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ON THE CONCEPTUAL MODEL OF OIL AND GAS BUSINESS TRANSFORMATION IN THE TRANSITIONAL CONDITIONS TO THE INDUSTRY 4.0

Tatyana V. Alexandrova, Vladimir G. Prudsky

Abstract: Digital transformation of business centers in the transition period to the Industry 4.0 is becoming a key competitiveness growth factor for Russian oil and gas factories. It is characterized by a wide range of potential effects, which often do not show themselves fully in reality due to dominant fragmentary approach to the introduction of the Industry 4.0 innovation technologies; as well as the fact that companies’ managers do not have an integral view on the business digital transformation. The aim of the research consists in developing a conceptual model of oil and gas business digital transformation, allowing to make more reasonable managerial decisions on the implementation of digital technologies at enterprises. The research used the method of information statistical analysis about the state of the oil and gas industry and the methodology of conceptual approach to ensuring the transition of these companies to the Industry 4.0. The authors made the conclusion that the developed conceptual model improves the coordination and planning of works implementing digital transformation of oil and gas business, defines strategic priorities of the company’s digital development, promotes the development of corporate knowledge about business processes digitalization and formation of positive social and economic effect.

Keywords: Oil and Gas Business, Digital Transformation, Conceptual Model, Industry 4.0 Technologies, Potential Effects.

JEL Classification: M15, L71, O32

Introduction

The new digital technologies dissemination in the conditions of implementing the Industry 4.0 principles leads to radical changes in business process in all economic sectors. Nowadays the development of technological infrastructure and big data use have led not only to the provision of mass access to the Internet, but also integrated a wide range of digital services, products and systems into one cyber physical system (Cagnin et al., 2013; Jeschke et al., 2017).

Digital business transformation in traditional sectors, including the oil and gas one, is the key direction of Russian economy digitalization, which successful implementation can significantly increase the country’s economic role in global digital processes. To speed up the transition of traditional economic sectors to modern digital technologies and through digital processes one needs to develop a systematic policy in this sphere, taking into account specific features of separate branches digitalization. A united conceptual approach is also required to implement digital transformation in any given sector. Digital transformation needs a profound understanding of its priorities, opportunities and risk for a certain business; the problems it solves and the ways of achieving that (Rogers, 2017).
1 Statement of a problem

Today Russia does not have an official document reflecting the business digital transformation features in key economic sectors. The governmental program «The Russian Federation digital economy» (Legislation, 2017), accepted in 2017 and functioning to 2024, has a general character. It does not provide detailed plans on digitalizing oil and gas sector. «Russian energy strategy to 2030» (Ministry, 2015) gives a long term forecast of oil and gas industry development. But it does not show how digital technologies influence on achieving the forecast indicators. The measures, providing the energy strategy implementation, include only general directions of an increase in oil and gas business efficiency, such as «energy sector modernization» and «innovative technologies acquisition».

The absence of ISO international standards regulating the implementation of innovative digital technologies makes the situation, connected to the lack of a systematic conceptual approach to macroeconomic digital transformation of oil and gas industry, more complicated. So far the project of ISO standard «Information technology. Compatibility requirements and model for devices within IIoT systems» has been developed. Three more ISO standards «Artificial Intelligence» are also being worked out (Comnews, 2019). The new standards are suggested to come into force in 2020. Now companies mostly focus their digital solutions on current ISO standards of 9000-9004 series «Quality management system», 14000 series «Ecological management», and 21500 series «Project management». The digital business transformation is seen in this case not as an independent development strategy, but as a special process, focused on achieving the aims of the sphere regulated by a current ISO standard.

In the scientific aspect, the research prevail, which deal with studying separate areas of digital transformation. Especially, there are many works, describing the issues of digital fields use (Berezina, 2015; Dmitriev et al, 2016; Tcharo 2018), and summarizing the best practices of enterprises’ digitalization (Tcharo et al, 2018). There are few publications where authors approach to digital processes as complex ones, connected to green economy demands (Perle, 2018), current ISO standards (Levchenko, 2018), and company’s strategic development (Bauer et al, 2018). At the moment there are no publications, containing a developed model of business digital transformation in relation to specific economic conditions of oil and gas business in Russia.

The literature review showed that currently there is no unified notion of «Digital business transformation». Different authors interpret it differently trying to link it to the Industry 4.0 principles (Berman, 2012; Garifullin, 2018; Gray & Rumpe, 2017; Mat et al, 2015; Nylén & Holmström, 2015). Besides, international organizations, focused on doing research in the digital economy sphere, greatly contribute to studying this issue (World Bank, 2016; UNO, 2018; OECD, 2017; EEC, 2017). In our opinion, the definition, given by OECD, suits oil and gas business most of all: «Digital business transformation is a process integrating digital technologies in all aspects of business activity, and requiring the transformation of business operation models, managerial paradigms, economic relations and social practices» (OECD, 2017).

As far as Russian digital business transformation practice is concerned, in most cases enterprises introduce only separate digital projects, without developing the
digitalization strategy for all business lines. At the same time, the leading oil companies have generated some experience in the sphere of complex digital business transformation. For example, the oil company «Transneft» actively introduces digital solutions on pipelines. The oil company «Gazprom Neft» started the first Russian open digital platform EvOil and began the construction of the first digital refinery. The «LUKOIL» group of companies is implementing the technologies of integrated production modeling and planning. The companies «Gazprom Neft», «Tatneft», «Rosneft», and «LUKOIL» are the leaders in the number of digital oil fields. But even the leaders need to bolster their efforts to achieve a better integration of digital solutions with a general strategy of the company’s development.

The given problems are extremely actual for Russian oil and gas companies, whose share in the country’s GDP reaches about 70%, in the export structure about 50%, and the in federal budget formation up to 40% (VYGON consulting, 2018). Their scientifically based solution could speed up the digital transformation process of the oil and gas industry, as well as Russian national economy in general. So far Russia has taken the 42nd place out of 63 countries in the IMD digital competitiveness rating (VYGON consulting, 2018).

The above listed issues determine the aim and tasks of the research. The research purpose is to develop a conceptual model of Russian oil and gas sector transformation in the transition to the Industry 4.0. To achieve the aim, the following tasks had to be solved:

- To formulate strategic challengers for Russian oil and gas industry, which predetermine the necessity of oil and gas business digital transformation;
- To structure the conceptual model of oil and gas business digital transformation in the transitional conditions to the Industry 4.0.
- To determine the conditions of the developed model’s successful implementation into managerial practice as well as its influence on oil and gas company’s activity indicators.

2 Methods

The research used the methodology of conceptual approach to stating and solving a scientific problem, as well as the statistics analysis method of the information on oil and gas companies’ activity.

Table 1 (Tab. 1) presents the statistic indicators, characterizing the efficiency of Russian oil and gas companies development. The sample includes data from 2013, when the first information collection started to make an annual public rating of Russian oil and gas companies’ ecological responsibility. Before 2013, Russian official statistics did not single out oil and gas industry as a separate one in extracting industries of the economy; and these companies did not provide nonfinancial accounts on their ecological activity. The data demonstrate a number of negative trends in their activity, such as low growth rates of labour efficiency indicators; the increase in fixed assets depreciation; the decrease in returns on assets accompanied by the rise in capital-labour ratio; a low share of highly technological working places.
Tab. 1: Russian oil and gas industry efficiency development indicators

<table>
<thead>
<tr>
<th>Indicators</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Oil conversion ratio, %</td>
<td>71,6</td>
<td>72,4</td>
<td>74,3</td>
<td>79,0</td>
<td>81,0</td>
</tr>
<tr>
<td>2. Labour productivity index</td>
<td>100,8</td>
<td>102,8</td>
<td>98,3</td>
<td>100,3</td>
<td>100,4</td>
</tr>
<tr>
<td>3. Capital-labour ratio change index</td>
<td>103,7</td>
<td>106,6</td>
<td>106,4</td>
<td>104,7</td>
<td>104,5</td>
</tr>
<tr>
<td>4. Returns on assets change index</td>
<td>91,1</td>
<td>96,6</td>
<td>94,9</td>
<td>94,5</td>
<td>93,45</td>
</tr>
<tr>
<td>5. Fixed assets depreciation, %</td>
<td>53,2</td>
<td>55,8</td>
<td>55,4</td>
<td>57,5</td>
<td>57,7</td>
</tr>
<tr>
<td>6. A share of highly technological working places, %</td>
<td>5,0</td>
<td>4,7</td>
<td>5,1</td>
<td>5,3</td>
<td>5,8</td>
</tr>
<tr>
<td>7. Specific emissions of pollutants into the atmosphere kg/ tfoe</td>
<td>3,82</td>
<td>3,16</td>
<td>2,09</td>
<td>1,92</td>
<td>2,48</td>
</tr>
<tr>
<td>8. Specific gross greenhouse emissions kg/ tfoe</td>
<td>No data</td>
<td>No data</td>
<td>41,18</td>
<td>71,81</td>
<td>87,68</td>
</tr>
<tr>
<td>9. The ratio of polluted land area at the end of the year to the beginning of the year ha/ ha</td>
<td>0,39</td>
<td>0,18</td>
<td>0,17</td>
<td>0,19</td>
<td>0,31</td>
</tr>
<tr>
<td>10. The level of oil associated gas utilization, %</td>
<td>78,22</td>
<td>84,88</td>
<td>85,90</td>
<td>88,21</td>
<td>86,7</td>
</tr>
</tbody>
</table>

*Note: accountability on greenhouse gases emission was introduced only in 2015

Source: made based on data (FSSS, 2018; WWF.2018)

Changes that are even more negative can be seen in the dynamics of oil and gas companies’ impact on the environment. For example, for the period from 2015 to 2017 specific emissions of pollutants into the atmosphere increased by 18%; specific gross greenhouse emissions rose more than twice; the land pollution index grew by 1.8 times. This situation can be partly explained by the introduction of sectoral sanctions in 2014 – 2015, as the result, oil and gas industry forfeited the benefits of buying foreign innovative technologies in the required quantity. The decrease in environmental pollution level should be considered one of the priorities of Russian oil and gas sector digital transformation.

Tab. 2: The profitability indicators of the oil and gas industry leaders for 2013-2017

<table>
<thead>
<tr>
<th>Indicators</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales profitability, %</td>
<td>82,987</td>
<td>83,540</td>
<td>82,165</td>
<td>85,548</td>
<td>70,605</td>
</tr>
<tr>
<td>LUKOIL</td>
<td>82,987</td>
<td>83,540</td>
<td>82,165</td>
<td>85,548</td>
<td>70,605</td>
</tr>
<tr>
<td>Rosneft</td>
<td>5,880</td>
<td>3,626</td>
<td>3,049</td>
<td>9,782</td>
<td>7,357</td>
</tr>
<tr>
<td>Gazprom</td>
<td>24,459</td>
<td>23,061</td>
<td>18,733</td>
<td>8,455</td>
<td>8,706</td>
</tr>
<tr>
<td>Assets profitability, %</td>
<td>16,828</td>
<td>24,371</td>
<td>16,000</td>
<td>9,197</td>
<td>9,197</td>
</tr>
<tr>
<td>LUKOIL</td>
<td>16,828</td>
<td>24,371</td>
<td>16,000</td>
<td>9,197</td>
<td>9,197</td>
</tr>
<tr>
<td>Rosneft</td>
<td>5,628</td>
<td>7,855</td>
<td>2,778</td>
<td>1,023</td>
<td>1,321</td>
</tr>
<tr>
<td>Gazprom</td>
<td>6,017</td>
<td>1,636</td>
<td>3,199</td>
<td>3,066</td>
<td>0,710</td>
</tr>
<tr>
<td>The average, %</td>
<td>37,77</td>
<td>36,742</td>
<td>34,649</td>
<td>34,595</td>
<td>28,889</td>
</tr>
<tr>
<td>Sales profitability</td>
<td>37,77</td>
<td>36,742</td>
<td>34,649</td>
<td>34,595</td>
<td>28,889</td>
</tr>
<tr>
<td>Assets profitability</td>
<td>9,491</td>
<td>11,287</td>
<td>7,326</td>
<td>4,429</td>
<td>3,743</td>
</tr>
</tbody>
</table>

Source: made based on data (LUKOIL, 2018; Rosneft, 2018; Gazprom, 2018)

The problem of decreasing operating costs has become actual for oil and gas companies in the conditions of world oil price decrease. The data in the table 2 (Tab.2) allow to conclude that the profitability of sales and assets of Russian oil and gas companies is constantly falling. One more problem of Russian oil and gas
industry development consists in the growth of costs for current land wellsites repair and reconstruction, as well as high capital costs for offshore oil field development, mainly in Arctic.

**Fig. 1: Strategic challenges for Russian oil and gas sector**

The cost of offshore works can exceed hundreds millions dollars. The question inevitably arises about the purposefulness of investments in such expensive projects, because such «expensive oil» cannot compete with traditional cheap oil (VYGON consulting, 2018). The use of digital technologies can reduce operating costs; extend the brown fields’ lifecycle; reduce risks and cost of offshore drilling considerably; increase the depth of oil extraction of the volume of oil production.

The strategic challenges for Russian oil and gas sector are presented in the figure 1 (Fig. 1).

The given data prove the necessety of systematic modernization for Russian oil and gas sector based on new Industry 4.0 digital technologies, which allow to solve business development problems quicker, more economical, with less risks and better results. It is forecasted that due to the implementation of the Industry 4.0 technologies the potential oil deposit extraction will reach 6.8 bln tons to 2035; the oil production volume will reach 607 mln tons; the depth of oil extraction will increase to 90%; the operating costs will decrease by 2.2 tln. roubles; the production cost of oil and gas extraction and refining will decrease by 15% (VYGON consulting, 2018). This will allow Russian oil and gas companies compensate for fall in income due to the constant decrease in world oil prices.
3 Problem solving

The development process of Russian oil and gas industry is regulated by different legislative documents, which lack the concept of the sector’s digital transformation. An objective reason for that constitutes in the complexity and variety of business processes in oil and gas industry, which leads to a more labour intensive process to develop a strategic vision of digital modernization of oil and gas companies’ activity.

The authors believe, that the specific features determining the necessity of conceptual approach to oil and gas business digital transformation include the following ones:

- The technological process is complex and resource intensive, which functions in a close connection with the development of energy saving programs, the development of energy efficiency, the use of low waste and wasteless as well as resource efficient technologies.

- The oil and gas business is based on fragmented combination of different spheres. That is why different digital directions of the 4.0 Industry are often united here in one technological solution. For example, a digital wellsite includes the elements of the commercial Internet of things, big data, robotics and others.

- Ecological requirements to the oil and gas business activities in the implementation of green economy concept (CSD, 2018) predetermine the priority focus of digital transformation process in oil and gas business on implementing tasks that are connected to providing industrial security and environmental protection.

- The leading oil and gas companies aim at achieving the leadership position in the sphere of oil and gas extraction and refining. They include such oil business giants as Petroleum, Conoco Philips, Exxon Mobil, Royal Dutch Shell, Total,Gazpromneft, LUKOIL and other big corporations (Perfiljev & Solomatov, 2016). Moreover, exporting companies get involved into the processes of forming intercountries’ digital space (EU, EAEU, BRICS and others), and participate in global digital processes.

- The biggest oil and gas companies are characterized by the trend to diversification of their activities. One should also note a quite complex product supply chain and a large number of business partners from other industries. In these conditions, the intensive development of digital processes in oil and gas sector contributes to a more efficient cross-sector digital transformation.

The figure 2 (Fig. 2) demonstrates the digital environment of Russian oil and gas sector, modeled taking into account all given above specific functioning features of oil and gas companies.
The methodological approach, developed by the research group of the World Bank and Eurasian Economic Commission (EEC, 2017) constituted the basis to form a conceptual model of oil and gas business digital transformation. This methodology recommends a complex approach to digitalization process, taking into account possibilities and risks of the Industry 4.0 technologies, qualitative and quantitative aspects of digitalization, measures to provide business digital transformation. In the research process it was specified relating to peculiarities of oil and gas companies development.

The authors’ model is presented in figure 3 (Fig. 3). It includes 6 blocks, each having its own structure and performing a certain function:

- **Block 1 «Priority purposes»*. It performs the goal setting functions.
- **Block 2 «Target indicators»*. It gives details of priority purposes in the form of quantity indicators, which can be measured and estimated.
- **Block 3 «Digital transformation directions»*. It reflects the key trends of using digital technologies in oil and gas business.
- **Block 4 «Possible effects»*. It reflects potential benefits from implementing digital transformation in oil and gas business.
- **Block 5 «Possible risks»*. It informs about potential risks, connected to ignoring digital transformation of business.
- **Block 6 «Implementation mechanisms»*. It describes the necessary measures to regulate the digital transformation process in oil and gas business.
### Fig. 3 The conceptual model of Russian oil and gas business digital transformation

| Priority purposes | • A sustainable development of oil and gas business in Industry 4.0  
|                   | • Digital environment formation in oil and gas sector  
|                   | • Environmental protection and restoration |
| Target indicators | • Increase in oil extraction coefficient  
|                   | • Decrease in operating and capital costs  
|                   | • Decrease in pollutants emission  
|                   | • Increase in highly technological work places  
|                   | • Increase in the energy efficiency of production |

<table>
<thead>
<tr>
<th>Directions</th>
<th>Digital twins creation</th>
<th>Labour automation</th>
<th>Providing the staff with digital devices</th>
<th>Creation of digital ecosystem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible effects</td>
<td>Increase in efficiency of oil and gas extraction and refining</td>
<td>Optimization of the number of staff, development of digital labour</td>
<td>Improvement of working conditions, the increase in production safety rate</td>
<td>Increase in transactions speed, improvement of collaboration with third parties</td>
</tr>
</tbody>
</table>
| Possible risks | • Missed profit risk  
|               | • Risk of digital technologies late implementation  
|               | • Risk of decrease in competitive ability  
|               | • Risk of increase in digital space control from leading market players  
|               | • The risk of resistance to digital innovations |
| Implementatio n mechanisms | • Support of digital initiatives and pilot projects  
|                           | • Working out of new generation standards  
|                           | • Stimulating investments in digital technologies  
|                           | • Creating sectorial centers of competence and techno parks  
|                           | • Promoting best practices of digital business transformation |

*Source: made by the authors*
The main research results can be used by oil and gas companies to organize the digital business transformation process; by scientific-research and expert organizations to work out digital programs and projects; by sectorial ministries to work out strategies of industry development; and by governmental bodies to develop state innovation policy for both country and regions.

4 Discussion

In 2018 the conceptual model of digital oil and gas business transformation, developed by the authors, was tested in the management practice of OOO «LUKOIL Perm» in the part concerning the measures of planning digital technologies implementation in the spheres of industrial security and environmental protection. The company conducts these activities based on ISO standard 14001. The model approbation results are presented in Table 3 (Tab. 3).

The presence of general concept of oil and gas business transformation in the conditions of 14001 ISO standard allowed OOO «LUKOIL Perm» to implement a complex approach to developing and introducing digital solutions for providing industrial security and environmental protection. The actions taken have led to positive effects, for example, in 2018 OOO «LUKOIL Perm» decreased the water intake from surface watercourses by 7%, atmosphere pollution dropped by 14%, the number of new wellsites rose by 30%, operating costs fell by 10%, and energy consumption by 15%.

Tab. 3: The approbation results of oil and gas business digital transformation model at OOO «LUKOIL Perm»

<table>
<thead>
<tr>
<th>Conditions necessary for model implementation</th>
<th>Measures taken by OOO «LUKOIL Perm»</th>
<th>Measures efficiency prof*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation on digital standards demand regulating the development of «smart» production, when they are absent, the choice of business priorities, which aims will make a basis for model functioning.</td>
<td>The model is focused on maintaining a high level of production security and environmental protection in compliance with 14001 ISO standard.</td>
<td>Economic efficiency:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Decrease of operating costs by 10%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Drop of energy consumption by 15%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Increase in the number of new wellsites by 30%</td>
</tr>
<tr>
<td>Top priority introduction of Industry 4.0 innovation technologies into production business processes, which provide a decisive contribution into forming positive effects of digitalization.</td>
<td>Introduction and gradual development of three intellectual oil fields. A preparatory work of mastering digital technologies of off-shore oil drilling.</td>
<td>Ecological efficiency:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Decrease of fresh water intake from watercourses by 7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fall in atmosphere pollution by 14%</td>
</tr>
<tr>
<td>Use of automated management methods in making strategic and tactical decisions.</td>
<td>Using methods of preventive diagnosis of wellsites states; monitoring of productivity loses; oil extraction indicators analysis in real time.</td>
<td>Social efficiency:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Development of the workers’ digital thinking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Increasing staff’s adaptability to digital technologies introduction</td>
</tr>
<tr>
<td>The use of model in the company’s strategic planning.</td>
<td>The model is used at the initial stage of strategic planning as a set of key guidelines for developing programs, plans and projects.</td>
<td></td>
</tr>
<tr>
<td>Creating managerial departments to coordinate different business processes.</td>
<td>Three Centers of integrated operations are created within the company’s management.</td>
<td>Public efficiency: The visit of «Ernst &amp; Young» experts to study the digitalization experience at OOO «LUKOIL Perm».</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>The development of staff’s digital competencies, necessary for comprehension and implementation of the model; providing the implementation of developed measures.</td>
<td>Working out further training programs in the digital sphere; introducing personal responsibility of workers for fulfillment of the company’s digitalization plan.</td>
<td></td>
</tr>
</tbody>
</table>

*Note: the indicators are calculated as the ratio of 2018 data to 2017 ones.

The conducted research allows to make the following conclusions:

- The worked out conceptual model contributes to the development of corporate knowledge about managing digital processes and technologies. It forms a holistic vision of oil and gas business digital transformation perspectives in the transition to Industry 4.0, increases the level of coordination between departments and services of managerial apparatus in digitalization processes;

- Methodological approach, used at model working out, develops the methodology of making the digitalization concept of the World Bank and Eurasian Economic Commission as it takes into account industrial peculiarities of business digital transformation using the example of Russian oil and gas companies;

- The developed conceptual model of oil and gas business digital transformation satisfies managerial demands in justification the choice of companies’ strategic development options. Compliance with parameters, embedded in separate blocks of the model, can serve as a datum mark for including corporate measures and projects in strategic programs and development plans of oil and gas companies;

- To implement the developed model into managerial practice it is necessary to comply with conditions, which guarantee a successful integration of an innovation into oil and gas companies’ activities. Positive effects are noticed as the result of model approbation at OOO «LUKOIL Perm». They prove a positive influence of this approach on the oil and gas business digital transformation process and an increase in the company’s efficiency;

However, some difficulties were observed alongside with the positive effects from implementing this model. They were connected to the fact, that the digital business transformation procedure has become more complex, varied and labour intensive. Managerial and production staff needed a higher qualification level and readiness to work in new conditions. A specialized training in digital technologies was organized at OOO «LUKOIL Perm» to solve the problem of knowledge deficiency and unstable performance discipline. The company also introduced personal responsibility of workers for compliance with the requirements of 14001 ISO standard and performance of plan actions connected to development and implementation of digital solutions in the sphere of industrial security and environmental protection.

