy ju postupne znižovali. Z pohľadu posledných štyroch uvedených rokov svoju zadlženosť znížili, čím pre rozvoj využívali iné zdroje, resp. znižovali kapitálové výdavky, čo dokumentuje vývoj bilancie kapitálového účtu .

Veľké mestá generujú najvyššie objemy kapitálových výdavkov a vykazujú najvyššie objemy čistého majetku, no financovanie sa uskutočňuje na báze zadlžovania, ktoré však postupne klesá. Odpoveďou na druhú výskumnú otázku sú teda veľké mestá, ktoré sú schopné vytvárať najväčšie objemy finančných prostriedkov pre rozvoj. Pre hlbšie overenie tohto konštatovania by bolo potrebné analyzovať dlhší časový rad, no údaje ďalších (predchádzajúcich) rokov pre danú štruktúru ukazovateľov neboli k dispozícii.

Záver

Hodnotenie účinnosti politík samosprávy na ochranu a zlepšenie finančnej situácie pre zabezpečenie svojho udržateľného rozvoja je možné aj na základe vývoja finančnej kapacity. Analýza relevantných ukazovateľov umožňuje identifikovať problémy, analyzovať príčiny a včas urobiť predbežné kroky, ktoré budú prínosom pre lepšie plánovanie a tvorbu finančných prostriedkov a súčasne budú reagovať aj na zmeny v sociálnych, ekonomických a demografických procesoch na svojom území. Uvedená analýza predstavuje jeden z prístupov na hodnotenie finančnej situácie miest v Slovenskej republike vo vzťahu k schopnosti financovania svojho rozvoja. Analýza nezohľadňovala žiadne miestne špecifiká, ktoré mohli ovplyvniť ich finančnú kapacitu. Zhodnotenie miestnych špecifík, resp. meranie signifikantných faktorov finančnej kapacity je priestorom pre ďalšie skúmanie s ambíciou formulovania vhodnej finančnej politiky samosprávy pre dosahovanie (generovanie) udržateľného rozvoja. Daná problematika má aj svoj územný rozmer – hodnotenie kapacity financovania miest z hľadiska ich príslušnosti k vyššiemu územnému celku teda, v ktorom z nich vytvárajú mestá najväčšie objemy prostriedkov pre svoj rozvoj a aké to má implikácie na úroveň vyššieho územného celku.

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