Conclusions

- The conducted research allows to make the following conclusions:

  - The worked out conceptual model contributes to the development of corporate knowledge about managing digital processes and technologies. It forms a holistic vision of oil and gas business digital transformation perspectives in the transition to Industry 4.0, increases the level of coordination between departments and services of managerial apparatus in digitalization processes;

  - Methodological approach, used at model working out, develops the methodology of making the digitalization concept of the World Bank and Eurasian Economic Commission as it takes into account industrial peculiarities of business digital transformation using the example of Russian oil and gas companies;

  - The developed conceptual model of oil and gas business digital transformation satisfies managerial demands in justification the choice of companies’ strategic development options. Compliance with parameters, embedded in separate blocks of the model, can serve as a datum mark for including corporate measures and projects in strategic programs and development plans of oil and gas companies;

  - To implement the developed model into managerial practice it is necessary to comply with conditions, which guarantee a successful integration of an innovation into oil and gas companies’ activities. Positive effects are noticed as the result of model approbation at OOO «LUKOIL Perm». They prove a positive influence of this approach on the oil and gas business digital transformation process and an increase in the company’s efficiency;

Source: created by the authors
• The use of conceptual approach to business digital transformation does not only contributes to improving productive and managerial activity of an oil and gas company, but also creates problems, connected to using new knowledge and skills. Companies’ managers must quickly identify these problems and provide measures to develop staff’s competence and performance discipline.

The conducted research contributes to the theory of modern industry-based management. If this model is applied, it will allow to formalize the process of making managerial decisions in the sphere of business digital transformation; it will help to determine the features of digital technologies implementation for separate oil and gas companies more reasonably. The use of this model will also contribute to the growth of positive influence of oil and gas sector on achieving target indicators of the governmental program «The digital economy of the Russian Federation», which will provide a factor and a more successful transition of the country’s economy to the Industry 4.0.

The authors see further research direction in working out the adoption strategy of Russian oil and gas companies to the principles of the Industry 4.0.

Acknowledgement

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References


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BLACK FRIDAY SHOPPING IN HUNGARY

Kovács András, Sikos T. Tamás

Abstract: The central question of our study is to examine what features the Black Friday phenomenon has in Hungary, how it resembles to or differs from the international Black Friday trends. To answer this question we provide an overview of the main ideas on the topic discussed in international literature. Then with the help of answers of a questionnaire research from 2016 and one from 2017 we will highlight the most important similarities and differences. As we will see, in Hungary the buyers’ intent to participate is similar to other countries, but retailer behavior shows considerable differences compared to international examples. Descriptive methods, cross-tabulation, cluster analysis applied in our research.

Keywords: Black Friday, Retail, Customer Behavior

JEL Classification: M31

Introduction

By now, Black Friday has not only become the day of biggest turnover for retailers in the United States, but it is also the real start to the "Christmas shopping fever", a serious social event, a hedonistic feast of consumption for the U.S. consumer society as Bell and her colleagues point out (Bell et al., 2014).

Since due to its importance and size Black Friday is now far from having simply business or marketing significance, it also raises serious social, psychological, decision-making and security issues. In the international (mainly US and UK) literature, math-based decision theory study (Wu, Zitikis, 2017) and an analysis of security issues related to Black Friday can also be found (Smith, Raymen, 2015).

Obviously, most researches related to Black Friday focus mainly on the aspects of consumer behavior. Consumer/shopper behavior researches primarily focus on the question of purchase/non-purchase and purchasing motivations (Kwon, Brinthaupt, 2015) (Delcea, Ioanas, Paun, 2017), examine the relationship between Black Friday and its dynamically growing online counterpart, Cyber Monday (Swilley, Goldsmith, 2013), and reveal the buyers’ shop-preferences and shopping behavior (Simpson et al., 2011). In addition to customer and shopper behavioral researches, commercial logistic studies (McLeod et al., 2016) and social responsibility analyzes (Lennon et al., 2014) can be found in international literature.

We approach the well-known “Black Friday phenomenon” from a marketing point-of-view. After providing an international literature overview, we will highlight the special features and characteristics of Black Friday in Hungary. Relying on the results of online questionnaires, shopping behaviour (product and shop preferences, prices) and shopper-groups will be set up and described.

Our aim is to contribute to a better understanding of this important retail and marketing phenomenon by unveiling shopper behaviour, and describing and grouping different customers.
1 Statement of a problem

Hereinafter, we attempt to summarize all the relevant aspects of Black Friday, as it would be a rough simplification to examine Black Friday sales from a single specific marketing sub-perspective (Töröcsik, 2017) (Rekettye, 2003) (e.g. pricing, shopping behavior, or marketing communication aspect) (Tab. 1).

**Tab. 1. Black Friday’s marketing relevancies**

<table>
<thead>
<tr>
<th>Marketing sub-area concerned</th>
<th>Connection point to Black Friday</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shopper, consumer behavior</td>
<td>revealing and understanding shopper motivation</td>
<td>It can effectively contribute to reaching/retaining target groups</td>
</tr>
<tr>
<td>Marketing strategy - planning</td>
<td>Inserting Black Friday sales into company marketing strategy</td>
<td>Might influence the implementation of marketing strategy goals</td>
</tr>
<tr>
<td>Product portfolio management</td>
<td>inventory management, “swap outs”</td>
<td>contributes to creating optimal product portfolio</td>
</tr>
<tr>
<td>Pricing, pricing strategy</td>
<td>Discounts considering company, competitor, buyer points of view</td>
<td>It contributes to maximizing profit through its price tactics and price-strategic role</td>
</tr>
<tr>
<td>Marketing communications</td>
<td>Communicating Black Friday and company involvement</td>
<td>It supports the growth of Black Friday's reputation and the achievement of corporate sales goals</td>
</tr>
<tr>
<td>CSR – corporate social responsibility</td>
<td>hedonistic vs. conscious shopping</td>
<td>Responsible buyer-incentives to increase long-term loyalty</td>
</tr>
<tr>
<td>Distribution</td>
<td>appropriate handling of extremely large number of orders</td>
<td>Prerequisite for customer satisfaction (current stock information, on-time delivery)</td>
</tr>
</tbody>
</table>

Source: own edition

The most important lessons learned from Tab. 1 are that Black Friday sales (in optimal cases) are not just a communication campaign with intensive price promotions aimed at boosting short-term pre-Christmas turnover, but are also affecting the marketing strategies and activities of the company for long-term business success in a rather complex way (Józsa, 2014). In order for the Black Friday sales to achieve the desired favorable effect, it is very important to consider logistical, CSR, product management and strategic aspects besides communication and pricing tasks.

Our above review highlights that even a sales-promotion activity may have many additional marketing implications, so it is particularly important to explore and analyze these connecting points.

2 Methods

Since previous research in Hungary did not deal with the "Black Friday phenomenon", we consider it important to reveal the most important features of consumer and shopper behavior related to it.
In the next part of our study we analyze the results of the questionnaire research (carried out between November 25-27, 2016 and November 24-27, 2017) on the Black Friday phenomenon, with the aim of exploring the most important features of the Hungarian consumer behavior.

As outlined in Tab. 1, we have already highlighted that several marketing dimensions of the Black Friday phenomenon could be investigated. Naturally, all aspects of Black Friday cannot be investigated within a framework of a single research because the different marketing areas, the company (supply) and the buyer (demand) side can only be explored with different methodologies and tools.

In our research, from the areas enumerated in Tab. 1 we focus only on the most important features of shopper behavior related to Black Friday in Hungary, and we do not deal with other marketing areas, such as Black Friday's marketing strategy and its specific sub-areas.

Our aim is to reveal awareness connected to Black Friday, purchase/non-purchase relations and the key determinants of purchases, including spending, shop and product preferences, as well as opinions related to Black Friday.

We have chosen the online questionnaire method for the research, although several other methods are available today, as pointed out by Kemény, Simon 2015. The questionnaire seemed to be the most suitable method for conducting the research for two reasons: on the one hand, as Babbie points out, this method is capable of executing a large number of direct observations (Babbie, 2008). On the other hand, the aim of our research is to describe and analyze the opinions and behavioral characteristics of consumers on Black Friday, and to this the questionnaire method provides a good basis (Ghauri, Grønhaug, 2011). The questionnaire method was supported by the fact that in the international literature a similar approach was used to explore the Black Friday shopping habits (Tsiotsou, 2017). We preferred the method of online questionnaire (Google Forms) because this made it possible to reach a large number of potential respondents in a short time, since due to the nature of Black Friday (it takes place once a year), it is of utmost importance to reach customers and get the most accurate information. In the period 27-30 November 2016 a total of 272 respondents filled in our questionnaire and in November 2017 a total of 96 respondents provided answers. The results (after data cleansing and re-encoding) were analyzed using IBM SPSS Statistics 20 and Microsoft Excel 2017 with descriptive statistical methods. Descriptive statistical methods, cross-tabulation and cluster analysis (Ward-method) were applied.

In our research we aimed to answer the following research questions:

- What is the extent of awareness of Black Friday in international and in Hungarian dimension?
- How can Black Friday customers be characterized by the terms of spending, product and shop preference?
- What is Black Friday's satisfaction like among buyers and among non-buyers?
- How did the respondents' opinions change between 2016 and 2017, given the fact that the special features of the Hungarian Black Friday campaign have also changed considerably.
• What are the “Black Friday shopper groups” formed with statistical methods (cluster analysis)?

In the course of the research, single- and two-pole differential scales were used to ensure that online response is fast and smooth, whatever platform respondent (computer, tablet, smartphone) used. Hereinafter, after the presentation of the sample, we will deal with each research question in separate chapters.

In our research, from a methodological point of view, the biggest challenge was how to measure the awareness of the Black Friday phenomenon and the shoppers’ behavior in the relatively short duration (a few days) of the event. The advantage of online questionnaires is that they are very quickly "applicable" and a large number of potential respondents can be reached, but the problem is that the resulting sample is not representative. Generally, as it is in our case, among the respondents young urban residents with higher education, and above the average digital literacy are overrepresented. (Tab. 2).

**Tab. 2: Descriptives of the samples 2016 and 2017**

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex, percent</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>35,3</td>
<td>42,7</td>
</tr>
<tr>
<td>female</td>
<td>64,7</td>
<td>57,3</td>
</tr>
<tr>
<td><strong>Age, percent</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>under 20 years</td>
<td>9,9</td>
<td>0</td>
</tr>
<tr>
<td>21-30 years</td>
<td>41,5</td>
<td>33,3</td>
</tr>
<tr>
<td>31-40 years</td>
<td>21,7</td>
<td>30,2</td>
</tr>
<tr>
<td>41-50 years</td>
<td>14,7</td>
<td>13,5</td>
</tr>
<tr>
<td>51-60 years</td>
<td>7,7</td>
<td>7,4</td>
</tr>
<tr>
<td>over 60 years</td>
<td>4,4</td>
<td>15,6</td>
</tr>
<tr>
<td><strong>Highest school degree, percent</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary school</td>
<td>4,4</td>
<td>1,1</td>
</tr>
<tr>
<td>Vocational school</td>
<td>1,5</td>
<td>5,2</td>
</tr>
<tr>
<td>Secondary school</td>
<td>20,2</td>
<td>12,5</td>
</tr>
<tr>
<td>BSc, BA degree</td>
<td>33,1</td>
<td>30,2</td>
</tr>
<tr>
<td>MSc, MA degree</td>
<td>40,8</td>
<td>51,0</td>
</tr>
<tr>
<td><strong>Place of residence, percent</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>capital (Budapest)</td>
<td>33,2</td>
<td>38,5</td>
</tr>
<tr>
<td>county seats</td>
<td>30,6</td>
<td>22,9</td>
</tr>
<tr>
<td>other towns</td>
<td>23,8</td>
<td>24,0</td>
</tr>
<tr>
<td>villages</td>
<td>12,5</td>
<td>14,6</td>
</tr>
</tbody>
</table>

Source: own research

The demographic structure of the two examined samples represents the social groups that are important target groups for the Black Friday campaign: urban, highly educated, groups, relevant for advertising.

Although our sample does not represent all layers and groups of the Hungarian society, we aimed to reach people living in different parts of Hungary. Altogether we surveyed our responders in 83 different settlements and in all districts of the capital, Budapest.
3 Problem solving

In connection with the Black Friday phenomenon, we first investigated what sources the respondents use to obtain information. As Fig. 1 shows, Hungarian customers primarily use online sources to get informed. One possible reason for this is that – opposed to the international trends – Cyber Monday, specialized in online shopping, is not widespread in Hungary, so online retailers and companies using multi-channel distribution systems all focus on Black Friday. While in the US, Cyber Monday generates more revenue for e-tailers than Black Friday (Richter, 2015) (McGee, 2017), its role in Hungary – for the time being – is negligible.

**Fig. 1: Information sources of Black Friday, 2016**

It is also a special Hungarian phenomenon that the "official" day of Black Friday is not considered "binding" for commercial companies. This phenomenon was particularly strengthened in 2017 when, in addition to the "official" Black Friday Day of November 24, several major domestic retailers announced an “alternative Black Friday" day, or even a week. (The trend can be observed in other countries (Telegraph Reporters, 2017), but it has become rather "extreme" in Hungary.)

In our research we asked the respondents about the dates of Black Friday sales for the four largest domestic retailers dealing in home appliances.

A smaller proportion (20-40 percent) of respondents were able to the Black Friday day (Tab. 3) of the particular retailer select from the predetermined list. The best result was achieved by eMAG online retailer, who held its own sales on the "official" Black Friday Day on the 24th of November.

**Tab 3: Dates of Black Friday deals by the largest electronic retailers and their reputation among responders, 2017**

<table>
<thead>
<tr>
<th>Company</th>
<th>Date(s) of Black Friday deals</th>
<th>Ratio of right answers, percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media Markt</td>
<td>17th and 24th of November</td>
<td>19,8</td>
</tr>
<tr>
<td>Euronics</td>
<td>Between 20th-26th of November</td>
<td>30,2</td>
</tr>
<tr>
<td>E-Digital</td>
<td>17th of November</td>
<td>18,8</td>
</tr>
<tr>
<td>eMAG</td>
<td>24th of November</td>
<td>44,8</td>
</tr>
</tbody>
</table>

*Source: own data collection from the websites of the selected retailers*

It is also a Hungarian phenomenon that the expression "Black Friday" is merely a synonym for a significant price discount, and has no strong historical, socio-cultural
background like it does in the USA (Bell et al., 2014). As a result, in 2017 and 2018, "Winter Black Friday" and "Spring Black Friday" are advertised by major touristic and retail companies (Auchan, szallasvadasz.hu, etc.) If this trend continues, we are afraid, Black Friday will become only a synonym for a (significant?) price reduction in Hungary and will lose (or fail to get) the prestige value it has in the US and other Western European countries.

3.1 Product preferences, spending, distribution channels

According to our research, 37 percent of the respondents did some shopping on Black Friday in 2016. This rate rose to 44 percent in 2017, which is roughly equivalent to the rate of participation observed in countries of similar development. Tsiotsou also found a 1/3 turnout in Greece (Tsiotsou, 2017), but in developed countries this rate is much higher. In the US Kwon and Brinhaupt identified 63 percent customer involvement (Kwon, Brinhaupt, 2015), but the research conducted by Pricewaterhouse Coopers in 2017 showed “only” 35 percent participation rate. At the same time the significance of Cyber Monday increased considerably (PricewaterhouseCoopers, 2017).

The product preference of Black Friday buyers is in line with international trends. Most of the surveyed respondents purchased technical items (50 percent) and clothing products (30 percent) during the period of sales. However, our research reveals that none of the retailers wants to miss out on Black Friday, so more food retailers, furniture shops, and book and toy stores have announced a Black Friday sale.

The amount spent and type of product purchased during the Black Friday campaign is well illustrated by spendings (Fig. 2). In Hungary willingness to spend is naturally limited by the amount of the available disposable income (Medgyesi, 2016), so spending per capita is far behind the values of the more developed countries. While the modal value of Hungarian spending allows for the purchase of a small household appliance, an IT accessory or a few fast-fashion garments (between EUR 30 and EUR 80), in the US the per capita Black Friday spending is 100-500 USD (Kwon, Brinhaupt, 2015).

![Fig. 2: Spending on Black Friday, 2016, 2017](Source: own research)

As mentioned earlier, the fact that Cyber Monday has not (yet) been established in Hungary has a significant role in the preference of retail outlet, so online retailers concentrate almost exclusively on Black Friday. This is due to the fact that the popularity of webstores is the greatest (Fig. 3), which is in line with international trends (Swilley, Goldsmith, 2013) (PricewaterhouseCoopers, 2017).
3.2 Shopping satisfaction

In the last part of our research, we investigated customer satisfaction connected to Black Friday sales on a four-stage, two-pole differential scale where we offered the possibility to answer "I do not know" because we asked the question from all respondents, not only from those who actually did buy something. (We asked all respondents because we have also investigated factors (prices, marketing communication, etc.) which are not directly related to the purchase.).

In the following, we examined satisfaction with product selection, prices and advertising (marketing communication) based on the respondents' answers. Generally speaking, both in 2016 and 2017, 30-40 percent of the respondents (typically those who did not buy anything on Black Friday) were unable to judge prices, supply, and company communications. Among the respondents – those who expressed a firm opinion about prices and the supply of products – those who were satisfied and those who were not were almost in the same proportion (Fig. 4). From 2016 to 2017, the proportion of respondents who were satisfied somewhat reduced, which can be explained by the fact that retailers lured buyers with smaller (generally 20-40 percent) discounts, 60-70 percent reductions were low. The rate of price reduction is also a significant difference between the Hungarian and international Black Friday events.

Satisfaction with product availability and price levels is considerably lower than satisfaction with marketing messages (Fig. 5). This indicates that most Black Friday retailers are investing significant resources in informing potential buyers about the range of discounted products and the extent of their sales.
3.3 Classification of shoppers and non-shoppers

After not finding space-based differences in shopping patterns, we tried to form groups from surveyed people, based on their opinions related to the Black Friday product supply, prices, communication, availability, services and delivery. These six categories (Tab. 4) were measured in 1-4, bipolar Likert scales with an additional “I cannot judge” (0) value. (value 1: totally dissatisfied; 2: rather dissatisfied; 3: rather satisfied; 4: totally satisfied)

In order to group the sample, we first used hierarchical clustering with Ward’s method. The test and its visualisation (dendrogram) indicated 6 different clusters, then we launched a K-mean clustering with 6 clusters. In Tab. 4 the final cluster center values can be seen which show the differences among the clusters. Using these values and cross-tabs with cluster membership and shopping activity we named each cluster, as Tab. 4 indicates. In Tab. 5 a crosstab of the shopping activity in each cluster (shopper/non-shopper numbers) can be found.

Tab. 4: Final cluster center data, 2016

<table>
<thead>
<tr>
<th>Clusters</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfied shoppers</td>
<td>3,15</td>
<td>.74</td>
<td>1,52</td>
<td>2,55</td>
<td>2,63</td>
<td>.05</td>
</tr>
<tr>
<td>Advertising sensitive non-shoppers</td>
<td>2,94</td>
<td>.81</td>
<td>1,38</td>
<td>2,45</td>
<td>2,86</td>
<td>.06</td>
</tr>
<tr>
<td>Dissatisfied shoppers</td>
<td>2,89</td>
<td>2,90</td>
<td>1,24</td>
<td>3,27</td>
<td>3,34</td>
<td>.04</td>
</tr>
<tr>
<td>Informed shoppers who hardly shop</td>
<td>2,86</td>
<td>.29</td>
<td>1,76</td>
<td>1,77</td>
<td>2,26</td>
<td>.02</td>
</tr>
<tr>
<td>Semi-satisfied shoppers and non-shoppers</td>
<td>3,39</td>
<td>.23</td>
<td>1,19</td>
<td>.00</td>
<td>2,31</td>
<td>.02</td>
</tr>
<tr>
<td>Non-informed people – non shopper</td>
<td>3,39</td>
<td>.00</td>
<td>1,29</td>
<td>.14</td>
<td>1,06</td>
<td>.01</td>
</tr>
</tbody>
</table>

Source: own research
Tab. 5: Crosstabs on shopping and cluster membership, 2016

<table>
<thead>
<tr>
<th>Have you shopped on Black Friday week?</th>
<th>Cluster Number of Case</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Satisfied shoppers</td>
<td></td>
</tr>
<tr>
<td>Advertisement sensitive non-shoppers</td>
<td></td>
</tr>
<tr>
<td>Dissatisfied shoppers</td>
<td></td>
</tr>
<tr>
<td>Informed shoppers who hardly shop</td>
<td></td>
</tr>
<tr>
<td>Semi-satisfied shoppers and non-shoppers</td>
<td></td>
</tr>
<tr>
<td>Non-informed people-non-shoppers</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Count</th>
<th>Count</th>
<th>Count</th>
<th>Count</th>
<th>Count</th>
<th>Count</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>60</td>
<td>0</td>
<td>9</td>
<td>7</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>31</td>
<td>12</td>
<td>15</td>
<td>18</td>
<td>89</td>
</tr>
</tbody>
</table>

Number of Cases in each Cluster | 272 | 66  | 31  | 21  | 22  | 35  | 97  |

Source: own research

The above mentioned groups of customers can be characterised as follows:

1. Satisfied shoppers

They are the most satisfied group in each measured dimension (Tab. 4). In this group most responders shopped during the Black Friday week (90 percent), and – according to the data in Tab. 4 – they were rather or totally satisfied as the average values show in Tab. 4. To this group belong 22 percent of all responders, and they supposed to be the “Black Friday fans in Hungary”.

2. Advertisement sensitive – non-shoppers

This group of customers was focused on Black Friday communication. They had information from different ad-sources, but none of them shopped during the Black Friday week (Tab. 5). The group average values are close to zero in case of prices, product availability, etc. (the responders could not judge them – because they did not shop), but they were rather satisfied with the marketing communication of the Black Friday, it means that the messages of companies reached them. We can conclude that in case of these shoppers the marketing communication was partly successful because retailers reached the awareness of customers, but they failed to convince them to shop.

3. Dissatisfied shoppers

In this group customers were rather or totally dissatisfied with the Black Friday event. The average values of all the measured dimensions are near 1 (Tab. 4). Maybe this is the reason why only 43 percent of this group shopped during the Black Friday week. Supposedly they originally planned to shop in the Black Friday week, but they were dissatisfied with the offer of retailers in general.

4. Informed shoppers who hardly shop

Only 32 percent of this group reported that he or she shopped during the Black Friday week. On average basis they were rather satisfied the product supply and prices (average values over 2), and they were almost totally satisfied with the advertisement activity of retailers (value over 3), but they could not judge the product availability, retail services and delivery. It means that they were reached by the retailers’ messages, they reviewed the market offer but eventually they did not shop. The main differences between the 3rd group (“Dissatisfied shoppers”) and this 4th group (“Informed shoppers who hardly shop”) are the shopping decisions during the Black Friday week.
shoppers who hardly shop”) can be depicted by the judgement of product supply, prices and advertisement. While the 3rd group members were totally dissatisfied with them, the members of 4th group were generally satisfied with these dimensions. Further researches are needed to unveil the reasons behind. The 4th group composes nearly 10 percent of the entire sample, it means their shopping behavior may be relevant and important enough for different retailers.

5. Semi-satisfied shoppers and non-shoppers

This group of surveyed people forms about 15 percent of the total sample. This group of responders are the “unconfirmed ones”. About 50-50 percent are the ratio of shoppers and non-shoppers in the group. They average satisfaction with the researched dimensions (prices, product availability, delivery, etc.) are between the “rather unsatisfied” and “rather satisfied” levels. Considering these data, we can conclude that there is still room to improve the retail companies’ marketing and retailing activities in order to extend the ratio of Black Friday shoppers.

6. Non-informed people – non shoppers

More than 36 percent of the sample reported that they had no information on Black Friday at all. The mass majority of this group (over 90 percent) has not shopped during the Black Friday week. Although the Black Friday event started in 2014 in Hungary, 1/3rd of the surveyed people was still totally uninformed after 3 years. These people mean the most important target group for retailers even nowadays if searching for new customers.

4 Discussion

In our paper the Hungarian Black Friday is described from a customer behavioural point-of-view. Because of the non-representative sampling method our findings may be not valid for the entire Hungarian society, although our results are in line with other international examples especially in those countries that have similar socio-economic conditions (e. g. Greece, Romania) (Tsiotsou, 2017) (Delcea, Ioanas, Paun, 2017). The shoppers-non-shoppers ratio shows similar values (1/3-2/3 of the shoppers), the frequencies also show similarities in international comparison, but spending values may vary depending on the economic development level of the selected country.

Further Black Friday researches are needed to unveil the shopping motivations and the behaviour of different retailers in Black Friday sales. Our findings may contribute to a more effective and efficient marketing activities of retail companies that are or will be engaged to Black Friday sales in Hungary and in third countries too.

Conclusions

During our research we highlighted some important features of shopper behavior observed during the 2016 and 2017 Hungarian Black Friday campaigns, in comparison with strong international trends.

Our main findings are as follows:

- In the Hungarian Black Friday sales more than 1/3 of the respondents participate as a buyer, and this trend is in line with international examples, especially in respect of countries where the per capita income is similar to the Hungarian income level.
• Hungarian spending significantly lags behind the international spending level, primarily smaller household appliances, fast fashion clothing and smaller IT devices are bought during the sales period.

• During the Hungarian Black Friday sales period online retailers are the most successful, presumably due to the demand side, because domestic buyers prefer shopping opportunities with practical, fast, and lower-priced products to shopping experience. On the supply side, it is crucial that Cyber Monday is missing from the Hungarian trade palette

• The decisive part of the respondents (about half of the strong opinion formers) is not satisfied with either the range of discounted products or with the available discounts. The reason for this might be that a wide range of customers in the online and offline media are aware of the product range and price discounts of the international Black Friday phenomenon, compared to which the discounts and the available product range is more modest. Thus, it is understandable that a large number of customers are dissatisfied with the characteristics of domestic supply

• There are no geography-based differences in the shopping behavior of the surveyed people, we could not identify statistically significant differences in several space-divisions.

• We defined six different groups with cluster analysis. There are solid differences among the groups referring to the advertisement sensitivity, the evaluation of product supply and price levels, and different retail services (availability, delivery)

We found that Hungarian Black Friday is in line with international trends with some special national characteristics. Among them the low level of spending, the online dominancy (lack of Cyber Monday) are the most important. Our customer grouping highlights the differences in shopping/non-shopping, satisfaction/dissatisfaction and information supply. These findings may be useful for international comparison in future Black Friday researches.

References


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DESIGNING AN ADVANCED PPE MODEL TO MEASURE PERFORMANCE AND EFFICIENCY OF SLOVAK SPA ENTERPRISES

Veronika Čabinová, Erika Onuferová

Abstract: Each model for measuring performance and prediction is different as it uses different mathematical approaches and works with different indicators. In the era of rapidly changing economic environment, the standard methods for measuring financial performance and assessing financial health are less adequate. Most authors focus on enhancing the predictive ability of original models by responding appropriately to the existing changed economic environment as the identification, increasing and managing enterprise performance and efficiency represent a key tool of today's competitive struggle. The objective of the paper is to create and then apply in practice a new innovative 3D model (PPE model) evaluating the current financial position of Slovak spa companies (P – position), their future development prognosis (P – prognosis) as well as their efficiency (E – efficiency). The aim of the paper is to identify and implement traditional key indicators, predictive models and efficiency indicators within each of the model dimensions while respecting sectoral characteristics and financial particularities of Slovak spa enterprises. Creating a PPE model will help to better identify the current financial position of the sampled enterprises and, in this way, it will be able to reveal the causes hindering the development of their financial performance to a more accurate extent.

Keywords: PPE Model, Financial Health, Bankruptcy Models, Enterprise Efficiency, Spa Health Sector.

JEL Classification: C0, C53, M31, M21.

Introduction

Nowadays, the analysis and management of enterprise performance and efficiency is getting more and more attention than in the past due to the constantly changing global business environment bringing new, modern approaches to solve the issue in question. Kita, Šimberová (2018) claim that business activities have a large influence on the economy, environment, and society. Therefore, choosing the right key performance metrics is very important to ensure the performance evaluation with the high information value and the ability to subsequently influence and manage performance of enterprises as well as economies. As reported by Gallo, Mihalčová (2016), the main factor to company success is monitoring the actual market situation, therefore, a competitive struggle is won only by enterprises that are adequately dedicated to measuring and evaluating performance as well as efficiency and use the right approaches and measuring tools. Neither the Slovak spa enterprises are no exception, as thanks to them Slovakia belongs to one of the major and the most interesting spa countries in Europe. Although Slovakia is not well known on the international tourism market yet, regional specificity and variability predetermine the Slovak area for the development of tourism, which has become increasingly popular in recent years (Štefko et al., 2018).
1 Statement of a problem

Performance and efficiency assessment helps managers guide their organization toward achieving excellence leadership and impressive results (Hajiagha et al. 2013). As reported by Stříteská, Zapletal, Jelinková (2016), there is a growing effort to continually develop new financial performance assessment tools that can access the financial situation as accurately as possible, identify future risks, forecast business performance with the intention of determining the starting position of the business. In this regard, Yadav, Sushil, Sagar (2013) add that effective performance management systems and models should be based on system dynamics, sustainability and simulated performance. Their goal is according to Almajali, Alamro, Al-Soub (2012) to gain useful information and background on the efficiency and effectiveness, while encouraging managers to make the best decisions in favour of the enterprise. However, managers solve problems how to measure the performance to prevent the improvement of one part of the business at the expense of another as increasing the implementation of enterprise performance systems is linked to many problems in need of answering.

1.1 The importance of assessing the financial health of enterprises

As reported by Robinson et al. (2015), Narkunienė, Ulbinaitė (2018), despite the significant glorification of modern concepts, financial analysis indicators are most often used in current practice to assess the company's financial health. Palepu, Healy (2013) state that financial analysis can be defined as a comprehensive and systematic analysis of historical and planned financial statements using the financial indicators systems in order to evaluate the current and expected financial situation and to support the quality of its strategic management. According to Kiseľáková, Šoltés (2017), the main objective of financial analysis is to assess not only the state of the company's finances, but rather to analyse the financial health of the company, that is, the ability of the company to obtain returns from the capital invested.

According to Knápková, Homolka, Pavelková (2014), the financial and economic analysis allows revealing whether the company is profitable enough, whether it has the appropriate capital structure, whether it effectively exploits its assets and a whole range of other significant financial facts. Kraftová, Kašparová (2017) add that its aim is not only analysing the accounting data, but also identify the internal and external conditions in which the company carries out its activities. Mihalčová, Gallo, Pružinský (2017) emphasize that measuring company performance by means of generally accepted financial indicators is a source to key information on company efficiency and its future prospects. Vavrek, Adamišin, Kotulič (2017) add that these indicators and methods are easy to implement. However, they are the most distorted and were created for the purposes of the private sector. As reported by Goel (2016), the analysis of the set of financial ratios (indicators of liquidity, activity, capital structure, profitability and market value) is crucial in understanding the company's financial statements, identifying future trends and measuring the overall financial health of an enterprise.

1.2 Bankruptcy and creditworthy prediction models

The knowledge of the financial position of an enterprise ought not to be associated only with its past; however, financial management ought to be predominantly oriented towards the estimation of the company's future development through ex-ante's predictive financial analysis forecasting future development based on the use of
creditworthy and bankruptcy models. Therefore, methods based on ex-ante financial-economic analysis are currently getting more and more into the forefront. Kubíčková, Jindřichovská (2015) claim that there are several types of classification available in the literature, however, the most commonly used one is the following:

- **Bankruptcy models** – Altman’s Z-score, Taffler’s Model, Springate Model, Fulmer's Model, Beerman's Model, Bilderbeek's Model, Index IN95, IN99, IN01, IN05, Virág-Hajdu model, Poznański's model.

- **Creditworthy models** – Quick test, Doucha's Balance Analysis, Creditworthiness index, Aspect Global Rating.

Creditworthy models are based on a company's financial health diagnostics following the score evaluation of the individual areas of economic development. Consequently, the company is assigned according to the gained points to a certain performance category, on the basis of which the financial development is estimated. Bankruptcy models tackle the questions of whether or not the enterprise is going bankrupt, or more precisely its bankruptcy possibility (Karas, Řezňáková, 2017). The models of one-dimensional analysis (classifying companies as being prosperous or not based upon only one criterion) and multidimensional analysis (taking into account several indicators) are applied in this area. The main difference between bankruptcy models and creditworthy ones is that the bankruptcy models are based on real empirical data, while creditworthy models are partly based on theoretical knowledge.

1.3 Enterprise efficiency and its measurement

According to Cyrek (2017), the efficiency is understood as the relationship between outputs and inputs and it is often analysed in terms of goals. Carstina et al. (2015) emphasise that efficiency is closely interdependent to effectiveness, meaning that an efficiency undertaking without being effective will not have a very long period of existence, and an effectiveness of enterprise without obtaining efficiency automatically lead to unfavourable economic results. Enterprise performance evaluation is also based on the analysis of the manner of fulfilment of indicators specific to the different activities performed within processes. In many research studies, the concepts of performance, efficiency and effectiveness are perceived in the same meaning. Wagner (2009) states that efficiency can be perceived as one of the enterprise performance dimensions (see Fig. 1).

![Fig. 1: Basic dimensions of performance](source:wagner2009)

The efficiency is an important prerequisite for business performance as it represents one aggregate value comprised of multiple areas of financial and business performance assessment. Hedija, Fiala, Kuncová (2017) investigated this link between efficiency
and performance (measured by ROE, ROA and ROS). They found very weak or in many cases not statistically significant relationship between efficiency and profitability indicators. Based on the above-mentioned statements we can define performance measurement as a process of quantifying the efficiency and effectiveness of enterprise activities.

2 Methods

Spa tourism is one of the economy sectors with high growth potential and the main product line of tourism in Slovakia. For this reason, we focused on creating an innovative PPE model evaluating the current financial position of Slovak spa companies, their efficiency and forecasting their future development while respecting sectoral characteristics and financial particularities. We analysed links between the dimensions of the business performance and efficiency as we consider them to be some of the most important areas of business activity leading to the achievement of the strategic goals set. When modelling and analysing business processes and models, the main emphasis is usually put on model validity and accuracy, i.e., the model meets the formal specification and also models the relevant system (Ibl, Čapek, 2016). The new PPE model's structure is illustrated in the following Fig. 2.

**Fig. 2: The basic scheme of the new PPE model**

<table>
<thead>
<tr>
<th>Position</th>
<th>Prognosis</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial-economic analysis ex-post</td>
<td>Financial-economic analysis ex-ante</td>
<td>Simplex Linear Programming Method</td>
</tr>
</tbody>
</table>

PPE model (performance & efficiency)

Source: (own processing)

2.1 Research sample and data

The research sample consisted of the 28 Slovak health spa enterprises with the official permission from the Ministry of Health of the Slovak Republic to operate the natural health spas and spa medical institutions in Slovakia. According to the statistical classification of economic activities (SK NACE Rev. 2), Slovak spa enterprises belong to section \( Q \) – Health and social assistance, Division 89 – Health and specific subcategory 86.909 – Other health care activities. During the years 2013 – 2017, the total number of employees operating in the section \( Q \) – Health and social assistance was 6,305 on average and registered number of employees fluctuated on the average level of 81,792 (Statdat, 2019). The financial statements of the analysed spa enterprises' sample were drawn from a publicly available internet portal managed by the company DataSpot, Ltd. Data related to upper and lower quartile values within the subcategory SK NACE 86.909 were provided by CRIF - Slovak Credit Bureau, Ltd. All data obtained were processed in Microsoft Excel and statistical program STATISTICA, 5th edition. The identified outliers of financial indicators and prediction models have been removed due to the distortion of the final results and model created.
2.2 Quantification of individual dimensions of the PPE model

The assessment of the current financial position of the mentioned group of companies for the period of 2013-2017 was carried out on the basis of an ex-post financial-economic analysis. From each of the basic groups of ratio indicators (liquidity, activity, rentability and indicators of capital structure) we selected and quantified 10 ratio indicators (see Tab. 1) generally widespread and most commonly used in business practice. The calculation of the initial values of the financial indicators entering the financial health dimension was performed on the basis of Transformation Tab. 1. It was compiled according to the average upper and lower quartile values of the selected 10 indicators within the sector SK NACE 86 909. These values were used to determine the range of intervals (a total of 6) that were assigned points between 0 and 10. On the basis of the average value reached over the years 2013-2017, a particular spa company was rated by a maximum of 100 points. For a better understanding the calculation methodology and converting values of financial indicators to points, the transformation table is set out in Attachment 1.

So as to evaluate the financial prediction dimension, 10 selected ex-ante financial prediction models were used, focusing on the selection of creditworthy and bankruptcy models designed and applied under European conditions (see Tab. 2). The calculation of the original values of the predictive models entering the financial prediction dimension was performed on the basis of a Transformation table compiled in the same way as in the previous dimension. The only difference was that ranges of intervals were not based on quartile values, but on the generally recommended ratings and multilevel scales according to the individual prediction models. In the case of Bilderbeek's and Poznański's Model, the limit value between "safe" and "distress" zone of bankruptcy is 0. It would not be possible to set up a range of intervals, so we have determined the values of 5 and -5 as limit values. For a better understanding the calculation methodology and converting values of prediction models to points, the transformation table is set out in Attachment 2.

The calculation of the efficiency of spa companies was addressed using the Simplex Linear Programming Method (SLPM). According to Grell, Hyránek (2012), in the practical solution it is necessary to start from its simplification, while minimizing the deviations between the indicators of efficiency and effectiveness. The $u_i$ vectors (in relation to efficiency indicators) and $t_r$ vectors (in relation to effectiveness indicators) were obtained as a solution of:

- the basic equation:
  \[
  \min \Sigma_j w_j = 0 \tag{1}
  \]
- under the conditions:
  \[
  \Sigma_i u_i S^j_{iMJ} - \Sigma_r t_r c_{ij} - w_j = 0; \Sigma t_r = 1; u_itr_j w_j \geq 0 \tag{2}
  \]
- so finally, the order of transformation process efficiency was calculated by:
  \[
  E_j = \frac{\Sigma_r t_r c_{ij}}{\Sigma_i u_i S^j_{iMJ}}, \tag{3}
  \]

where:
- $w_j$ – deviations in individual years,
- $u_i$ – value of weights for inputs,
- $S^j_{iMJ}$ – inputs needed for linear programming,
- $t_r$ – value of weights for outputs,
- $c_{ij}$ – outputs needed for linear programming,
- $E_j$ – efficiency.
The conversion of the original values of financial ratio indicators, bankruptcy models and achieved level of enterprise efficiency was realized on the basis of modified scoring method according to Rejnuš (2014). Each indicator from a given dimension can get a maximum of 10 points. If the maximum is not reached, points are assigned as follows: in the case of indicators whose development is going to be growing, we calculate the point rating by substituting the highest value of the indicator into the denominator; in the case of indicators whose development is going to be decreasing, we calculate the point rating by substituting the lowest value of the indicator into the numerator. A summary of points within the individual PPE dimensions was then plotted along the x-axis (the dimension of financial position), the y-axis (the dimension of financial prognosis) and the z-axis (the dimension of enterprise efficiency). Based on the cross point of the values achieved, we can determine the position of particular spa enterprise within the five performance fields:

- `< 0 – 20 >     → unacceptable result,
- `< 20 – 40 >    → unsatisfactory result,
- `< 40 – 60 >    → acceptable result,
- `< 60 – 80 >    → satisfactory result,
- `< 80 – 100 >   → superior result.

3 Problem solving

3.1 Evaluation of financial position of enterprises (1st dimension)

The following partial analysis is aimed at evaluating and interpreting the development of selected financial ratio indicators of all spa companies forming the first dimension of the PPE model (see Tab. 1).

Tab. 1: The development of average values of selected ratio indicators applied to spa companies in Slovakia over the years 2013 – 2017

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Liquidity coeff.</td>
<td>0.99</td>
<td>0.94</td>
<td>1.06</td>
<td>1.02</td>
<td>0.98</td>
<td>0.0402</td>
<td></td>
</tr>
<tr>
<td>Total Liquidity coeff.</td>
<td>1.04</td>
<td>0.99</td>
<td>1.10</td>
<td>1.08</td>
<td>1.13</td>
<td>0.0487</td>
<td></td>
</tr>
<tr>
<td>Days Short-term Receivable</td>
<td>37</td>
<td>47</td>
<td>84</td>
<td>77</td>
<td>43</td>
<td>19.096</td>
<td></td>
</tr>
<tr>
<td>Days Short-term Payable</td>
<td>103</td>
<td>108</td>
<td>148</td>
<td>147</td>
<td>118</td>
<td>19.156</td>
<td></td>
</tr>
<tr>
<td>Total Indebtedness %</td>
<td>28.40</td>
<td>28.32</td>
<td>33.31</td>
<td>33.57</td>
<td>31.90</td>
<td>2.3084</td>
<td></td>
</tr>
<tr>
<td>Interest Coverage Ratio coeff.</td>
<td>2.33</td>
<td>5.51</td>
<td>8.00</td>
<td>8.91</td>
<td>0.56</td>
<td>3.2054</td>
<td></td>
</tr>
<tr>
<td>Total Credit Indebtedness %</td>
<td>42.96</td>
<td>18.15</td>
<td>12.50</td>
<td>11.22</td>
<td>27.05</td>
<td>11.708</td>
<td></td>
</tr>
<tr>
<td>Return On Assets %</td>
<td>1.29</td>
<td>2.61</td>
<td>2.67</td>
<td>2.79</td>
<td>0.19</td>
<td>1.0183</td>
<td></td>
</tr>
<tr>
<td>Return On Equity %</td>
<td>0.33</td>
<td>2.13</td>
<td>2.36</td>
<td>2.61</td>
<td>-1.03</td>
<td>1.4069</td>
<td></td>
</tr>
<tr>
<td>Return On Sales %</td>
<td>0.55</td>
<td>3.46</td>
<td>3.67</td>
<td>4.09</td>
<td>-1.53</td>
<td>2.1836</td>
<td></td>
</tr>
</tbody>
</table>

Source: (own processing)

As for ratio indicators, we focused on Current liquidity, which belongs to the key performance indicators. In the course of the monitored period, the indicator indicating the illiquidity of the spa enterprises was below the value of 1, except for years of 2015 and 2016. Identical below-average values were also recorded for the Total Liquidity indicator. The analysis of Days Short-term Receivable Outstanding pointed out the poor payment discipline for business entities in the spa tourism. The spa enterprises
had been receiving a commercial loan throughout the period, so businesses lived to the
detriment of their suppliers and acted relatively unethically. This matter is an issue of
the bad business and credit policy. Based on the average Total Indebtedness of the spa
enterprises at 31.10%, the level of Creditor Risk can be considered as optimal. The
enterprises were financed mainly by means of their own capital, which demonstrates
their financial independence. In 2013, they were unable to pay the price of foreign
capital without problems. However, in the last year, the pre-tax profit was down by
93.45%, causing a significant negative downward trend in the indicator and directly
reducing the business performance. Return on Assets, as one of the key performance
indicators, averaged only at 1.91%, indicating the weak manufacturing power of the
industry. A more profound analysis of Return on Equity and Return on Sales showed
that during the years of 2013 and 2016 all indicators demonstrated a slow and
insignificant, yet positively growing trend.

3.2 Evaluation of financial prediction of enterprises (2nd dimension)

The following partial analysis was aimed at evaluating the prediction model results
of all spa enterprises forming the second dimension of the PPE model (see Tab. 2).

**Tab. 2: The development of average values of the selected prediction models applied
to spa companies in Slovakia over the years 2013 – 2017**

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick Test</td>
<td>coeff.</td>
<td>12.96</td>
<td>10.93</td>
<td>11.46</td>
<td>11.25</td>
<td>11.14</td>
<td>0.7032</td>
</tr>
<tr>
<td>Doucha's Balance Analysis</td>
<td>coeff.</td>
<td>2.85</td>
<td>1.07</td>
<td>0.82</td>
<td>1.19</td>
<td>4.24</td>
<td>1.3151</td>
</tr>
<tr>
<td>Aspect Global Rating Model</td>
<td>coeff.</td>
<td>9.04</td>
<td>4.60</td>
<td>4.76</td>
<td>4.04</td>
<td>3.27</td>
<td>2.0176</td>
</tr>
<tr>
<td>Altman's Model (SR)</td>
<td>coeff.</td>
<td>0.48</td>
<td>0.52</td>
<td>0.49</td>
<td>0.48</td>
<td>0.50</td>
<td>0.0150</td>
</tr>
<tr>
<td>Taffler's Model</td>
<td>coeff.</td>
<td>-0.04</td>
<td>0.33</td>
<td>0.42</td>
<td>0.43</td>
<td>0.40</td>
<td>0.1775</td>
</tr>
<tr>
<td>Creditworthiness Index</td>
<td>coeff.</td>
<td>0.34</td>
<td>1.24</td>
<td>1.29</td>
<td>1.24</td>
<td>0.62</td>
<td>0.3911</td>
</tr>
<tr>
<td>Beerman's Model</td>
<td>coeff.</td>
<td>-0.23</td>
<td>-0.08</td>
<td>-0.11</td>
<td>-0.08</td>
<td>-0.05</td>
<td>0.0629</td>
</tr>
<tr>
<td>Index IN05</td>
<td>coeff.</td>
<td>4.54</td>
<td>0.66</td>
<td>2.71</td>
<td>1.45</td>
<td>-1.51</td>
<td>2.0223</td>
</tr>
<tr>
<td>Bilderbeek's Model</td>
<td>coeff.</td>
<td>-9.32</td>
<td>-4.96</td>
<td>-6.37</td>
<td>-8.52</td>
<td>-5.28</td>
<td>1.4706</td>
</tr>
<tr>
<td>Poznański's Model</td>
<td>coeff.</td>
<td>13.27</td>
<td>5.51</td>
<td>5.05</td>
<td>4.64</td>
<td>3.79</td>
<td>3.4280</td>
</tr>
</tbody>
</table>

The legend:

- **Red** the financial situation and prospects are very good,
- **Grey** grey zone, the financial situation is uncertain,
- **Black** the financial situation and the prospects are very bad.

*Source: (own processing)*

On the basis of the resulting values of the selected credit models, it is possible to
state that the spa enterprises were in the grey zone as regards the tested results as part
of the Quick Test scoring and their financial situation for the future is, therefore,
uncertain. Excellent score evaluation, except in 2015, were achieved by spa companies
when the Doucha's Balance Analysis was applied, based on which one can expect a
favourable positive financial performance of businesses. The last (and at the same time
the only) creditworthy model, according to which the prospects of spa companies are
very poor, based on the results from 2017, is the Aspect Global Rating Model (spa
enterprises were included into the CCC rating group). According to Bilderbeek's
Model, Beerman's Model and Poznański's Model, the financial situation of the
companies was assessed as very good, with a very low probability of bankruptcy, free
of any problems regarding solvency and expected future. According to the results of
the Taffler's Model and Index IN 05, the group of the analysed enterprises was alternately assigned to successful and unsuccessful zones regarding their future development.

3.3 Evaluation of enterprises efficiency (3rd dimension)

To conclude, we evaluated the effectiveness of Slovak spa enterprises by means of SLPM. As input variables, we chose total costs, personnel costs and material costs. Output variables were represented by total revenues, net profit and value added. Based on the variables we considered to be the most determinant of the performance within the analysed sample of enterprises, we quantified the cost of returns, wage efficiency and material efficiency by applying the modified matrix system. The outputs were quantified in relation to the total revenues (index). In the following Tab. 3 are stated initial values of the selected inputs and outputs that represent the main basis for the efficiency quantification. Individual values (in €) represent the average values within the all health spa enterprises and indexes are quantified to overall revenues.

<table>
<thead>
<tr>
<th>Tab. 3: Input data needed for application of SLPM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>2013</td>
</tr>
<tr>
<td>2014</td>
</tr>
<tr>
<td>2015</td>
</tr>
<tr>
<td>2016</td>
</tr>
<tr>
<td>2017</td>
</tr>
</tbody>
</table>

**Source:** (own processing)

The Simplex Linear Programming Method analysis of efficiency consisted of weights \((u_i, t_t)\) of selected indicators and deviations \((w_j)\), the sum of which had to be minimized. Based on the results, we can state that the highest weight of the selected inputs was proved in the case of material efficiency indicator \((u_3 = 2.03604)\) and wage efficiency indicator \((u_2 = 1.35644)\). No significant weight was identified for the other selected input and output items. On the basis of calculated weights, we subsequently quantified the efficiency of the selected sample of enterprises. Maximum efficiency (1.000) was reached in 2015, vice-versa, the lowest in 2016 (0.7889). In the other years of the analysed period, the efficiency ranged from 0.8514 (2013) to 0.9912 (2017). The overall average efficiency of the Slovak health spa enterprises reached the level of 0.9254, so it can be considered relatively high.

3.4 Designing a final PPE model

On the basis of created methodology and results of the individual dimensions, we compiled the final PPE model evaluating the efficiency and effectiveness of Slovak spa companies over the years 2013 – 2017 (see Fig. 3).
Based on the overall average score achieved after the transformation of values across all PPE dimensions, SE03 (Spa Bojnice, Inc.) obtained the first place. When carrying out a more detailed analysis of its position, we came to conclusion that the selected company achieved the highest overall values in the 1st dimension "Position" (72 points); for the 2nd dimension "Prognosis" achieved the 2nd place (86 points), while by obtaining 100 points in the area of efficiency, obtained the 1st place together with SE21 (Spa Pieniny Resort, Ltd.). The second highest overall score for the PPE was achieved by SE23 (Specialised spa Marina, s.p.), but it obtained leading score only in financial rating (68 points) and financial prediction (88 points). The resulting business efficiency reached 81 points, which was the main negative determinant worsening its overall score. The third most successful company was SE26 (Specialised spa SR Bystrá). However, the enterprise obtained significant score (84 points) only in the 2nd dimension of "Prognosis". Within the overall assessment of spa companies based on PPE model application as well as within its individual dimensions, it was SE04 (Spa Brusno, Inc.) that achieved the worst results. It was only in the dimension of financial prediction that it overcame another company, namely the SE10 (Spa Sliač, Inc.) by 4 points. Another cause of the unfavourable values of this business was its markedly low efficiency level achieved (16 points). It was SE15 (Spa Čiž, Inc.) that ended up being the last but two, whose overall score was negatively affected by the results of the 1st dimension "Position" (26 points) and the third "Efficiency" (33 points).

In the end of our research, we categorized the average scores of individual spa companies into the performance and efficiency fields defined in the Methodology section. The results are graphically processed in Fig. 4. Based on the values, we may ascertain that only one of the enterprises achieved an unacceptable result (SE04 – having obtained the last place in the PPE model) and only one reached values highly above the average (SE03 – having obtained the first place in the PPE model). Nearly half of the analysed spa companies (46.43%) achieved on average acceptable results, which we consider quite positive. Most of the remaining research sample (28.57%) showed satisfactory results, with the remaining 17.86% pointing to problems with achieved levels of financial performance and efficiency.
4 Discussion

The authors Harumová, Janisová (2014), Šofranková, Kiseľáková, Horváthová (2017), Hyránek et al. (2018) have also focused on creating new models for evaluating the performance of Slovak enterprises using various methods and approaches. However, the motivation to create PPE model arose also from the fact that in the current Slovak conditions there is a lack of a 3D models analysing the performance and efficiency within the tourism sector. As we consider spa enterprises to be the main product line of tourism in Slovakia with a high growth potential, we have focused on creating an innovative PPE model that will help to analyse the current and future financial health of spa enterprises. Moreover, it will identify more accurately causes that hinder the development of financial performance and efficiency of the selected sample of enterprises.

Conclusion

Sustainable development is now found as a central theme (Lešáková, Baťa, Provazníková, 2017). Therefore, performance and efficiency measurement is considered to be a topical issue. Choosing the right key metrics is very important to ensure the performance and efficiency evaluation and the adaptation of the models created to the sectoral characteristics and financial specifics of individual sectors of the economy is increasingly desirable. As reported by Pawliczek, Kozel, Vilamová (2018), strategic planning as well as continuous improvement are very important factors close to business performance. Based on the above-mentioned facts, we focused on creating a 3D model design (PPE model) in the conditions of the Slovak spa enterprises, which would be able to evaluate the level of three important dimensions of each business activity – financial position (P – position), prognosis of future development (P – prognosis) as well as efficiency (E – efficiency).

After having applied the created PPE model in Slovak spa companies, we have come to the following conclusions. Based on the overall average score achieved after the transformation of values across all PPE dimensions, spa companies SE03, SE23, SE26 with an average score of 78 points reached the first three places. On the other hand, the worst rated companies were SE04, SE10, SE15 whose score in the PPE model was only around 23 points. It can be, however, generally stated that almost half of Slovakia's spa companies (46.43%) achieved on average acceptable results of
32.14%, while 32.14% of the results were satisfactory and in one case, they were much higher than the average. Only one of the enterprises showed an unsatisfactory level in all the dimensions of the PPE model. The remaining 17.86% pointed to certain problems in the analysed area of financial performance and efficiency, the more detailed research of which will be the subject of our further scientific studies.

Acknowledgement
This contribution was supported by project GAMA/19/2, “Designing an Advanced PPE Model to Measure Performance and Efficiency of Slovak Spa Enterprises”.

References


Attachment 1: Transformation Tab. 1 – financial ratio indicators

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Note:
* average upper quartile values over the years 2013 – 2017 within the sector SK NACE 86 909
** average lower quartile values over the years 2013 – 2017 within the sector SK NACE 86 909

Source: (own processing)
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**Note:**
* limit value to "safe zone" (negligible probability of filing bankruptcy)
** limit value to "distress zone" (high probability of reaching the stage of bankruptcy)

Source: (own processing)
MODEL FOR DETERMINATION OF NATURAL RATE OF UNEMPLOYMENT FROM GDP GAP

Jiří Dobrylovský

Abstract: Since the moment when Milton Friedman introduced a natural rate of unemployment into economic theory, this indicator has been one of the most important quantities in macroeconomics. However, in contrast to other key macroeconomic indicators, the natural rate of unemployment is very difficult to be accurately quantified. The following paper suggests a simple mathematic model, on whose base the natural rate of unemployment can be determined. This model was used to set the natural rate of unemployment in the Czech Republic and its development over time period of the last 23 years based on the Macroeconomic Forecast by the Ministry of Finance of the Czech Republic and compared with Okun’s Law. When calculating the natural rate of unemployment the suggested model eliminates the differences resulting from different utilization of production capacities and the changing rate of economic activity of population in the course of time. As all other models, this model also works with certain simplified assumptions; however, its advantage is the possibility of gradual implementation of more and more difficult parameters of real economy as new variables. Nevertheless, even in its basic form, the model provides good results, which coincide with theoretic basis and monitored facts.

Key words: Natural Unemployment Rate, Participation Rate, Potential Product, Okun’s Law, Labor Market.

JEL Classification: C29, E32, J64

Úvod

Přirozená míra nezaměstnanosti, kterou do ekonomické teorie uvedl Milton Friedman (Friedman, 1968), je jedním z klíčových pojmů ekonomie hlavního proudu. Je definována jako stav rovnováhy na agregátém trhu práce a z hlediska vymezení druhů nezaměstnanosti je souhrnem nezaměstnanosti frikční a strukturální (viz např. Mankiw, s. 158).

Namísto pojmu „přirozená míra nezaměstnanosti“ se zejména v posledních desetiletích často používá „míra nezaměstnanosti neakcelerující inflaci“ (non-accelerating rate of unemployment, zkratka NAIRU), odvozovaná z Phillipsovy křivky, kterou zavedli F. Modigliani a L. Papademos (1975), tehdy ještě jako NIRU, tj. neinflační míra nezaměstnanosti. Přestože se nejedná o definitoricky identické pojmy (na dlouhodobé Phillipsové křivce může tatáž přirozená míra nezaměstnanosti odpovídat různým míram inflace, které již nebude dále akcelerovat), mnozí ekonomové je od sebe explicitně neodlišují. Pro účely této stati, a to zejména kvůli porovnání výsledků empirických analýz, budou oba pojmy považovány za totožné.

Z definičního hlediska nepředstavuje přirozená míra nezaměstnanosti ani NAIRU žádný problém, avšak o to větší komplikaci je její kvantitativní určení. Výše zmíněná rovnováha na pracovním trhu, tedy rovnost nabízeného a poptávaného množství,
koresponduje hypotetickým dokonale konkurenčním podmínkám, tedy takovému trhu práce, na němž dochází k pružnému přizpůsobování ceny práce, neboli mzdové sazby, vzájemnému poměru poptávky a nabídky. Jenže trh práce z celé řady důvodů dokonale konkurenční není a ze stejných důvodů nedochází ani k pružným změnám mzdových sazeb. Z tohoto hlediska je tedy stanovení přirozené míry nezaměstnanosti spíše jen obtížně odhadovatelnou úrovní.

Podle MCAdama a McMorrowa (1999) se dokonce v případě přirozené míry nezaměstnanosti jedná o teoretickou konstrukci, pro kterou neexistují nástroje přímého měření.

Shodně s tímto názorem tvrdí i Jašová (2010), že není možné NAIRU přímo pozorovat, dodává ale, že může být odvozována z analýzy pozorovatelných proměnných, spojených s definicí této veličiny. Na základě toho pak autorka za použití empirických metod dochází ke stanovení intervalových hodnot NAIRU v několikaletých obdobích v letech 1999-2010.

Empirickou cestou se pokouší určit NAIRU Kadeřábková a Jašová (2011), a to dokonce nejen pro české národní hospodářství jako celek, ale i pro jednotlivé sektory primární, sekundární a terciární.

Je ale nicméně ještě jeden prostředek, pomocí něhož lze přirozenou míru nezaměstnanosti relativně přesně stanovit. Tímto prostředkem je tzv. potenciální produkt.

Potenciální produkt je vymezen (Okun, 1962) jako výstup ekonomiky (tj. reálný produkt), který je vytvářen při tzv. plné zaměstnanosti, jež koresponduje v té době ještě nedefinované přirozené míře nezaměstnanosti. Takto řečeno by se mohlo zdát, že se jedná o tautologii či důkaz v kruhu, ale skutečnost je naštěstí jiná. Jde o to, že velikost reálného produktu je možné pomocí statistických metod naprosto spolehlivě vyčíslit.

Lze provést i kvalifikovaný odhad mezery produktu, neboť rozdíl mezi produktem reálným a potenciálním. Ministerstvo financí ČR každé čtvrtletí vydává Makroekonomickou predikci, shrnující aktuální stav vývoje základních makroekonomických indikátorů České republiky a obsahující kvalifikované odhady vývoje v oblasti ekonomického výkonu (včetně mezery produktu za jednotlivé kvartály), cen a situace na českém trhu práce. Tato skutečnost umožňuje provádět návazné analýzy, protože za situace, kdy známe výši reálného produktu a velikost mezery produktu, můžeme pomocí vhodných nástrojů, jako je např. Okunův zákon, stanovit i produkt potenciální, resp. výši přirozené míry nezaměstnanosti, jež potenciálnímu produktu odpovídá.

Výpočet přirozené míry nezaměstnanosti na základě určení mezery produktu a dalších parametrů, uvedených v následujících kapitolách, s tato stať klade jako svůj stěžejní cíl.

1 Formulace problematiky

Graf na obr. 1 s připojenou tabulkou ukazuje hodnoty produktové mezery v ČR za jednotlivá čtvrtletí v letech 1995-2018. Z grafu je jasně patrný cyklický vývoj české ekonomiky, zároveň se na něm však ukazuje ještě jedna důležitá okolnost, a sice že česká ekonomika se v současné době sice nachází nad úrovní potenciálního produktu, avšak tzv. inflační mezera jako kladný rozdíl produktu reálného a potenciálního se pohybuje pod dvěma procentními body. Časté označování současného stavu
ekonomiky ČR jako „přehřáté konjunktury“ je tudíž za těchto okolností poněkud přehnané, což potvrzuje i poměrně nízká meziroční míra inflace, pohybující se v letech 2017-18 na úrovni 2 - 2,5 %.

**Obr. 1: Mezera produktu v ČR 1995-2018 (v % potenciál. produktu, po čtvrtletích)**

![Graph showing quarterly GDP gap in Czech Republic from 1995 to 2018](image)

**Tab. 1: Mezera produktu v ČR 1995-2018 (v % potenciál. produktu, po čtvrtletích)**

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**Zdroj: Makroekonomická predikce České republiky - listopad 2018 (vlastní úpravy)**

Teoreticky by nyní stačilo stanovit okamžiky, kdy je mezera produktu rovná nule, (a reálný produkt se tudíž shoduje s potenciálním) a k těmto okamžikům pak např. na webu Českého statistického úřadu odečíst míru nezaměstnanosti. Realita je ale podstatně komplikovanější, poněvadž zde do hry vstupují dva klíčové faktory:

1. Na tvorbě produktu se vedle práce podílí též kapitál, a jak je patrné z obr. 2, míra jeho využití se v jednotlivých čtvrtletích lišila, někdy i velmi výrazně. O tyto odchylky je nutné mezeru produktu upravit, aby výsledný údaj odrážel výhradně vliv faktoru práce.

2 Metody

Na základě výše uvedeného lze formulovat jednoduchý matematický model, uvádějící do souvislosti všechny uvažované činitele, tedy velikost mezery produktu, její ovlivnění nestejným využitím kapitálu a rovněž vliv měnící se míry ekonomické aktivity obyvatelstva. Pro vytvoření příslušného modelu byly uvažovány následující předpoklady:

a) Při tvorbě HDP se tvrde uplatňovaly konstantní výnosy z rozsahu, přičemž mezní produktivita práce a mezní produktivita kapitálu se sobě rovnaly.

b) Využití kapitálu bylo za sledované období 1995-2018 uvažováno v jednotné výši 84,1 % instalovaných kapacit, tedy na úrovni, kterou graf 2 uvádí jako průměrně využití kapitálu za celé období. Rozdíly ve skutečném využití kapitálu oproti
průměrné hodnotě byly v souladu s předpokladem ad a) kompenzovány koeficientem \( X \), který je určen jako převrácená hodnota podílu skutečné a průměrné hodnoty využití kapitálu v daném čtvrtletí.

c) Míra ekonomické aktivity byla ve sledovaném období 1995-2018 uvažována v jednotné průměrné výši 64,6 %, s tím, že rozdíly ve skutečné míře ekonomické aktivity oproti průměrné úrovni byly v souladu s předpokladem ad a) kompenzovány koeficientem \( Z \), který je určen jako převrácená hodnota podílu skutečné a průměrné hodnoty míry ekonomické aktivity v daném čtvrtletí.

Výsledný matematický vztah, pomocí něhož lze určit čtvrtletní mezeru produktu očištěnou o proměnlivě využití kapitálu a rozdílnou míru ekonomické aktivity obyvatelstva, pak nabývá podoby:

\[
KMP = MP \cdot X \cdot Z
\]

kde \( KMP \) je kompenzovaná mezera produktu, neboli mezera produktu očištěná o vliv proměnlivého využití kapitálu a měnící se míry ekonomické aktivity, \( MP \) je skutečná mezera produktu, uvedená v makroekonomické predikci a rovněž v Tab. 1, \( X \) je koeficient kompenzující proměnlivé využití kapitálu na střední hodnotu 84,1 % a \( Z \) je koeficient kompenzující v čase se měnící míru ekonomické aktivity na střední hodnotu 64,6 %.

Po získání hodnot kompenzované mezer produkty je možné pro takto nalezené hodnoty použít veřejně publikované údaje o míře nezaměstnanosti a následně podle Okunova zákona vypočíst přirozenou míru nezaměstnanosti. Okunův zákon lze matematicky vyjádřit různými způsoby; vyjděme např. z formulace (Helísek, 2000):

\[
\frac{Y}{Y^*} = 1 + c (u^* - u)
\]

kde \( Y \) je reálný produkt, \( Y^* \) potenciální produkt, \( c \) je empiricky zjištěný koeficient lineární závislosti (pohybuje se obvykle v intervalu od 0,02 do 0,03; pro další výpočty je uvažována jeho dolní hranice, neboli 0,02), \( u^* \) je přirozená míra nezaměstnanosti a \( u \) je skutečná míra nezaměstnanosti. Jednoduchou úpravou rovnice (2) dostaneme výraz:

\[
\frac{(Y)}{(Y^*)} - 1 = 0,02 (u^* - u)
\]

kde \( (Y/Y^*) - 1 \) představuje mezeru produktu v desetinných číslech, přesněji řečeno kompenzovanou mezeru produktu (KMP) vypočtenou pomocí rovnice (1). Po následném vynásobení KMP číslem 100 dostaneme KMP v procentech, jak je zvykem ji udávat. Poněvadž míra nezaměstnanosti je rovněž standardně udávána v procentech, tak hledanou přirozenou míru nezaměstnanosti následně vypočítáme podle vzorce:

\[
u^* = 0,5 \text{KMP} + u
\]

3 Rozbor problému

S využitím dat z makroekonomických predikcí a údajů Českého statistického úřadu lze za pomoci rovnic (1), (2) a (3) dospět k následujícím výsledkům (viz. Tab. 2) ohledně výše přirozené míry nezaměstnanosti v České republice
Tab. 2: Mezera produktu a skutečná a přiroz. míra nezaměstnanosti v ČR 1995-2018

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Zdroj: Vlastní výpočty dle Makroekonomické-predikce 2018

Jak je patrné, vypočtené hodnoty přirozené míry nezaměstnanosti vykazují poměrně značné kolísání. To je ve zdánlivém rozporu s představou o přirozené míře nezaměstnanosti jako vytrvale stabilní úrovni, měnící se v e velmi dlouhodobém horizontu v důsledku hysterezi na trhu práce (Tobin, 1980), tzv. „vydržovacích poměrů“ (Mindorf, 1985) či tzv. „vykazovacích efektů“ (Dornbusch - Fischer, 1994).

Ale česká ekonomika ve svém transformačním období v 90. letech ještě nebyla standardní tržní ekonomikou, z jejíhož fungování odvozují své závěry výše uvedení ekonomové. Odvětvová skladba ekonomiky ČR zaznamenávala v 90. letech velké strukturální změny (útlum těžkého průmyslu, později zánik velkých podniků typu ČKD, Poldi atd.) a situace na trhu práce tomu zákonitě odpovídala. Vzhledem k tomu, že součástí přirozené míry nezaměstnanosti je strukturální nezaměstnanost, dá se tím snadno vysvětlit její strmý nárůst v druhé pol. 90. let, kdy za nikala dříve tradiční pracovní místa v těžkém průmyslu a namísto nich vznikaly pracovní příležitosti nové, převažně v terciárním sektoru. Tím vznikala strukturální nezaměstnanost, jež se začala výrazně snižovat až o několik let později po uskutečněné requalifikaci alespoň u části pracovních sil.

Dále je třeba si uvědomit, že ve vzájemných interakcích makroekonomických ukazatelů se prosazuje jistá setrvačnost a že tedy situace na trhu práce neodráží vývoj HDP v reálném čase, nýbrž až se značným, zpravidla několikaměsíčním zpožděním. Např. při nástupu recese, kdy HDP klesá, míra nezaměstnanosti se po řadu měsíců chová zdánlivě indiferentně; tento jev je způsobován existencí pracovní legislativy, neumožňující propustit nadbytečné pracovníky okamžitě, ale až po uplynutí příslušné výpovědní doby. Naopak při ekonomickém oživení firmy svůj výstup nejprve zvysují dokonalejším využitím výrobních kapacit při nezměněné pracovní síle a až teprve
s odstupem, daným probíhajícími konkurzy a výběrovými řízeními, začínají nabírat nové pracovníky. Proto se tedy empirická závislost mezery produktu a míry nezaměstnanosti dle Okunova zákona v reálném čase od sebe odchyluje a vede ke zdánlivým disproporcím.

Ze všech těchto důvodů je třeba za hlavní indikátor vývoje přirozené míry nezaměstnanosti považovat ani ne tak spojnicovou křivku v grafu na obr. 4, odrážející údaje z Tab. 2, jako spíše z ní vycházející trendovou linii, jež vykazuje v dlouhodobém, třiadvacetiletém časovém horizontu sestupnou tendenci:

**Obr. 4: Vývoj přirozené míry nezaměstnanosti v ČR v letech 1995-2018**

Z grafu je patrné, že přirozená míra nezaměstnanosti se ve sledovaném období snížila z původních cca 7% na současných 4 až 5 procent. To plně odpovídá jak teoretickým postulátům, tak i realitě pracovního trhu v ČR. Přirozená míra nezaměstnanosti sestávající z nezaměstnanosti strukturální a fríkční není nějaká neměnná konstanta; její výše je ovlivňována řadou skutečností. Strukturální nezaměstnanost se od 90. let snížila, na čemž měla nepochybně podíl celá řada skutečností; počínaje schválením zákona o zaměstnanosti č. 435/2004 Sb., kladoucím prioritní důraz na prosazování aktivní politiky zaměstnanosti, přes odvětvové změny české ekonomiky (sektor služeb, který v současnosti dominuje tvorbě HDP, se s výjimkou jazykové vybavenosti pracovníků vesměs vyznačuje nižšími nároky na specializovanou profesní kvalifikaci oproti odvětvím těžkého průmyslu, zejména strojiremnství) až po strukturní změny výuky ve školství, v němž se v současnosti klade velký důraz právě na jazykovou přípravu žáků a studentů, požadovanou obzvláště v sektoru služeb.

Co se týče druhé složky přirozené míry nezaměstnanosti, kterou je nezaměstnanost fríkční, tak ta se nepochybně v dlouhodobém horizontu snižuje rovněž, což je způsobováno zlepšujícími se informacemi o situaci na pracovním trhu. Zdánlivě by to mohlo být považováno za rozpor s obecně uznávanou tendenci k nárůstu fríkční nezaměstnanosti v zemích s výraznými projevy tzv. „sociálního státu“. Důvodem je zejména štědrá sociální politika, vedoucí k dobrovolné nezaměstnanosti, jež
představuje podstatnou součást nezaměstnanosti frikční, a dále zneužívání této sociální politiky, kdy formální registrace na úřadu práce a pobírání podpory v nezaměstnanosti je doprovázeno tzv. prací načerno.

Faktem ale je, že oproti zemím jako Francie, Švédsko apod. jsou sociální dávky v České republice neporovnatelně nižší a uvedené negativní jevy, i když samozřejmě existují i zde, tak ale se projevují v daleko menší míře.

4 Diskuze

Model pro výpočet přirozené míry nezaměstnanosti, uplatněný v této stati, vedl k výsledkům, jež jsou sice jen aproximací skutečných hodnot přirozené míry nezaměstnanosti, ale které, jak bylo ukázáno v grafu 4, přesto odrážejí teoretické předpoklady o závislosti přirozené míry nezaměstnanosti na dostupnosti informací o situaci na pracovním trhu a účinnosti uplatňování aktivní politiky zaměstnanosti jako nástroje pro řešení zejména nezaměstnanosti strukturální. Na základě získaných hodnot přirozené míry nezaměstnanosti lze tudíž konstatovat, že dosažené výsledky mají vypovídací hodnotu a jsou dostatečně validní.

Porovnáme-li získané údaje s výsledky v obdobných studiích z poslední doby, zjistíme, že vedou k podobným závěrům.

Podle autorek Kadeřábkové a Jašové (2011) se NAIRU v letech 2001-10 vyvíjela následovně (viz obr. 5):

\[\text{Obr. 5: Vývoj NAIRU v ČR v letech 2001-2010}\]

Komparaci zde komplikuje odlišný sledovaný časový interval, ale je zřejmé, že v grafu 5 se v letech 2001-2010 NAIRU snižovala od výchozích cca 6,3 % do konečných cca 5,3 %.

To je v dobré shodě s výsledky dosaženými modelem z tohoto článku, podle něhož ve stejném období přirozená míra nezaměstnanosti klesala z 6,3 % na 5,5 %.

Jiné empirické výsledky přináší výzkum E. Jašové (2010), podle níž NAIRU v letech 1999 až 2008 (s predikcí do r. 2010) nabývala intervalových hodnot, uvedených v obr. 6:
Obr. 5: Skutečná míra nezaměstnanosti a NAIRU v ČR v letech 1999-2010

Zde jsou výsledky naopak zřetelně odlišné, což má svou primární příčinu v rozdílné metodice, neboť zde nebyla NAIRU odvozována jako spojitá trendová přímka (u modelu z této stati) či křivka (v grafu na obr. 5) v rámci časového intervalu, nýbrž jako množina horizontálních přímek v rámci kratších období.

Nicméně i zde je vidět shoda v tom, že po roce 1999 má NAIRU zřetelně sestupnou tendenci.

Pro dosažení přesnějších výsledků by nicméně bylo možné sestrojit model podstatně náročnější, a to zejména z hlediska předpokladu ad a) v kapitole 1. Metodika. Tedy jinými slovy, vzít v potaz reálný vývoj výnosů z rozsahu ve výrobě (resp. v jednotlivých výrobních odvětvích, neboť ta se od sebe tvarem produkční funkce nepochybně liší), skutečný průběh křivky rostoucího výstupu v daných odvětvích (zejména se zřetelem na to, zda je ta která výroba pracovně či kapitálově náročná), a vývoj mezní produktivity kapitálu.

Takto vytvořený rozvinutý model výpočtu přirozené míry nezaměstnanosti by pro Českou republiku vycházel z údajů o tvorbě HDP (hrubá přidaná hodnota podle odvětví), publikovaných na stránkách ČSÚ, a do metodiky výše uvedeného jednoduchého modelu by vnesl následující korekce:

Namísto rovnice (1) pro výpočet Kompenzované mezery produktu by musela být použita rovnice ve tvaru:

\[ OMP = \Delta K_O \cdot MP_K \cdot X \cdot Z \]  \hspace{1cm} (5)

kde OMP je odvětvová mezera produktu, neboli mezera produktu jednotlivých národněhospodářských odvětví očištěná o vliv proměnlivého využití kapitálu v daném odvětví a měníci se míry ekonomické aktivity, \[ \Delta K_O \] je meziroční přírůstek kapitálu v daném odvětví, \[ MP_K \] mezní produktivita kapitálu v daném odvětví, vyjádřená jako podíl přírůstků produkce daného odvětví a přírůstku hrubého fixního kapitálu v odvětví za jednotlivá čtvrtletí, \[ X \] je koeficient kompenzující proměnlivé využití kapitálu na střední hodnotu 84,1 % a \[ Z \] je koeficient kompenzující v čase se měnící míru ekonomické aktivity na střední hodnotu 64,6 %.
Kompenzovaná mezera produktu by pak byla následně určena jako vážený průměr za jednotlivá hospodářská odvětví, přičemž váhou jednotlivých odvětví by byl jejich podíl na tvorbě HDP České republiky.

Rovnice (2), udávající velikost mezery produktu podle Okunova zákona, by teoreticky měla vycházet z konkrétních podmínek dané (české) ekonomiky, s tím, že do rovnice by měla být zakomponována empiricky zjištěná cítlivost mezery produktu na fluktuacích trhu práce. Problémem je, že neexistuje uskutečněná časová řada empirických podkladů pro určení koeficientu lineární závislosti c v rovnici (2), a z toho důvodu by bylo nutné i nadále uvažovat hodnotu koeficientu c ve výši 0,02.

Rovnice (3) by byla použita v nezměněném tvaru, přičemž parametr KMP (kompenzovaná mezera produktu) v rovnici by byl váženým průměrem soustavy rovnic (5).

Aplikace výše popsaného komplexního modelu na výpočet přirozené míry nezaměstnanosti by nesporně byla velmi ambiciózním úkolem, zejména z důvodu mimořádně komplikovaného sběru podkladových dat; volně dostupné údaje o hrubé tvorbě kapitálu jsou totiž k dispozici za ekonomiku jako celek (nikoliv za jednotlivá národněhospodářská odvětví). V principu ovšem není nemožné tato data získat.

Závěr

Jednoduchý matematický model, využívající pro výpočet přirozené míry nezaměstnanosti hodnoty mezery produktu, vede k výsledkům potvrzujícím teoretické předpoklady založené na důvodech nezaměstnanosti frikční i strukturalní. Frikční nezaměstnanost může být snížena lepšími informacemi o situaci na pracovním trhu (vliv online informací dostupných na internetu je ve sledovaném období 1995-2018 neoddiskutovatelný, navíc vznikly specializované zprostředkovatelské pracovní agentury), strukturalní celou řadou aktivní politiky zaměstnanosti (rekvalifikace, veřejné práce, podpora malého soukromého podnikání apod., přičemž na aktivní politiku zaměstnanosti se v současné době kladne nejen v rozhodně větší důraz, než v 90. letech). Přestože se jedná o model založený na řadě zjednodušujících postulátů, vzhledem k dlouhodobé datové řadě získané období 23 let se výstupy získané jeho prostřednictvím jeví jako dostatečně validní.

Další zpřesňování dosažených výsledků by bylo možné, pokud by faktory pokládané v prezentovaném modelu axiomaticky za konstanty, jako typ výnosů z rozsahu, shoda mezní produkivity práce a kapitálu apod. byly uvažovány jako proměnné. Ani takovýto komplexní model by však nic zásadního nezměnil na vypovídací schopnosti údajů zjištěných modelem jednoduchým, pouze by umožnil dokonaleji specifikovat údaje zjištěné v této státi.

Reference


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WORKING CAPITAL AND ITS IMPACT ON BUSINESS PERFORMANCE

Irena Honková

Abstract: A number of studies indicate that the decision on the level of working capital affects business performance. Managing optimal working capital brings businesses sustained reduction of working capital, improves liquidity and increases profitability through effectively managed capital. The aim of this paper is to conduct empirical research of Czech companies on the relationship between working capital and the performance of a company. An OLS model is used that can calculate quadratic regression for calculating the optimum amount of working capital. Models are created that describe the dependency of earnings on the components that determine working capital. By deriving the quadratic function of performance, an inflection point is found, indicating a theoretical net trade cycle of 134 days for Czech companies with inventory and 70 days for Czech companies with no inventory. However, there is a level of working capital at which a higher working capital begins to be negative in terms of profitability due to the additional interest expenses and, hence, the higher probability of bankruptcy and credit risk of firms. Thus, firm managers should aim to keep as close to the optimal level as possible and try to avoid deviations from it that destroy profitability.

Keywords: Working Capital, Net Trade Cycle, Ordinary Least Squares (OLS) Method

JEL Classification: M21.

Introduction

Research conducted by the PricewaterhouseCoopers consultancy (PwC, 2012) highlighted the inefficient management of working capital in the practice of European businesses. The research was based on comparing working capital with a percentage of the sales performance of businesses, and included the 4000 largest European companies from 34 countries, including the Czech Republic, during the years 2007 - 2011. The research found that the largest European businesses lost about 400 billion EUR due to inefficient management of working capital. This is equivalent to about a third of their earnings. Companies in southern Europe could gain up to 40% of their earnings, with British and Irish companies gaining 22%. The results confirmed that, on the contrary, companies that are able to manage working capital effectively are doing better.

The authors Madhou, A., Moosa, I. & Ramiah, V. (2015), Kim and Chung (1990) seem to think that the decision about the amount of working capital affects corporate performance. Managing an optimal working capital provides businesses with (PWC, 2007) a sustained reduction of working capital, improving liquidity and increasing return on assets through effectively managed capital.

1 Statement of a problem

Terminology in the definition of working capital is unclear, as different Czech authors often use two terms – “working capital” and “net working capital” - interchangeably.

In the narrower sense, some, such as Hrdý & Krechovská (2013), define working capital as current assets and net working capital after deducting short-term liabilities.
Due to the terminology of foreign authors, the term working capital will be used in this paper for the difference between current assets and short-term liabilities.

As has been said, working capital is defined as the difference between current assets and short-term liabilities. It is a part of long-term financial resources that is used to cover short-term assets. It serves to finance the normal day-to-day operation of a business (Jindřichovská, 2013).

Investments in receivables and inventories represent a significant proportion of a company's assets, while liabilities to suppliers are a significant source of funding for most businesses. Research (Honková, 2016) carried out in 2014 found that 48% of the total capital were commitments to suppliers. In the UK, the business loan represents about 41% of the total debt of medium-sized enterprises (Baňos, 2014). Working capital should achieve positive values because of the positive effect on the liquidity of a company (Fazzari & Petersen, 1993). According to the authors Blinder and Maccini (1991), larger inventories can minimize delivery costs and price fluctuations and act as a means of preventing production breaks and losses due to lack of material or products. It enables businesses to provide better customer service and protects from increased production costs (Schiff & Lieber, 1974). Kroflin & Kratz (2015) traditionally show high attention to liquidity. Authors Ding, S., Guariglia, A. & Knight, J. (2013) display high sensitivities of investment in working capital to cash flow and low sensitivities of investment in fixed capital to cash flow. On the other hand, if businesses provide trade credit, they can increase their sales (Brennan, Maksimovic, & Žechner, 1988); trade credit enables customers to check and use the goods or services prior to payment and strengthens supplier-customer relationships (Wilner, 2000, Smith & Tirell, 1987). Trade credit also reduces the information inequality between the buyer and the seller. Shipley and Davis (1991) believe that trade credit is also an important criteria for choosing a supplier if it is otherwise difficult to differentiate the product.

The positive level of working capital has, of course, a However, working capital is not purely maximizing, as there are arguments that criticize too high a working capital. Storing too many goods increases warehouse and inventory insurance costs (Kim & Chung, 1990). A large amount of working capital raises the need for additional capital and therefore additional capital costs. Interest costs and credit risk are increasing. (Kieschnick, LaPlante, & Moussawi, 2011). There are also financial constraints that complicate the financing of working capital. Fazzari and Petersen (1993) believe that investments in working capital are more sensitive than fixed capital investments. Hill, Kelly and Highfield (2010) show that businesses with lower financial constraints achieve higher levels of working capital. Financial constraints include paid dividends (Faulkender and Wang, 2006), size and interest coverage (Whited, 1992), cash flow (Moyen 2004) and financial costs (Fazzari, Hubbard & Petersen, 1988).

There is also a conflict between liquidity and return. Increasing short-term liabilities leads to a reduction of liquidity; on the other hand, short-term liabilities have lower financing costs than long-term instruments. Flexibility is definitely an advantage of short-term commitments, with another advantage being lower funding costs. The disadvantage is the fact that their costs are not fixed in the long term and that they may sometimes be unavailable. (Jindřichovská, 2013)
Thus, it can be generally said that the more the enterprise invests in working capital, the greater the liquidity, however the lower the return on assets. If we were looking at return on assets as a determinant of improving the performance of a business, we could at first glance say that the lower the working capital, the more the enterprise increases its value. However, efforts to minimize working capital could lead to many problems.

The studies listed in Tab.1 show the relationship between working capital and return on assets.

**Tab. 1: Studies focusing on the relationship between working capital and return on assets**

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</tr>
<tr>
<td>Banos &amp; Caballero et al. (2012), Spain</td>
<td>2002-2007</td>
<td>ROA</td>
<td>Concave</td>
</tr>
<tr>
<td>Enqvist et al. (2012), Finland</td>
<td>1990-2008</td>
<td>Gross oper. profit</td>
<td>NTC↓</td>
</tr>
<tr>
<td>Wöhrmann et al. (2012), Germany</td>
<td>2007-2010</td>
<td>ROCE</td>
<td>NTC↓</td>
</tr>
</tbody>
</table>

*Source: (own)*

Working capital management studies usually have two views. The first view states that higher amounts of working capital allow companies to increase their sales and therefore their business performance. Authors Fazzari and Petersen (1993) suggest in their analysis, that investing in working capital is more sensitive to funding limitations than investing in fixed capital. Alternative studies state that higher working capital needs increased funding and hence other financial costs that reduce profitability and can lead to bankruptcy. (Wang, 2002, Faulkender & Wang, 2006) The combination of these positive and negative effects of working capital on the performance of a business leads to the prediction that there is no direct linear relationship between the working capital and the value of a business. It can be assumed that the reduction of working capital may increase the performance of a business to some extent, but after achieving its optimum, further reduction of working capital would lead to a reduction in the value of a business. Therefore, it can be assumed that the influence of working capital on the performance of a company is a function in the form of the inverted U, i.e. a concave quadratic function, by means of which an optimal level of working capital can be found. Thus, raising working capital to a certain level increases the company's performance, but once
the optimal level is reached, the relationship between working capital and business performance becomes negative.

In terms of performance measurement, we turn to the return on equity (ROE) indicator, based on the Du point analysis. There is a model that calculates the performance of a company, primarily in terms of working capital from Shin & Soenen (1998) and others by Agrawal & Knoeber (1996), Himmelberg, Hubbard & Palia (1999), Thomsen, Pedersen & Kostakis & Ozkan (2009) and Wu (2011):

$$Q_{it} = \beta_0 + \beta_1 NTC_{it} + \beta_2 NTC^2_{it} + \beta_3 SIZE_{it} + \beta_4 LEV_{it} + \beta_5 ROA + \lambda_t + \eta_i + \epsilon_{it}$$  \hspace{1cm} (1)

where:

- $Q_i$ is business performance as expressed by the ROE indicator.
- Working capital is expressed in this model using the net trade cycle (NTC) (Shin & Soenen (1998)). Because of the mentioned quadratic function, the NTC is considered in the first and second powers. Other variables that affect business performance are according to the previous mentioned researches: size (SIZE), leverage (LEV) and return on assets (ROA).

The NTC is calculated as (accounts receivable/sales) * 365 + (inventories/purchases) * 365 – (accounts payable/purchases) * 365. Thus, NTC deals with the management of accounts receivable, the management of inventories and the trade credit received, with a shorter NTC indicating a more aggressive working capital policy. Previous publications report the importance of considering there three components at the same time because they influence each other as well as profitability and value. Schiff and Lieber (1974), for example, indicate the importance of taking into account the interrelationship between inventory and accounts receivable policies. We regress the profitability and against NTC and its square. The inclusion of these two variables allows us to test both the profitability and risk effects. The quadratic relation proposed in Eq.1 presents and breakpoint that can be derived by differentiating the firm’s profitability variable with respect to the NTC variable and making this derivative equal to 0. Since we expect NTC and corporate performance to relate positively at low levels of working capital and negatively at higher levels, the hypothesis is that $\beta_2$ is negative, because it would indicate that firms have an optimal working capital level that balances the costs and benefits of holding working capital and maximizes their performance.

We measure firm size (SIZE) as the natural logarithm of sales; leverage (LEV) by the ratio of total debt to total assets; and the measurement of return on assets (ROA) is through the ratio earnings before interest and taxes over total assets. The parameter $\lambda_t$ is a time dummy variable that aids to capture the influence of economic factors (e. i. GDP, inflation, unemployment, political and legislative background) that may also affect corporate performance but with companies cannot control. $\eta_i$ is the unobservable heterogeneity or the firm’s unobservable individual effects, so we can control for the particular characteristics of each firm. Finally, $\epsilon_{i,t}$ is the random disturbance. We also control for industry effects by introducing industry dummy variables.

The aim of this paper is to determine the coefficient $\beta_0$ and the variables $\beta_1 - \beta_5$, thus creating a model of influence of working capital on the company's performance.

In contrast to Shin & Soenen (1998), Agrawal and Knoeber (1996), Himmelberg, Hubbard & Palia (1999), Thomsen, Pedersen & Kvist, models are created separately for
no-inventory businesses and for inventory-holding businesses, as the most significant component of NTC's working capital is substantially influenced by inventory. The aim is to create a profit maximization model using an optimal level of net trade cycle.

2 Methods

The data in this paper is from the MagnusWeb database. It is a database of Czech companies of 2016 and 2015. All enterprises that keep their accounts and have published their financial statements in the monitored years were included in the research. This is a significant indicator for calculating working capital. The companies were divided according to whether or not they held inventory. A sample of companies with inventory was 3254. A sample of companies with no inventory was 1190. Due to incomplete data, this number was reduced to 1953 companies with inventory and 958 companies without inventory. Due to the sufficient number of samples, the assumption of the normality of distribution was assumed.

The data was edited in MS EXCEL and subsequently exported to the GRETL program, where statistical calculations were performed.

As mentioned in the previous chapter, the function of the influence of working capital on the company's performance is a function in the form of inverted U, i.e. a concave quadratic regression. Quadratic regression is the case of polynomial regression where the degree of polynomial $P_k$ is equal to two. As such, this is a special case of linear regression. The set of values is interleaved (approximated) by the quadratic function (parabola). Polynomial coefficients (parabola) are calculated using the Ordinary Least Squares (OLS) method.

Data are interleaved with a parabola, or a second order polynomial $P_2(x) = ax^2 + bx + c$. The sum of deviations squares $e_i = y_i - P_2(x_i)$ function $F$ depends on parameters $a$, $b$, $c$ in particular $\beta_0-\beta_5$. The minimum of the functional $F$ can be found by partial derivations (at the local extreme are equal to zero):

$$\frac{\partial F}{\partial \beta_0} = \frac{\partial F}{\partial \beta_1} = \frac{\partial F}{\partial \beta_2} = \frac{\partial F}{\partial \beta_3} = \frac{\partial F}{\partial \beta_4} = \frac{\partial F}{\partial \beta_5} = 0$$

(2)

The multiple regression model works with more than one explanatory variable, in our case (1). The task is to estimate parameters $\beta_0$, $\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$, $\beta_5$. These parameters indicate how much, on average, the estimated value $Q_{i,t}$ increases, if an explanatory variable increases by one, assuming that the other variables do not change.

3 Problem solving

Using the OLS method, multiple regression was calculated, where the dependent variable was the ROE indicator representing the performance of the business. Equations (3) and (4) represent a function of profit depending on the items that determine working capital. Equation (3) is for businesses with inventory and equation (4) for businesses with no inventory. Companies with inventory put a greater emphasis on NTC and ROA, companies with no inventory on size and financial leverage.

$$Q_{i,t} = -54,5751 + 0,0205NTC_{i,t} - 7,6146 e - 0,5 NTC^2_{i,t} + 3,7335 SIZE_{i,t} + 0,0773 LEV_{i,t} + 0,7162 ROA + \lambda_t + \eta_t + \varepsilon_{i,t}$$

(3)

$$Q_{i,t} = -54,5751 + 0,0205NTC_{i,t} - 7,6146 e - 0,5 NTC^2_{i,t} + 3,7335 SIZE_{i,t} + 0,0773 LEV_{i,t} + 0,7162 ROA + \lambda_t + \eta_t + \varepsilon_{i,t}$$
\[ Q_{t,t} = -67,073 + 0,0146NTC_{t,t} - 1,0336 e - 0,4 NTC^2_{t,t} + 5,6722 SIZE_{t,t} \\
+ 0,3284 LEV_{t,t} + 0,1794 ROA + \lambda_t + \eta_t + \varepsilon_{t,t} \]

(4)

Except the sq_NTC variable and the coefficient \( \beta_0 \), all variables are positively dependent on the profit, which means that the profit increases with increasing variables.

We test the hypothesis \( \beta = 0 \), that the model generally explains the ROE well. Critical t-test values fall into critical areas in the following cases: for businesses with inventories for all indicators except for the ROA indicator, for non-inventory enterprises these are const, NTC and sq_NTC constants (Tab 2 and Tab 3).

**Tab. 2: OLS Statistical Values - Businesses with inventories**

| The mean value of the dependent variable | -0,230163 |
| Determinative deviation of the dependent variable | 473,1739 |
| Sum of squares of residues | 7,23e+08 |
| Determinative error of regression | 471,9309 |
| Determination coefficient | 0,006776 |
| Adjustment Determination Coefficient | 0,005247 |
| F(5,) | 4,431652 |
| P-value(F) | 0,000503 |
| Logarithm of credibility | -24648,56 |

*Source: own*

**Tab. 3: OLS Statistical Values - Businesses without inventories**

| The mean value of the dependent variable | 6,650177 |
| Determinative deviation of the dependent variable | 186,4057 |
| Sum of squares of residues | 31557071 |
| Determinative error of regression | 182,0664 |
| Determination coefficient | 0,050999 |
| Adjustment Determination Coefficient | 0,046015 |
| F(5,) | 10,23211 |
| P-value(F) | 1,44e-09 |
| Logarithm of credibility | -6342,122 |

*Source: own*

ANOVA scattering analysis contains estimated values using the SSR model, unexplained random portion (SSE), and total SST sum (Tab 4. a Tab. 5). The created model is better for businesses with no inventory.
Tab. 4: ANOVA Analysis – Businesses with inventories

| Source: own |

<table>
<thead>
<tr>
<th>Sum of squares</th>
<th>df</th>
<th>Middle quadrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression (SSR)</td>
<td>4,93506e+006</td>
<td>5</td>
</tr>
<tr>
<td>Residue (SSE)</td>
<td>7,23391e+008</td>
<td>3248</td>
</tr>
<tr>
<td>Full (SST)</td>
<td>7,28326e+008</td>
<td>3253</td>
</tr>
</tbody>
</table>

Tab. 5: ANOVA Analysis – Businesses without inventories

| Source: own |

<table>
<thead>
<tr>
<th>Sum of squares</th>
<th>df</th>
<th>Middle quadrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression (SSR)</td>
<td>1,69588e+006</td>
<td>5</td>
</tr>
<tr>
<td>Residue (SSE)</td>
<td>3,15571e+007</td>
<td>952</td>
</tr>
<tr>
<td>Full (SST)</td>
<td>3,3253e+007</td>
<td>957</td>
</tr>
</tbody>
</table>

The problem that arises when testing model parameters is multi-collinearity. It results from a correlation between independent variables. The easiest way to determine if there is a strong correlation between the variables is to look at the correlation matrix. As can be seen in our model (Tab. 6 and Tab. 7), the values are not high as to not cause multi-collinearity problems. According to (Koop, 2008) the value is binding if there is a correlation in an absolute value greater than 0.9.

Tab. 6: Correlation Analysis - Businesses with inventories

| Source: own |

<table>
<thead>
<tr>
<th>ROA</th>
<th>ROE</th>
<th>Leverage</th>
<th>l_SIZE</th>
<th>NTC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,0000</td>
<td>0,0768</td>
<td>0,0007</td>
<td>0,0770</td>
<td>0,1006</td>
</tr>
<tr>
<td>1,0000</td>
<td>0,0159</td>
<td>0,0236</td>
<td>0,0084</td>
<td>ROE</td>
</tr>
<tr>
<td>1,0000</td>
<td>0,0219</td>
<td>-0,0054</td>
<td>Leverage</td>
<td></td>
</tr>
<tr>
<td>1,0000</td>
<td>0,1356</td>
<td>l_SIZE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,0000</td>
<td>NTC</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tab. 7: Correlation Analysis - Businesses without inventories

| Source: own |

<table>
<thead>
<tr>
<th>ROA</th>
<th>ROE</th>
<th>Leverage</th>
<th>l_SIZE</th>
<th>NTC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,0000</td>
<td>0,2013</td>
<td>0,0484</td>
<td>0,0026</td>
<td>0,0791</td>
</tr>
<tr>
<td>1,0000</td>
<td>0,0331</td>
<td>0,0309</td>
<td>0,0804</td>
<td>ROE</td>
</tr>
<tr>
<td>1,0000</td>
<td>-0,1011</td>
<td>0,0554</td>
<td>NTC</td>
<td></td>
</tr>
<tr>
<td>1,0000</td>
<td>0,0169</td>
<td>Leverage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,0000</td>
<td>l_SIZE</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

T-test is used to test the significance of variables (Tab. 8 and Tab. 9). It tests whether it is possible to reject the hypothesis that $\beta = 0$ and therefore say that statistically, the given coefficient is not insignificant at the chosen materiality level.
Tab. 8: T-test Businesses with inventories

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>95 confidential interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Const</td>
<td>-54,5761</td>
<td>(-128,648, 19,4960)</td>
</tr>
<tr>
<td>ROA</td>
<td>0,716165</td>
<td>(0,397802, 1,03453)</td>
</tr>
<tr>
<td>l_SIZE</td>
<td>3,73353</td>
<td>(-1,84715, 9,31420)</td>
</tr>
<tr>
<td>NTC</td>
<td>0,0204506</td>
<td>(-0,0244794, 0,0653806)</td>
</tr>
<tr>
<td>sq_NTC</td>
<td>-7,61461e-007</td>
<td>(-2,11102e-005, 1,95873e-005)</td>
</tr>
<tr>
<td>Leverage</td>
<td>0,0773368</td>
<td>(-0,123213, 0,277887)</td>
</tr>
</tbody>
</table>

Source: own

Tab. 9: T-test Businesses without inventories

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>95 confidential interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>const</td>
<td>-67,0733</td>
<td>(-119,024, -15,1225)</td>
</tr>
<tr>
<td>ROA</td>
<td>1,17940</td>
<td>(0,808187, 1,55061)</td>
</tr>
<tr>
<td>Leverage</td>
<td>0,328362</td>
<td>(0,0418209, 0,614904)</td>
</tr>
<tr>
<td>NTC</td>
<td>0,0146489</td>
<td>(-0,00741492, 0,0367126)</td>
</tr>
<tr>
<td>l_SIZE</td>
<td>5,67215</td>
<td>(1,05438, 10,2899)</td>
</tr>
<tr>
<td>sq_NTC</td>
<td>-1,03395e-006</td>
<td>(-1,10953e-005, 9,02744e-006)</td>
</tr>
</tbody>
</table>

Source: own

4 Discussion

How above mentioned, working capital should achieve positive values but it is not purely maximizing because of additional costs (Kim and Chung, 1990) (Kieschnick, LaPlante, & Moussawi, 2011). On the one hand, there is liquidity, continuity of production and lower financial constraints and on the other hand profitability. Both of these influences act against one another. Working capital includes return on assets (ROA) and liquidity. Both of these influences act against one another. Thus, the ROE profit maximization function with working capital is a concave quadratic function. The more the company invests in short-term assets, the better the liquidity of the company. The company may invest in short-term assets to improve its liquidity - cash and securities - but these assets generate a small return. Therefore, the company can reduce the risk of insolvency (low liquidity) only by reducing return on assets and vice versa (Jindřichovská, 2013).

Since we expect NTC and corporate performance to relate positively at low levels of working capital and negatively at higher levels, the hypothesis is that β2 is negative, because it would indicate that firms have an optimal working capital level that balances the costs and benefits of holding working capital and maximizes their performance. Models (3) and (4) that were developed describe the dependence of profit (ROE) on components determining working capital (net trade cycle, size, leverage, ROA). The concavity of this function was proved by negative parameters in models (3) and (4).
Model (1) allows us to determine when profit maximization occurs by derivation the inflection point becomes as \(-\beta_1 / 2\beta_2\). For the model (3) "Businesses with inventories" it is calculated as:

\[
N_{TC_{optimal}} = \frac{-0.0205}{-2+0.000076146} = 134 \text{ days}
\]

For the model (4) “Businesses without inventories” it is calculated as:

\[
N_{TC_{optimal}} = \frac{-0.0146}{-2+0.00010336} = 71 \text{ days}
\]

For model (3) – “businesses with inventories”, the optimal level of net trade cycle is calculated as 134 days. For model (4) “businesses with no inventory”, the optimal level of net trade cycle is calculated as 70 days.

**Conclusion**

The aim of this paper was to conduct empirical research into the relationship between working capital and business performance (ROE). A number of studies, generally agreeing that the amount of working capital affects the performance of a business, researches the relationship between the amount of working capital and business performance. Model (1) shows this dependence. The variables include net trade cycle, size, leverage and ROA of the business. On a representative sample of Czech companies, a model (3) was created for enterprises that do not have stocks and a model (4) for enterprises with stocks. These models show the dependence of working capital, enterprise size, indebtedness and ROA profitability on the resulting ROE profitability. While the dependence of these variables on ROE is statistically insignificant for the purposes of ROE maximization (since ROE depends on many other variables), the data from these models were used to calculate the optimum working capital, ie, net trade cycle at which highest profitability (ROE).

The OLS model was used, which calculated a quadratic regression of calculating the optimal amount of working capital.

The developed models (3) and (4) describe the dependence of profit on components determining working capital. However, it was calculated that except the sq_NTC variable and the coefficient \(\beta_0\), all variables are positively dependent on the profit, which means that the profit increases with increasing variables. The negative value sq_NTC has confirmed the concave shape of this quadratic working capital function. The inflection point was derived from this quadratic function, indicating a theoretical net trade cycle of 134 days for Czech companies with inventory and 70 days for Czech companies with no inventory.

However, there is a level of working capital at which a higher working capital begins to be negative in terms of profitability due to the additional interest expenses and, hence, the higher probability of bankruptcy and credit risk of firms. Thus, firm managers should aim to keep as close to the optimal level as possible and try to avoid deviations form it that destroy profitability.

Results suggest that managers should be concerned about working capital level because it seems to affect the corporate performance.
References


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SELECTED DETERMINANTS OF TOURISM DEMAND – PANEL COINTEGRATION ANALYSIS

Tomáš Jeřábek

Abstract: The aim of the paper is to investigate the effect of income of tourists, tourism price, trade openness and international outbound tourists in tourism origin countries on the tourism demand to the Czech Republic as well as to South Moravia Tourist Region of the Czech Republic from tourists coming from thirteen different countries is analysed. This paper applies panel co-integration analysis through a common correlation effect model (CCE). According to the obtained estimation results, income and trade openness have a significant positive influence on international arrivals to the Czech Republic, while for tourism price the results indicate that it has a negative influence on inflows, as expected. The effect of international outbound tourists on tourism demand in the Czech Republic is negative, against expectations, but it is not statistically significant. For tourism demand in the SMT region, income has a significant positive influence on international arrivals to the South Moravia tourist region, as it regards relative price, the negative sign of the coefficient is the same as the expected one. The effects of trade openness and international outbound tourists on tourism demand in the SMT region have expected positive signs but they are not statistically significant.

Keywords: Tourism Demand, Panel Cointegration Analysis, Real Exchange Rate, Gross Domestic Product, Trade Openness, International Outbound Tourists.

JEL Classification: F14, F47, Z3.

Introduction

Modelling and forecasting tourism demand has a long history. However, due to the development of a mixed autoregressive model (ARIMA) for the analysis of one-dimensional time series, it has started more pronounced since the 1970s. In the 1990s, ARIMA models added more advanced techniques for analysing multidimensional time series, namely vector autoregressive (VAR) models, error correction models (ECM), and vector ECM (VECM). One of the main advantages of these techniques is the ability to analyse causal relationships between the tourism demand as a dependent variable and its influential factors - explanatory variables. The applications of all these models can be seen in studies of the last decade. For example, Bonham et al. (2009) apply VECM to predict tourism in Hawaii. Chaiboonsri et al. (2009) through VECM seek to find short-term and long-term relationships between foreign tourists traveling to Thailand and economic variables such as international arrivals, gross domestic product, goods and services, transport costs and exchange rates. Gautam (2014), using cointegration techniques and the VECM model, examines long-term relationships between economic growth and tourism development in Nepal.

The above studies explore data in the form of time series that are capable of delivering a large number of results, but many observations remain hidden, such as more complicated spatial dependencies. The solution is to use so-called panel data. Panel data is spatial data that is repeatedly retrieved over multiple time periods. The
exploration of long-term relationships within panel data is the main purpose of this text. The paper represents a little-used approach to tourism demand analysis based on panel cointegration analysis. For example, Falk (2015) applied a panel ECM model to analyse the impact of the euro’s depreciation on the Swiss overnight stays in selected Austrian ski resorts. The author confirms the higher sensitivity of tourism demand to the development of the analysed exchange rate, in other words, Swiss visitors to Austrian ski resorts are strongly affected by CHF/EUR exchange rates. Ongan et al (2017) investigate the effects of real exchange rates and income on tourist arrivals from seven countries to the USA. According to the test results, the effect of income as a measure of GDP as well as the effect of RER on the number of tourists arriving in the USA is positive.

The aim of the paper is to investigate the effect of income of tourists, tourism price, trade openness and international outbound tourists in tourism origin countries on the tourism demand to the Czech Republic as well as to South Moravia Tourist Region of the Czech Republic by foreign tourists arriving from selected European, Asian and American countries. The rest of the text is divided into four parts. The first part provides a short problem statement. The second part presents the model apparatus used in the paper. In the third part, empirical model and results are presented. The fourth part provides discussion of results.

1 Statement of a problem

Knowledge of factors influencing the tourism demand in the Czech Republic is crucial for both managers and policy makers. The best known determinants are income and price variables. Income is a key variable in demand models. As an income measure, Gross Domestic Product (GDP) and Gross National Product, in nominal or real terms and in their per capita form, can all be considered, see Song and Li (2008). Important price variable is the exchange rates between the origin country and alternative destinations. The real exchange rate (RER) is defined as the ratio of the price level abroad (the Czech Republic) and the domestic (tourism origin country) price level, where the foreign price level is converted into domestic currency units via the current nominal exchange rate; see Li et al. (2005) or Seo et al. (2009) for RER applications in demand tourism models. Compared to previous similar studies, the harmonized consumer price index (HCPI) for hotels and restaurants is used to derive the real exchange rate instead of the general CPI that may not capture the price level of products and services that tourists often encounter.

For the Czech Republic, econometric models were applied in the studies of Babecká (2013) and Indrová et al. (2017). International tourism demand was measured in both studies through attendance at collective accommodation facilities. Babecká (2013) analyses the international tourism demand in the Czech Republic through the gravity model. Real GDP of tourism origin countries, real exchange rate and the distance of origin country from the Czech Republic and five dummy variables were considered as the tourism demand determinants. Indrova et al. (2015) monitored the impact of the development of income and price variables on the tourism demand in the Czech Republic. For this purpose, they used a dynamic panel with Arellano-Bond GMM estimator. Real GDP per capita for origin countries, RER, trade openness,
lagged value of tourism demand as dependent variable and two dummy variables are considered as determinants.

The previous papers did not take into account the cross-sectional dependences, i.e. unobserved time-specific heterogeneity which makes error terms contemporaneously correlated. In tourism demand context, the cross-sectional dependence can be induced by the presence of common shocks affecting tourism demand from observed countries and this can lead to different country-specific responses to these shocks. This approach has not been used in the tourism literature where cross-sectional dependence is usually ignored. However, cross-sectional units are almost certainly influenced by national or global shocks such as business cycles or national fiscal and monetary policies. Ignoring cross-sectional dependence of errors can have serious consequences.

This study examines the effect of four determinants on tourism demand from the France (FR), Austria (AT), the Netherlands (NL), Germany (DE), the Slovak Republic (SK), Spain (ES), Italy (IT), Sweden (SE), Israel (IL), Japan (JP), USA (US), Poland (PL) and Hungary (HU) to the Czech Republic and to the South Moravia Tourist (SMT) region in 2003:Q1-2017:Q4, i.e. from the first quarter of 2003 to the last quarter of 2017. These countries were included in the selection by meeting two conditions, such as availability of data and a greater number of visitors from the country.

The monitored time series of dependent variables (tourism demand for Czech Republic and tourism demand for SMT region) are presented in Fig. 1. There can be seen a similar development of most of the series, i.e. it can be assumed the existence of long-term relationships. Furthermore, in the crisis period, the number of tourists is decreasing, indicating possible long-term relationships between the number of tourists and some macroeconomic indicators.

**Fig. 1: Occupancy (in log) in CAE by selected countries in the Czech Republic**

In view of the aim of this paper, the explanatory (independent) variables are income as the gross domestic product (GDP) per capita at constant 2010 prices in the local currency. Tourism price as the real exchange rate (RER) based on the harmonized consumer price index (HCPI, 2010=100) for restaurants and hotels. Trade openness as the ratio of exports plus imports to GDP. In addition to determinants above, international outbound tourists as variable is used. International outbound tourists (IOT) are the number of departures that people make from their country of usual residence to any other country for any purpose other than a remunerated activity.
in the country visited. The effect of departures number changes in tourism origin countries is important to analyse. None of the tourism studies do not consider this variable. Some of the studies consider total population of the tourism origin country. However, the population tends to be highly correlated with income. To take into account the cross-sectional dependence between units, unobserved dynamic common shocks are approximated using the method proposed by Pesaran (2006). This approach have the benefit that it do not require selection of a set of observed proxies. Source of data for the number of tourists was the Czech Statistical Office, real GDP per capita, nominal exchange rates as well as consumer price indices were obtained through the FRED database, administered by the Federal Reserve Bank of the USA. The data on exports and imports were collected from World Bank data source as well as international outbound tourists data. All time series were seasonally adjusted using the X-13ARIMA-SEATS software developed by U. S. Department of Commerce, U. S. Census Bureau. All statistical analysis were performed using Gretl and Eviews 8. Data were logarithmically transformed for further analyses.

Four hypothesis were formulated to study the effects of variables to international tourism demand in the Czech Republic and in the SMT region: (1) It is expected that income (as the real GDP per capita) has a positive impact on the number of tourists (as tourism demand). (2) If RER is greater than one, it means that foreign (Czech) goods are actually more expensive, i.e. the foreign (Czech) price level is higher than the price level in the origin destinations of the monitored tourists. Thus, it can be expected a negative relationship between price level and tourism demand which follows the law of demand. (3) The positive effect of trade openness between the Czech Republic and tourism origin countries is expected. (4) An increasing number of departures from destinations can be seen as an increase in the interest of tourists from these countries to travel. Furthermore, if this increase also leads to an increase in the number of tourists from these countries to the Czech Republic, this is evidenced by the attractiveness of the Czech Republic for these tourists. Given the choice of the tourism origin countries, it can be assumed that the number of departures from these countries will have a positive effect on tourism demand.

2 Methods

This paper applies panel cointegration analysis through a common correlation effect model (CCE). In panel analysis, it is first important to test the independence of individual panels and homogeneity of the estimated coefficients. For this purpose, we consider a standard panel data model, see Banerjee and Carrion-i-Silvestre (2017), for instance.

Cross-sectional dependence means the correlation between residuals across all cross-section units. The reason for analyzing cross-sectional dependence is the fact that its existence (or non-existence) affects the specific choice of test to determine the presence of the unit root within the variables, see Sharif and Hamzah (2015). Information about the presence of a unit root is important in cointegration analysis, which is one of the focus of this paper.

Two test statistics are used to verify the above hypotheses. Specifically, LM statistic proposed by Breusch and Pagan (1980) and CD statistic proposed by Pesaran (2004). It is also necessary to determine whether the slope coefficients in panel data
model are homogenous. We are interested in whether these coefficients are the same (homogenous) or different (heterogenous) across cross-section units. Standard for this purpose is the test procedure provided by Swamy (1970), which works with the assumption of a relatively small number of cross-sectional units. For this reason, the extension of the given procedure provided by Pesaran and Yamagata (2008) is applied here, specifically, both delta statistics (\( \Delta \) and \( \Delta_{adj} \)) are used.

In order to check for the presence of cointegration relationships between the variables, it is important to test whether the variables contain unit root and therefore they are non-stationary, and are denoted as I(1). If the variables do not contain the unit root, they are stationary, I(0). In the panel analysis, two types of unit root tests can be applied, see Hurlin and Mignon (2007). The first type tests, sometimes referred to as the first generation tests, when the cross-correlation is not confirmed, for example, the Im-Pesaran-Shin test proposed by Im et al. (2003). For the second generation of panel unit root tests, the presence of cross-sectional dependence among the error terms is allowed within the panel, for example, the cross-sectionally augmented IPS test proposed by Pesaran (2007).

Following the determination of the stationary of the variables, the long-term cointegration relationship between the variables can be analysed by using the Durbin-Hausman (D-H) panel cointegration test proposed by Westerlund (2008). This test possible to conduct cointegration analysis in case the independent variables are I(1) or I(0), but dependent variable must be non-stationary in the sense of I(1). The test works with two statistics, Durbin-Hausman Group (DHG) and Durbin-Hausman Panel (DHP). In DHG, Westerlund (2008) allows the cointegration coefficients to differ between cross-sections, while the coefficients are considered to be the same for all cross-sections, in DHP. For these statistics, it is tested that there is no cointegration between variables in the null hypothesis. The alternative hypothesis for DHG indicates that there is cointegration relationship for at least some cross-sections. Rejection of the null hypothesis for DHP implies that there is a cointegration relationship for the whole of the panel, see Westerlund (2008).

Following the finding of cointegration between the variables, cointegration coefficients are estimated by using the Common Correlated Effects (CCE) method proposed by Pesaran (2006). One of the advantages of the CCE method is that cointegration coefficients can be estimated for each horizontal section unit. This makes an opportunity to individual interpretations cointegration coefficients for each section unit (country), see Banerjee and Carrion-i-Silvestre (2017).

### 3 Problem solving and results

The cross-sectional dependence was analysed for individual variables across the countries analysed as well as the whole model. The results of the cross-sectional dependence are presented in Tab. 1. Since, in all cases, the p-value is less than 0.01, the null hypothesis of the cross-sectional dependence was rejected at 1% significance level. Hence, it was concluded that there is cross-section dependence among the countries constituting the panel. In other words, the shock to one of the monitored countries is likely transmitted to the other countries.
Furthermore, Tab. 1 presents the homogeneity test of the estimated coefficients. According to the results, since the p-values of the tests were smaller than 0.01, null hypothesis of homogeneity was rejected and alternative hypothesis was accepted. Thus, it can be considered heterogeneous, in other words, it makes sense to look for their estimates for all cross-section units.

Tab. 1: Cross-sectional dependence test and homogeneity test

<table>
<thead>
<tr>
<th>Tests</th>
<th>lnTD_cz</th>
<th>lnTD_smt</th>
<th>lnRER</th>
<th>lnGDP</th>
<th>lnTO</th>
<th>lnIOT</th>
<th>Model (CZ)</th>
<th>Model (SMT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM</td>
<td>182.61***</td>
<td>193.24***</td>
<td>264.85***</td>
<td>263.48***</td>
<td>243.61***</td>
<td>196.93***</td>
<td>1270.17***</td>
<td>1277.21***</td>
</tr>
<tr>
<td>CD</td>
<td>18.10***</td>
<td>15.12 ***</td>
<td>13.08</td>
<td>13.90***</td>
<td>16.74***</td>
<td>15.02***</td>
<td>122.85</td>
<td>122.24***</td>
</tr>
</tbody>
</table>

Homogeneity test

<table>
<thead>
<tr>
<th>Tests</th>
<th>Czech Republic</th>
<th>SMT Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ</td>
<td>9.08</td>
<td>8.99</td>
</tr>
<tr>
<td>Δadj</td>
<td>9.97</td>
<td>9.12</td>
</tr>
</tbody>
</table>

### Significant levels
*** - statistically significant at 1% level, ** at 5% level, * at 10% level.

Source: Own elaboration.

For further analysis, it is necessary to determine the presence of unit roots in the panel data. Due to the existence of the cross-sectional dependence, the second generation test was used, namely CIPS test proposed by Pesaran (2007). The results in Tab. 2 shows that for all logarithmized variables, the null hypothesis was rejected at 1% level of significance. Thus, the variables contain the unit root, i.e. I(1). Furthermore, first differencing the time series removed the unit root, they were stationary, i.e. I(0). For these reasons, the cointegration analysis can be used.

Tab. 2: CIPS Unit Root Test Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>lnTD_cz</th>
<th>lnTD_smt</th>
<th>lnRER</th>
<th>lnGDP</th>
<th>lnTO</th>
<th>lnIOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.07</td>
<td>-2.01</td>
<td>-2.19*</td>
<td>-1.91</td>
<td>-2.02</td>
<td>-1.63</td>
</tr>
<tr>
<td>Critical value</td>
<td>1%: -2.45; 5%: -2.25; 10%: -2.15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant+trend</td>
<td>-2.69*</td>
<td>-2.43</td>
<td>-2.58</td>
<td>-2.06</td>
<td>-2.52</td>
<td>-1.99</td>
</tr>
<tr>
<td>Critical value</td>
<td>1%: -2.93; 5%: -2.76; 10%: -2.66</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>dif_lnTD_cz</th>
<th>dif_lnTD_smt</th>
<th>dif_lnRER</th>
<th>dif_lnGDP</th>
<th>dif_lnTO</th>
<th>dif_lnIOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-8.98***</td>
<td>-7.76***</td>
<td>-8.75***</td>
<td>-6.11***</td>
<td>-10.02</td>
<td>-4.21</td>
</tr>
<tr>
<td>Constant+trend</td>
<td>-9.05***</td>
<td>-8.12***</td>
<td>-8.86***</td>
<td>-7.07***</td>
<td>-10.25</td>
<td>-5.19</td>
</tr>
</tbody>
</table>

Source: Own elaboration

In order to confirm the existence cointegration relationships, a D-H test is applied. It offers two statistics, namely group statistic (DHG) and panel statistic (DHP). Tab. 3 presents the results of both these statistics, including their significance represented by the p-values. For both Durbin-Hausman panel and Durbin-Hausman group cointegration tests, the null hypothesis was rejected at 1% level of significance. In this case, the alternative hypothesis assuming that there are cointegration relationships in some countries and throughout the panel is accepted. Thus, cointegration test results show that there are some long-run relationships between tourism demand and independent variables and these relationships may be different for different countries. After deciding that there are long-run relationships, cointegration coefficients can be estimated.
Tab. 3: Durbin-Hausman Cointegration Test Results

<table>
<thead>
<tr>
<th></th>
<th>CZ (test statistic)</th>
<th>SMT (test statistic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durbin-Hausman (DHG)</td>
<td>7.84***</td>
<td>8.98***</td>
</tr>
<tr>
<td>Durbin-Hausman (DHP)</td>
<td>3.44***</td>
<td>4.21***</td>
</tr>
</tbody>
</table>

Source: Own elaboration.

Based on the above analysis, there are cointegration relationships between tourism demand (for the Czech Republic and for the SMT region) and GDP in the local currency (as income), real exchange rate, trade openness or international outbound tourists from tourism origin country.

The CCE results for the panel are reported in Tab. 4. The results show that the negative effect of the real exchange rate on the tourism demand is statistically significant, at 5% level. Thus, with the rising exchange rate, demand is decreasing, namely with 1% increase in the real exchange rate decreases tourism demand in the Czech Republic and the SMT region by 0.5% and 0.75%, respectively. The income effects as a measure of GDP on the tourism demand in the Czech Republic and SMT region are positive (0.85) at 10% level of significance and 5% level of significance, respectively. In other words, a 1% increase in GDP per capita in the tourism origin countries increases tourism demand by 0.85%. Trade openness is positively related to tourism demand in the Czech Republic, 1% increase in trade openness raises tourism demand by 0.066%. The results indicate that tourism demand is inelastic to bilateral trade and tourism demand is not very responsive to changes in trade volume between Czech Republic and respective countries. For tourism demand in the SMT region, trade openness is not statistically significant. Finally, the effect of international outbound tourists on tourism demand in the Czech Republic and SMT region, respectively is not statistically significant.

Tab. 4: CCE estimates for the Panel

<table>
<thead>
<tr>
<th></th>
<th>lnGDP</th>
<th>lnRER</th>
<th>lnTO</th>
<th>lnIOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Czech Republic</td>
<td>0.852*</td>
<td>-0.500**</td>
<td>0.066*</td>
<td>-0.039</td>
</tr>
<tr>
<td></td>
<td>(0.166)</td>
<td>(0.074)</td>
<td>(0.029)</td>
<td>(0.055)</td>
</tr>
<tr>
<td>South Moravia</td>
<td>0.845**</td>
<td>-0.747**</td>
<td>0.011</td>
<td>0.107</td>
</tr>
<tr>
<td>Tourist Region</td>
<td>(0.137)</td>
<td>(0.099)</td>
<td>(0.081)</td>
<td>(0.128)</td>
</tr>
</tbody>
</table>

Standard deviations are in round brackets.

Source: Own elaboration

Tab. 5 presents country-specific CCE estimates. It is clear from the table that the expected positive relationships between the income of tourists and tourism demand in the Czech Republic and the SMT region are statistically significant for 11 countries (all except Japan and Hungary) and 7 countries (all expect France, the Netherlands, Spain, Israel, Japan and USA), respectively. The expected statistically significant negative relationship between RER and tourism demand in the Czech Republic and SMT region have been found for 11 countries (all expect Italy, Japan and Hungary) and for 10 countries (all expect Spain, Israel and Hungary), respectively. The effect of the trade openness on tourism demand for the Czech Republic is statistically significant and positive for France, the Netherlands, Germany, Spain, Italy and Hungary. The negative statistically significant effect have been found for Austria and
Japan. In the SMT region tourism demand, the negative statistically significant effect have been found for Spain and Hungary, the positive statistically significant effect for the Netherlands and Italy. The effect of international outbound tourists on tourism demand in the Czech Republic is negative statistically significant for France and Spain, the positive statistically significant for the Slovak Republic and Hungary. In the SMT region tourism demand, the effect of international outbound tourists is statistically significant for Spain (positive) and Italy (negative).

**Tab. 5: CCE estimates for the Countries**

<table>
<thead>
<tr>
<th></th>
<th>Czech Republic</th>
<th>South Moravia Tourist Region</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lnGDP</td>
<td>lnRER</td>
</tr>
<tr>
<td>FR</td>
<td>1.267*</td>
<td>-0.416**</td>
</tr>
<tr>
<td></td>
<td>(0.235)</td>
<td>(0.029)</td>
</tr>
<tr>
<td>AT</td>
<td>1.470*</td>
<td>-0.183*</td>
</tr>
<tr>
<td></td>
<td>(0.433)</td>
<td>(0.046)</td>
</tr>
<tr>
<td>NL</td>
<td>1.497*</td>
<td>-0.783**</td>
</tr>
<tr>
<td></td>
<td>(0.283)</td>
<td>(0.050)</td>
</tr>
<tr>
<td>DE</td>
<td>0.900**</td>
<td>-1.114**</td>
</tr>
<tr>
<td></td>
<td>(0.137)</td>
<td>(0.051)</td>
</tr>
<tr>
<td>SK</td>
<td>0.908*</td>
<td>-0.793**</td>
</tr>
<tr>
<td></td>
<td>(0.221)</td>
<td>(0.094)</td>
</tr>
<tr>
<td>ES</td>
<td>1.541**</td>
<td>-0.965**</td>
</tr>
<tr>
<td></td>
<td>(0.127)</td>
<td>(0.068)</td>
</tr>
<tr>
<td>IT</td>
<td>0.650*</td>
<td>0.035</td>
</tr>
<tr>
<td></td>
<td>(0.140)</td>
<td>(0.037)</td>
</tr>
<tr>
<td>SE</td>
<td>0.007*</td>
<td>-0.655*</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.187)</td>
</tr>
<tr>
<td>IL</td>
<td>1.777*</td>
<td>-1.885**</td>
</tr>
<tr>
<td></td>
<td>(0.407)</td>
<td>(0.094)</td>
</tr>
<tr>
<td>JP</td>
<td>0.003</td>
<td>0.0401</td>
</tr>
<tr>
<td></td>
<td>(0.277)</td>
<td>(0.037)</td>
</tr>
<tr>
<td>US</td>
<td>0.803**</td>
<td>-0.202**</td>
</tr>
<tr>
<td></td>
<td>(0.127)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>PL</td>
<td>0.722**</td>
<td>-0.720**</td>
</tr>
<tr>
<td></td>
<td>(0.057)</td>
<td>(0.026)</td>
</tr>
<tr>
<td>HU</td>
<td>0.473</td>
<td>-0.445</td>
</tr>
<tr>
<td></td>
<td>(0.150)</td>
<td>(0.161)</td>
</tr>
</tbody>
</table>

Source: Own elaboration

According to the comparative elasticities of the variables, the income elasticity (for tourism demand in the Czech Republic) is above unity for France, Austria, the Netherlands, Spain, Israel, with the highest elasticity coefficient of 1.78 for Israel. Thus, the tourism demand in the Czech Republic from these countries is income elastic. While for Germany, the Slovak Republic, Italy, Sweden, USA, Poland is the tourism demand in the Czech Republic from these countries income inelastic (elasticity coefficients are less than one). Tourism demand in the SMT region is income elastic for Austria with highest elasticity coefficient of 2.05, i.e. a 1% increase in GDP per capita in the tourism origin countries increases tourism demand from...
Austrian tourists by 2.05%. Further, for Germany (1.27%), the Slovak Republic (1.58%), Hungary (1.29%) and Italy (1.29%). Tourists from these countries are more sensitive to the change in their income. On the other hand, tourism demand in the SMT region is income inelastic for Sweden and Poland that have elasticity coefficients of 0.58 and 0.32, respectively. Tourists from remaining countries do not respond to GDP changes since their coefficients are non-significant.

As far as the RER is concerned, Germany and Israel have elasticity coefficients of -1.11 and -1.89, respectively. For instance, a 1% increase in the tourism prices decrease the number of tourists from these two countries to the Czech Republic by levels of 1.11% and 1.89%, respectively. Thus, the tourism demand in the Czech Republic from these countries is price elastic. In terms of tourism demand in the SMT region, this demand is price elastic from France, Austria, the Netherlands, Germany and the Slovak Republic with the highest elasticity coefficient of -2.59 for German tourists. On the other hand, the lowest elasticity coefficients of -0.18 and -0.35 belong to Austria (in the Czech Republic) and Poland (in the SMT region), respectively.

Tourism demand in the Czech Republic is inelastic to bilateral trade. The trade openness has been found to be significant for France, the Netherlands, Germany, Spain, Italy, USA and Hungary. While, Germany has the highest elasticity coefficients of 0.28, the lowest elasticity coefficient of 0.05 belongs to USA. In terms of tourism demand in the SMT region, the trade openness has been found to be significant for the Netherlands and Italy. While the Italy has the highest elasticity coefficient of 0.193, the Netherlands have elasticity coefficients of 0.173.

In terms of tourism demand in the Czech Republic, the number of the international outbound tourists for tourism origin countries has been found to be positive, as expected, and significant for Hungary and the Slovak Republic but negative and significant for France and Spain. While Hungary has the highest elasticity coefficient of 0.67, the elasticity coefficients for France and the Slovak Republic are -0.48 and 0.39, respectively. The lowest elasticity coefficient of -0.25 belongs to Spain. With regard to tourism demand in the SMT region, the number international outbound tourists for tourism origin countries has been found to be positive and significant for Spain but negative and significant for Italy. For instance, a 1% increase in the number of departures that Spanish tourists make from their country of usual residence to any other country increase the number of tourists from Spain to the SMT region by levels of 0.47%.

4 Discussion

The main contributions of this paper are as follows: First, the effect of the examined four determinants on international tourism demand in the Czech Republic taking the cross-sectional dependence presence into account have been found. Second, the effect of these determinants on tourism demand in the South Moravia Tourist Region of the Czech Republic have been found.

From the findings of this study, results revealed that tourism demand in the Czech Republic as well as in SMT region is significantly and positively affected by income of foreign tourists but low value of the coefficient show that tourism demand is slightly dependent on the economic situation of the generating countries. This is consistent with
the result of Indrová et al. (2015), Surugiu et al. (2014) or Ongan et al (2017) which indicated that as the country’s income increases, more of its residents can afford to visit other countries, and therefore tourist arrivals are a positive function of income or directly related to income. In addition, our study shows that tourism demand in the Czech Republic and SMT region from some foreign tourists is income elastic.

As it regards relative price, the variable reduces the number of tourists to travel and the negative sign of the coefficient is the same as the expected one. The estimated price elasticity is suggesting that tourism demand is price inelastic. It holds for tourism demand in the Czech Republic as well as in the SMT Region. Different studies have used different measures of price explaining the differences in estimating price elasticities. As a standard, the real exchange rate adjusted by CPIs is used. In this paper, HCPI for hotels and restaurants is used to derive the real exchange rate instead of the general CPI. Found price inelasticity is consistent with the result of Indrová et al. (2015) or Yazdi and Kahanizadeh (2017). Eilat and Einav (2004) suggest that tourism demand to less developed countries is not very sensitive to fluctuation in prices, explained by the fact that prices in these countries are relatively low. However, this demand is price elastic from France, Austria, the Netherlands, Germany and the Slovak Republic.

As the empirical results suggest, increasing trade openness between Czech Republic and tourism origin countries has contributed to the increasing amount of tourists from these countries visiting the Czech Republic. Thus, the trade openness variable has an expected positive sign. Because of low coefficient elasticity, it is not very responsive to changes in trade volume between Czech Republic and tourism origin countries. These results are partly in agreement with Indrová et al. (2015) – they suggest that the trade openness is insignificant in explaining tourism demand. Statistically significant influence between the trade openness and tourism demand is confirmed by Surugiu et al. (2014). The effect of international outbound tourists on tourism demand in the Czech Republic and SMT region, respectively is not statistically significant.

Conclusion

The aim of the paper is to investigate the effect of income of tourists, tourism price, trade openness and international outbound tourists in tourism origin countries on the tourism demand to the Czech Republic as well as to South Moravia Tourist Region of the Czech Republic from tourists coming from thirteen different countries is analysed, namely France, Austria, the Netherlands, Germany, the Slovak Republic, Spain, Italy, Sweden, Israel, Japan, USA, Poland and Hungary over the period 2003:Q1-2017:Q4. This paper applies panel co-integration analysis through a common correlation effect model (CCE). LM and CD tests were used for testing cross-section dependence between the countries. The results showed existence of cross-section dependence between the countries. The stationarity of the series was tested using the CIPS unit root test. The cointegration relationships between the series were analysed by the Durbin-Hausman Cointegration Test which takes cross-section dependence into account.

According to the obtained estimation results, income and trade openness have a significant positive influence on international arrivals to the Czech Republic, while for tourism price the results indicate that it has a negative influence on inflows, as
expected. The effect of international outbound tourists on tourism demand in the Czech Republic is negative, against expectations, but it is not statistically significant. For tourism demand in the SMT region, income has a significant positive influence on international arrivals to the South Moravia tourist region, as it regards relative price, the negative sign of the coefficient is the same as the expected one. The effects of trade openness and international outbound tourists on tourism demand in the SMT region have expected positive signs but they are not statistically significant.

In order to get more specific results, the future research could to examine the dependence between tourism demand and selected determinants by using different approaches based on different copulas.

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References


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SOLUTION OF SOCIO-ECONOMIC EFFICIENCY OF PUBLIC PROJECTS UNDER THE CONDITIONS OF VARIABLE AMOUNT OF SUBSIDY

Petr Jiříček, Stanislava Dvořáková

Abstract. The paper will deal with modelling cash-flows of public investment projects under the conditions of variable amount of subsidy from public funds. A deterministic model based on a rational fractional function will be used to assessment of socio-economic efficiency of public projects subsidized from the European funds. In the model, we will examine the influence of the amount of the subsidy and critical changes of socio-economic cash-flows generated by a project on assessing public investments. We will use the European Union methodology for assessing socio-economic evaluation of project utility by means of cost-benefit analysis. The results of the crisis scenario analysis of the model in the Maple program created on the basis of the concept of Economic net present value (ENPV) and Economic internal rate of return (ERR) will be presented in 2D projection and evaluated by means of the ENPV function depending on the project parameters. The paper will also present using the model for stress test of socio-economic efficiency of innovation project from sphere digitalization of public government, and broadens so far published research.

Keywords: Public Projects, Socio-economic Efficiency, the ENPV Function, ERR, Subsidy from European Funds, Cost-benefit Analysis.

JEL Classification: C20, H43.

Introduction

The principles of socio-economic efficiency of public projects are provided in frame of welfare economics. Public project efficiency evaluation uses in its mathematical basis commercial methods – the net present value method, and the internal rate of return method (IRR). The commercial net present value method (NPV) is after applying the theoretical principles of welfare economics (cash-flows are the quantification of utility) available for evaluation public projects of investment character for its stress on expressing time-rated utility. It corresponds to utilitarian bipolar concept of utility as the difference between the benefit and harm (loss) to the welfare for a social entity. The adjusted method of economic net present value (ENPV) is generally used as the preferred method for evaluating investment oriented projects from European funds. These projects are characteristic by a certain amount of subsidy to the supported subjects determined according to the objectives of the European Union cohesion policy in case of European funds. The second in order preferred method for evaluating investment character projects subsidized from the European funds is the so called method of economic internal rate of return (ERR). This is based on finding a real root of the ENPV function from the parameters of the proposed project, which corresponds with the condition of indifferent evaluation of public project efficiency from the investor's perspective. The social discount rate of a public project is then compared to the ERR that has been found. (European Commission, 2015)
1. Statement of a problem

The order of preferences for using both methods for public projects corresponds also with the approach for evaluating commercial investment projects financed from private sources (Levi, Sarnat, 1994, Brealey et al., 2011). The recommendation for evaluating public projects by the commercial method of IRR reflects the fact that the IRR method has, in comparison with the NPV method, several significant disadvantages. These are connected namely with the so called non-conventional cash-flows generated by some projects, when more than one change of cash-flow polarity occur. The definition of the conventional type of investment is mentioned by (Bussey, Eschenbach, 1992) as an investment that contains one or more negative cash outflows, followed by one or more positive cash inflows. A non-conventional investment is defined as an investment that intersperses the positive and negative cash flows. Problems of the IRR method which are generally valid also for the ERR modification for public projects were completely dealt with in the past e.g. by (Teichroew et al., 1965) in compliance with solving the polynomial by the so called Descartes' rule. (Hazen, 2003) has solved the problem of multiple real IRRs by linking the present value of the outstanding capital expenditure of a project with the difference between any IRRs and the cost of capital. Derivation mathematical rules for the construction of the NPV function and solution for nonconventional stream of cash-flow is in (Marek, Radová, 2006). (The topic of using IRR and NPV criteria has been summarised by (Magni, 2011). The generalized net present value (GNPV) method for nonconventional project evaluation is dealt with (Kulakov, Kulakova 2013). The generalized internal rate of return (GIRR) and generalized external rate of return (GERR) indices based on the generalized net present value (GNPV) are presented by (Kulakov, Kastro 2015).

Besides the above stated topic of nonconventional cash-flows, for the area of public projects another significant problem is determining the discount rate of public projects, which cannot be derived on the basis of market principles. (Marglin, 1963) deals with criteria for evaluating public projects by the cost-benefit analysis method and the social discount rate of public projects and with. For evaluating the efficiency of public projects, he uses the Optimal Rate of Investment (Marglin, 1967). Similarly, (Feldstein, 1964) uses the term Net Social Benefit for evaluating public projects utility. (Dasgupta et al. 1972) create the methodology of development projects evaluation for UNIDO. Economic analysis of public projects is dealt with by (Squire, Van der Tak, 1975). The present methodology of the European Union issues namely from works of (Florio 2006, 2007) and distinguishes two phases in public investment projects evaluation (European Commission, 2015) In the first phase projects are evaluated on a purely commercial basis of financial cash-flows by means of the so called FNPV (financial net present value) and FRR (financial rate of return), which corresponds to the above mentioned IRR. In the other phase of the economic analysis of a project, economic cash-flows are aggregated by means of the so called fiscal corrections of calculated financial cash-flows and by adding quantified negative and positive externalities. The resulting evaluation of social efficiency of public projects is carried out on the basis of discounting economic cash-flows by means of the ENPV and ERR (European Commission, 2015).
Projects are supported from the EU funds in the situation when a project generates negative FRR and FNPV values and so it is inefficient from purely commercial perspective. By adding positive cash-flows from positive externalities of proposed projects we then arrive, in the stage of project economic analysis, from negative values of FRR and FNPV at positive values on the basis of \( \text{ERR} \) and \( \text{ENPV} \). A project built like this can obtain a subsidy from European funds because it shows positive utility and contributes to increasing social welfare and natural resources protection. In the real economic situation, however, there may be scenarios which can generate negative cash-flows in a project, usually proposed as a conventional one. Those will cause a nonconventional nature of the project, i.e. there may not be exactly one positive real-valued root of the \( \text{ENPV} \) function (i.e. the value of \( \text{ERR} > 0 \)). Then it is not possible to decide conclusively about a project on the basis of the ERR method.

The presented paper aims at analysing the impacts of the change in the amount of a subsidy of a public project in selected economically justified scenarios of evaluating a project by means of the \( \text{ERR} \), which is based on a modification of the commercial IRR method. This application contains both advantages and disadvantages of the commercial IRR method, described in the above mentioned specialist sources and summarized in (Magni 2011). For the description of public project behaviour under the conditions of variable amount of subsidy from European funds, we will use determinist model of the \( \text{ENPV} \) function within numeric solution of the model by the Maple program. These model scenarios will capture changes of behaviour of the \( \text{ENPV} \) function and its roots with a view of the amount of subsidy depending also on changes of further parameters, i.e. cash-flows generated by an investment in the building, operational and liquidation phases.

2. Methods

2.1 Notations

For construction and analysing the ENPV model, the following notation and assumptions are used (Dvořáková, Jiříček 2013).

\[
\text{ERR} \quad \text{Economic rate of return} \\
\text{ENPV} = f(k) \quad \text{Economic net present value displayed by means of the investment curve of project} \\
k \quad \text{Social discount rate} \\
t \quad \text{Years of project lifetime} \\
n \quad \text{Investment project lifetime} \\
\text{CF} = [\text{CF}_0, \ldots, \text{CF}_n] \quad \text{Stream of cash flows}
\]

2.2 Assumptions

Conventional projects – they are characterized by only one change of their polarity in the sequence of the stream of cash-flows generated within the project (e.g. \([-,-,+++++]\)).

Nonconventional projects – they are characteristic by more than one change of project generated cash-flows in the sequence of the CF stream (e.g. \([-,-,+++++-]\)).
Investment curve of the project – defined by the rationally fractional function

\[ \text{ENPV} = \sum_{i=0}^{n} \frac{CF_i}{(1+k)^i} = CF_0 + \frac{CF_1}{1+k} + \frac{CF_2}{(1+k)^2} + \ldots + \frac{CF_n}{(1+k)^n}. \]  

(1)

It expresses the relation between economic net present value \( \text{ENPV} \) of the project (dependent variable) and the social discount rate \( k \) of a public project (independent variable). The investment curve will be analysed with a view of solving real-valued roots.

The degree \( (n) \) of the \( \text{ENPV} \) investment (1) – it represents the period of economic lifespan of a public project (in the model, \( n \) will equal 6 years).

The constant term \( (CF_0) \) – it represents capital expenditures of the project in the model. It will acquire non-positive values, which corresponds to a negative cash-flow reflecting project investment costs or as the case may be various (i.e. up to 100%) amount of subsidy from the donor.

Coefficients \( (CF_1, \ldots, CF_n) \) – in the model represent cash-flows caused by the investment and they can generally acquire both positive and negative values, while \( CF_1, \ldots, CF_{n-1} \) represent the operational phase of the project and \( CF_n \) the liquidation phase of the project.

Years of project's lifetime \( (t) \) – the model is built on the initial prerequisite of the possibility to separate the investment phase (year 0), the operational phase (years 1 to \( n-1 \)) and the liquidation phase (year \( n \)) of the project.

Stream of CFs – the sequence of cash-flows generated by the project in the form of \( CF = [CF_0, CF_1, \ldots, CF_n] \), in the model in the basic form \( CF = [-6,1,1,1,1,1,1] \), which corresponds to realistically predictable flows of proposed public projects.

Economic internal rate of return of the project \( (ERR) \) – the root of the investment curve (1) of the project, i.e.

\[ \text{ENPV} = \sum_{i=0}^{n} \frac{CF_i}{(1+ERR)^i} = 0. \]  

(2)

3. Problem solving

3.1 Modelling the cash-flow of a public project

For the proposed model from a set of variants of public investment projects, this paper will only consider some chosen economically justified scenarios when an originally conventional project may change into a project of non-conventional character on the basis of social evaluation of utility. For the purpose of comparing modelling results, we analyse also two types of conventional projects – a classical conventional model of a public project whose stream of cash-flow contains a negative investment expenditure as well as positive utilities from the project, and a type when after a negative investment expenditure at the beginning of the operational phase of the investment there is a negative cash-flow (e.g. due to delay of the project implementation). We also analyse two types of non-conventional projects.

We display the course of the project investment curve \( \text{ENPV} = f(k) \) (see the definition (1)), i.e. the relation of the utility from the project to the social discount rate. We use 2D projection and seek the dependence of the curve course and root position
on the amount of the subsidy from public sources, manifesting in the change of $CF_0$ for the defined cases of (Dvořáková, Jiřiček 2013):

Classical conventional project $CF = [-, ++++++]$

Conventional project with a crisis in the building phase $CF = [-, ++++++]$

Nonconventional project with a crisis in the operational phase $CF = [-, ++++++]$

Nonconventional project with a crisis in the liquidation phase $CF = [-, ++++++]$

For these alternatives we chose basic scenario with sequence of cash flow in shape $CF = \left[ CF_0, CF_1, CF_2, CF_3, CF_4, CF_5, CF_6 \right] = [-6, 1, 1, 1, 1, 1, 1]$

In each of these alternatives we will simulate situation, when the public investment project will be supported in level 0%, 30%, 70% and 100% subsidy from European funds.

3.2 The investment curve course in 2D projection

First, we will analyse the course of the investment curves $ENPV$ for classical conventional projects and for a conventional project with a crisis in the building phase; then the $ENPV$ functions for nonconventional projects will be displayed.

The course of the investment curve of a classical conventional project shows the influence of subsidy of investment costs on the position of the $ENPV$ function roots at a given unit stream of cash-flows in the operational and liquidation phases of the project. The subsidy amount influences the shift of the curves along the $y$ axis.

**Fig. 1: The course of the investment curve of the project $ENPV=f(k)$ according to the subsidy amount (a classical conventional project)**

From the perspective of assessing the project efficiency by the ERR method, we look for positive real-valued roots. According to Descartes' rule of signs these conventional projects have one real-valued root greater than $-1$. There is a monotonously decreasing function with the asymptote in the value $CF_0$ for $k \to \infty$. In case of a classical conventional project (Fig. 1) the $ENPV$ function does not have a final positive root at 100% subsidy, but $ERR = \infty$ (see Tab. 1).
Fig. 2: The course of the investment curve of the project $\text{ENPV}=f(k)$ according to the subsidy amount (conventional project – crisis in the building phase)

Source: authors

Tab. 1: Roots (ERR) of investment curves at various subsidy amounts (conventional projects)

<table>
<thead>
<tr>
<th>subsidy parameter $CF_0$</th>
<th>ERR (classical conventional project) $CF = [CF_0,1,1,1,1,1]$</th>
<th>ERR (crisis in the building phase) $CF = [CF_0,-1,1,1,1,1]$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>$-6$</td>
<td>$-1.67$</td>
</tr>
<tr>
<td>30%</td>
<td>$-4.2$</td>
<td>$-1.705$</td>
</tr>
<tr>
<td>70%</td>
<td>$-1.8$</td>
<td>$-1.787$</td>
</tr>
<tr>
<td>100%</td>
<td>$0$</td>
<td>$-2$</td>
</tr>
</tbody>
</table>

Source: authors

In this case, the ERR method cannot be efficiently used for evaluation projects, in the positive area the root limits to $+\infty$ and the project is thus efficient for any amount of the social discount rate chosen by the investor. The influence of a negative cash-flow due to the project building (Fig. 2) causes a change of the curve course. This curve is still monotonously decreasing. In cases of 30% and 0% subsidy the ERR method cannot be used either, because the roots $\text{ERR}$ of the $\text{ENPV}$ are negative (see Tab. 2).

The course of the investment curve of a nonconventional project in the situation of a crisis in the operational phase (change of $CF_3$ – see Fig. 3) is not different in the right half of the curve from the course of the conventional project (Fig. 1). According to Descartes' rule of signs this project has three or one real-valued root greater than $-1$. The course of the $\text{ENPV}$ function is quite different in case of a crisis in the liquidation project phase (Fig. 4), when the curves "turn over" in $k=1$ to $-\infty$ on the vertical asymptote. According to Descartes' rule this nonconventional project has two or no root greater than $-1$. 

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**Fig. 3:** The course of the investment curve of the project $ENPV=f(k)$ according to the subsidy amount (nonconventional project – crisis in the operational phase)

**Fig. 4:** The course of the investment curve of the project $ENPV=f(k)$ according to the subsidy amount (nonconventional project – crisis in the liquidation phase)

**Tab. 2:** Roots ERR of investment curves at various subsidy amounts (non-conventional projects)

<table>
<thead>
<tr>
<th>subsidy</th>
<th>parameter $CF_0$</th>
<th>ERR (crisis in the operational phase) $CF = [CF_0,1,1,\ldots,1]$</th>
<th>ERR (crisis in the liquidation phase) $CF = [CF_0,1,1,\ldots,1,-1]$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>−6</td>
<td>−1.784</td>
<td>−0.098</td>
</tr>
<tr>
<td>30%</td>
<td>−4.2</td>
<td>−1.848</td>
<td>−0.013</td>
</tr>
<tr>
<td>70%</td>
<td>−1.8</td>
<td>−2.2024</td>
<td>0.282</td>
</tr>
<tr>
<td>100%</td>
<td>0</td>
<td>−2.792∞</td>
<td>−2.792∞</td>
</tr>
</tbody>
</table>

*Source: authors*
4. Results

Now we will discuss the results of using the proposed 2D model by means of a case study depicting a crisis in the liquidation phase of a public investment project in the conditions of predicted cash-flows (instead of the unit cash-flow in the model). Here, the proposed model testing will be carried out by means of a real-life public project, (see Tab. 3) financed from the European funds from the Integrated Operational Programme from the period of 2007–13.

Tab. 3: E-Government project cash flows

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment costs</td>
<td>−576,150</td>
<td>−57,273,850</td>
<td>−300,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wage costs</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>−400,000</td>
<td>−400,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Implementation</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>−830,000</td>
<td>−830,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Technical support</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>−2,600,000</td>
<td>−2,600,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maintenance</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>−800,000</td>
<td>−800,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Time saving – region</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>27,871,200</td>
<td>27,871,200</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Time saving – state</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>340,000</td>
<td>340,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Time saving – clients</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12,000,000</td>
<td>12,000,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: (Olomoucký kraj, 2011)
It is a thirteen-year-long project with the aim to create a technology centre of the region in the system of electronic document and records management system, which should be part of e-Government centres within the CR public administration digitalization. The subsidy of the conventionally proposed project will be 85% of eligible budget costs (Olomoucký kraj, 2011).

Based on the proposed model, we will now carry out the project socio-economic efficiency evaluation within the scope of one of the model scenarios – the crisis scenario in the liquidation phase due to increased maintenance costs and positive externalities decrease (time saving for project stakeholders) related to the transition of part of the users to newer technologies (see Tab. 4). The year of 2022, i.e. the last year of the project where a decrease of the above-mentioned values is highly probable after twelve years of the project lifetime, was selected as the critical year.

Tab. 4: E-Government project cash flows, crisis in liquidation phase (in CZK)

<table>
<thead>
<tr>
<th>CF item</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment costs</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wage costs</td>
<td>400,000</td>
<td>400,000</td>
<td>400,000</td>
</tr>
<tr>
<td>Implementation</td>
<td>830,000</td>
<td>830,000</td>
<td>830,000</td>
</tr>
<tr>
<td>Technical support</td>
<td>2,600,000</td>
<td>2,600,000</td>
<td>2,600,000</td>
</tr>
<tr>
<td>Maintenance</td>
<td>6,800,000</td>
<td>6,800,000</td>
<td>16,800,000</td>
</tr>
<tr>
<td>Time saving – region</td>
<td>27,871,200</td>
<td>27,871,200</td>
<td>3,000,000</td>
</tr>
<tr>
<td>Time saving – state</td>
<td>340,000</td>
<td>340,000</td>
<td>0</td>
</tr>
<tr>
<td>Time saving – clients</td>
<td>12,000,000</td>
<td>12,000,000</td>
<td>0</td>
</tr>
<tr>
<td>Project cash flow</td>
<td>29,581,200</td>
<td>29,581,200</td>
<td>−17,630,000</td>
</tr>
</tbody>
</table>

Source: (authors according to Olomoucký kraj, 2011)

Fig. 5: The course of the ENPV function of the e-Government project

We can see that despite the impact of the crisis situation in the liquidation phase on project efficiency social evaluation, the project is stable even in this scenario (see Tab. 5), which is also reflected by the smooth course of the plane in the following Fig. 10.

As shown in Tab. 5, after modelling a crisis in the liquidation phase of the project there was no significant decrease of the project’s internal rate of return. It testifies little
sensitivity of the project to the changes of increasing maintenance costs and positive externalities resulting from time savings. The reason may be overstated cash-flow values, especially those from positive externalities in previous years. By further detailed examination of this phenomenon by the sensitivity analysis method in the next stage of modelling, we could find out the sensitivity of the economic internal rate of return of the project to cash-flow changes in individual years and determine the so-called cash breakeven points of the project.

Tab. 5: Results of testing the case study of the e-Government project; evaluation of social efficiency of a nonconventional model (crisis in liquidation phase)

<table>
<thead>
<tr>
<th>Project social efficiency evaluation</th>
<th>Project proposal</th>
<th>Crisis in liquidation phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERR</td>
<td>0.401</td>
<td>0.393</td>
</tr>
</tbody>
</table>

Source: authors

5. Conclusion

Efficiency evaluation of a public project of investment type is carried out on the grounds of cost-benefit analysis which includes, beside evaluating commercial utilities of the project on financial basis (corresponding to commercial projects), also evaluation of social utilities according to theoretical principles of welfare economics. As stated in the article, basic criteria methods for evaluating public projects exploit the same mathematical principles and are based on the same mathematical foundations as commercial methods, i.e. on the grounds of net present value of the project and internal rate of return of the project.

In the area of public investment, the NPV method (according to the EU methodology the ENPV) is considered the preferential method as it reflects the basic principle of welfare economics regarding maximizing the social utility from their implementation, similarly as maximizing the market value of a company is the goal of commercial projects.

Just like in case of commercial projects, the IRR method (according to the EU methodology the ERR) is only the second most preferred method of public investment evaluation; the reason is well-known disadvantages of this method in case of nonconventional projects, mentioned in this article. Yet, some theoretical and practical concepts prefer, as stated in the article, the IRR (ERR) method.

The paper solves nonconventional public projects when negative cash-flows arise due to crisis situations in operational and liquidation phase of a public project. The paper also presents a comparison with public projects of conventional type as usually constructed by applicants for subsidy.

The model is applicable also for commercial projects due to identical mathematical basis of the ERR (IRR) methods. The model application based of cost-benefit analysis principles proves suitable especially for evaluating those commercial projects that cause negative externalities in the form of environmental damage by their implementation.

Acknowledgement

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References


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LIFE SATISFACTION OF CZECH SENIORS: WHAT ACTUALLY MATTERS?

Lea Kubíčková, Vladimír Hajko, Naďa Hazuchová, Martina Rašticová

Abstract: We estimate the influence of various factors on life satisfaction of Czech seniors in a large survey sample. We find that good health, more education and awareness of voluntary work participation, employee satisfaction and being currently employed are the main factors that contribute to being satisfied with the current quality of life in the group of Czech seniors. Surprisingly enough, increasing self-reported financial sufficiency is negatively associated with the quality of life. The main factors contributing to the life dissatisfaction are associated with being socially separated. The worst outcomes are recorded for those living in social homes and living alone. Any reported expectations of expected life changes (both positive and negative expectations) are associated with lower probability of life satisfaction.

Keywords: Seniors, Employee Satisfaction, Life Satisfaction, Well-being, Logit.

JEL Classification: J26, J28.

Introduction

The proportion of older people in the population is increasing and this long-enduring demographic trend (resulting from the so-called age pyramid) will only become more and more pronounced. The increasing number of seniors influences all areas of social and economic development across the EU. Demographic aging is a new challenge for 21st century society, both in terms of economic growth, and new forms of social integration (Čevela, Kalvach, Čeledová, 2012). The positive representations of ageing, which also include the image of active old age, form hand in hand with discussions pointing out the increasing number of older adults in the population as a negative phenomenon (Hasmanová Marhánková, 2017). Among the major emerging topics in this context in the individual countries is the life satisfaction of seniors.

Studies suggest the quality of life of elderly is influenced by physical health, mental status, personal conviction, social relationships, and interaction of many other social, health, economic and environmental conditions that affect human and social development. From the psychological point of view, it is mainly the subjective well-being of individuals and life satisfaction (Hnilicová, Benko, 2005). The possibility of declining life satisfaction levels over the retirement transition, retirees with low levels of individual pension income with a paid job are much better off – financially and psychologically – than retirees in the same position without a paid job (Dingemans, Henkens, 2014). The ageing process is characterized by physical and cognitive slowdown (Cullati et al. 2014), and health issues correlate with and determine life satisfaction (Gana et al. 2013). As individuals become older, health status is characterized by high heterogeneity (Mitnitski et al. 2017).

As stated by Gabriel and Bowling (2004), European research in particular has often focused on the positivist and functionalist aspect of aging (i.e., the attempt to describe available social welfare resources or to normalize the appropriate limits for "ensuring" an "adequate quality of life"). Attention has thus been paid almost
exclusively to the negative aspects of aging. The subjective perception of one’s satisfaction is, however, remarkably neglected – although, as noted by, for example, Kolosnitsyna, Khorkina and Dorzhiev (2017), the life satisfaction of most people can be represented by a U-shaped curve with the lowest satisfaction roughly in middle-age – an increase in life satisfaction can actually be expected in elderly. Instead, the general anticipation is a decline associated with negatively perceived aspects, for example in the deterioration of health.

Considering this persistent lack, this article analyzes the primary data to identify the factors which influence the perceived life satisfaction of seniors in the Czech Republic. Conclusions can be used in policy design and also provide the evidence on the the significant importance of these cognitive findings in addition to the normative approach – as recommended e.g. in Kolosnitsyna, Khorkina, and Dorzhiev (2017).

1 Statement of a problem

The issues of life satisfaction of seniors are investigated in Diener and Suh (1998), Borg et al. (2006), Cheng and Chan (2006) or Baird et al. (2010). Existing literature focuses mainly on psychological factors, health quality (especially frequent in medical research), or relatively broadly conceived quality of life estimates (QoL). While without a doubt all these areas relate to life satisfaction, nevertheless the perceived life satisfaction remains relatively outside the focus of interest. Šolcová and Kebza (2004, p. 21) argue that from a psychological point of view, the well-being is linked to the subjective assessment of the quality of life as a whole, a long-term state in which the satisfaction of the individual with his or her life is reflected. Gabriel and Bowling (2004) draw attention to the fact that most existing QoL models do not take into account the views and priorities of seniors and have not adequately tested their validity.

Personal well-being must be understood and measured through cognitive components (life satisfaction, moral principles), emotional ones (positive and negative emotions) and characterized by consistency in different situations and stability over time. Some studies focus only on "psychological well-being" – e.g. Hao (2008) deals with the psychological well-being of seniors. Surveys related to the life satisfaction of elderly and their determinants are quite rare. Kolosnitsyna, Khorkina and Dorzhiev (2017) conducted a survey of life satisfaction among Russian elderly and found the strongest correlation with indicators of family status, state of health, social status and personal income. However, they point to significant gender differences in life satisfaction factors, when having a job and higher education increases the satisfaction of women, but not men.

Multiple factors can influence the perceived satisfaction with the life situation of seniors. Baird et al. (2010) performed a comparison of two representative panel studies in Britain and Germany that assessed changes in satisfaction over the course of one’s life. In both panels they found that life satisfaction dropped sharply in people over 70. Similarly, Diener and Suh (1998) examined subjective well-being among many nations and found life satisfaction to be fairly stable. From the British results analyzed by Baird et al. (2010), however, a slight increase in life satisfaction could be observed from 40 to 70 years. Hamarat et al. (2002), however, did not find any differences in life satisfaction among groups of people between 45 and 89 years. Blanchflower and Oswald (2008), on the other hand, offer international evidence that there is a link
between life satisfaction and age. In addition, Walker (2005), Pinquart and Sorensen (2000, 2001) and Bourque et al. (2005) are inclined toward the claim that the determinants of life satisfaction may vary by age, gender, family status and cultural context, which in particular indicates the need for specific research within individual groups (especially those to be targeted by a specific policy, i.e. seniors).

2 Methods

As existing studies suggest, life satisfaction is influenced by a number of socio-economic characteristics in elderly (such as the income situation, the form of housing, whether the given person is still working, etc.) along with the state of health, social relations, place of residence but also unevenly represented interventions resulting from government or local policies (e.g. accessibility of social care centers, etc.). Because of the complex character of the issue on hand, we analyze the data from several points of view. We use three mutually complementary approaches.

First we examine the existing secondary data from Eurostat EU-SILC Survey (European Union - Statistics on Income and Living Conditions). In 2014, questions directly related to life satisfaction were added to the survey.

Primary data on satisfaction with the life situation of Czech seniors were collected as a part of TACR Beta project No. TB05MOSV004 "Survey on the Quality of Life of Elderly Citizens in the Czech Republic". This article uses the primary quantitative data obtained from the questionnaire survey among the Czech seniors in 2016.

The total number of respondents surveyed was 3,045, while the number of complete observations obtained for quantitative analysis was 2931. Of these, 36.73% of respondents were men and 63.27% of respondents were women. The respondents' age ranged from 55 years and over. The largest part consisted of respondents aged 66-70, a total of 39.5%, almost a third (33%) of respondents were in the youngest category 55-65 years, less than a fifth (18.3%) of respondents were aged 71-75 And almost 10% of respondents were over 76 years of age (of which 3.1% of respondents were over 81 years of age). The original questionnaire contained more than 100 questions, but only 19 variables were quantitatively applicable. The description of the variables and their values is available in the appendix. Data are represented by categorical variables (X3, X4, X5, X6, X10, X116, X117), binary (dummy) variables (X1, X8, X11, X34, X35, X101, Ysafe, X115) and ordinal variables (X2, X39, X49, X100). For estimation, the categorical variables were broken down into individual categories (note the values of the coefficients of the categorical variables in the model therefore express the contrast with the basic category. For example in Tab. 1, X117val2 represents the dummy variable with the value of 1 for observations of X117 = 2 (i.e. "How did you perceive retirement?" = "I cannot identify with it so far"), and 0 otherwise. The coefficient value for X117val2 reported in Tab. 1 thus records the effect of this category compared to the basic category (of negative perception). Note that default categories are marked with the asterisk (*) symbol in Tab. 3 in the appendix).

To identify the important factors that positively or negatively affect the subjective perception of life satisfaction of seniors in the Czech Republic, the article uses the so-called binomial logistic regression model.
3 Problem solving

EU-SILC data provide some information about the satisfaction of Czech seniors with the selected areas of life. Seniors are understood here to be a person aged 50 years or more, Fig. 1 illustrates in greater detail the level of seniors' satisfaction with selected areas of life. It is clear that most of the seniors are dissatisfied with the financial situation of households (37%) and with the amount of free time (28%), which is related to the fact that working seniors (persons over 50) are included in this analysis. On the contrary, they are most satisfied with housing (70%) and personal relationships (70%). Overall, it is clear from the EU SILC data that Czech seniors are more satisfied (52%) than dissatisfied (29%) and 16% of people have expressed a neutral attitude. The most satisfied are people in the 60-65 age group (54%).

**Fig. 1: The level of satisfaction with the selected areas of life**

<table>
<thead>
<tr>
<th>Area</th>
<th>% Dissatisfied</th>
<th>% Rather Dissatisfied</th>
<th>% Neutral</th>
<th>% Satisfied</th>
<th>% Don't Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>with the financial situation of household</td>
<td>22.4</td>
<td>11.0</td>
<td>16.3</td>
<td>73.4</td>
<td>22.4</td>
</tr>
<tr>
<td>with the environment where he/she lives</td>
<td>21.3</td>
<td>10.8</td>
<td>19.5</td>
<td>46.5</td>
<td>24.5</td>
</tr>
<tr>
<td>with the green places or places to relax</td>
<td>21.5</td>
<td>14.0</td>
<td>17.5</td>
<td>47.5</td>
<td>25.5</td>
</tr>
<tr>
<td>with personal relationships</td>
<td>20.9</td>
<td>15.5</td>
<td>14.1</td>
<td>56.0</td>
<td>25.0</td>
</tr>
<tr>
<td>with the amount of leisure time</td>
<td>22.4</td>
<td>17.8</td>
<td>18.7</td>
<td>40.5</td>
<td>22.5</td>
</tr>
<tr>
<td>with the commuting to employment/business</td>
<td>20.2</td>
<td>23.5</td>
<td>12.4</td>
<td>58.8</td>
<td>26.8</td>
</tr>
<tr>
<td>with current employment/business</td>
<td>20.3</td>
<td>16.4</td>
<td>12.4</td>
<td>56.2</td>
<td>26.2</td>
</tr>
<tr>
<td>with housing</td>
<td>20.7</td>
<td>7.1</td>
<td>15.6</td>
<td>53.6</td>
<td>25.6</td>
</tr>
<tr>
<td>in total</td>
<td>21.9</td>
<td>6.8</td>
<td>16.4</td>
<td>24.3</td>
<td>28.3</td>
</tr>
</tbody>
</table>

Source: (EU-SILC, own calculations, 2018)

The satisfaction of seniors is closely related to seniors’ anticipation of the development of their life situation for the future. Fig. 2 shows the anticipated development of the overall life situation of Czech seniors. The EU SILC data suggests that most seniors assume that their situation will not change or it will worsen and only a small percentage across all the relevant age categories assume their life situation will improve.
The identification of factors that positively or negatively affect the perception of the feeling of satisfaction of Czech seniors is based on the binomial logit model. The results of the model estimates (after top-down sequential elimination) are summarized in the following table (Tab. 1).

**Tab. 1: logit model for X115A, N = 2931**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Odds ratio</th>
<th>Standard error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial sufficiency (X100)</td>
<td>-0.37196</td>
<td>0.689383</td>
<td>0.042125</td>
<td>0.000</td>
</tr>
<tr>
<td>Dependence on social benefits (X101A)</td>
<td>-0.68031</td>
<td>0.506460</td>
<td>0.270226</td>
<td>0.012</td>
</tr>
<tr>
<td>Life situation will get worse (X116val3)</td>
<td>-0.54858</td>
<td>0.577770</td>
<td>0.249375</td>
<td>0.028</td>
</tr>
<tr>
<td>Life situation will get better (X116val4)</td>
<td>-1.38541</td>
<td>0.250220</td>
<td>0.574107</td>
<td>0.016</td>
</tr>
<tr>
<td>Positive perception of retirement (X117val1)</td>
<td>-1.200716</td>
<td>3.322494</td>
<td>0.432884</td>
<td>0.006</td>
</tr>
<tr>
<td>I cannot identify with retirement (X117val2)</td>
<td>-1.35062</td>
<td>0.259080</td>
<td>0.385176</td>
<td>0.000</td>
</tr>
<tr>
<td>Awareness of voluntary work participation (X34A)</td>
<td>0.580033</td>
<td>1.786096</td>
<td>0.245019</td>
<td>0.018</td>
</tr>
<tr>
<td>Health quality (X39)</td>
<td>1.277264</td>
<td>3.586812</td>
<td>0.176704</td>
<td>0.000</td>
</tr>
<tr>
<td>Housing – social home (X4val1)</td>
<td>-2.40202</td>
<td>0.090535</td>
<td>0.440569</td>
<td>0.000</td>
</tr>
<tr>
<td>Housing – Rented apartment (X4val2)</td>
<td>-0.80857</td>
<td>0.445495</td>
<td>0.283746</td>
<td>0.004</td>
</tr>
<tr>
<td>Living alone in a social home (X5val4)</td>
<td>-0.69175</td>
<td>0.500699</td>
<td>0.247546</td>
<td>0.005</td>
</tr>
<tr>
<td>High school education (X6val2)</td>
<td>0.93093</td>
<td>2.536876</td>
<td>0.263308</td>
<td>0.000</td>
</tr>
<tr>
<td>University/college education (X6val3)</td>
<td>0.901156</td>
<td>2.462447</td>
<td>0.33014</td>
<td>0.006</td>
</tr>
<tr>
<td>Currently employed (X8A)</td>
<td>0.603184</td>
<td>1.82793</td>
<td>0.315751</td>
<td>0.056</td>
</tr>
<tr>
<td>_cons</td>
<td>1.387253</td>
<td>0.587531</td>
<td>0.018</td>
<td></td>
</tr>
</tbody>
</table>

Source: (authors, own calculations, 2018)

Significant variables positively influencing the perceived life situation are X39 (with a better health condition the probability of choice 1 increases, with an additional increase on the given scale, the odds ratio for satisfaction with their current life situation increases 3.5 times), X117val1 (i.e. a well-perceived retirement – a surprising
finding is that \( X_{117\text{val2}} \) indicates that the inability to identify with retirement reduces satisfaction with the current life situation, even compared to a poorly perceived retirement (Sic!), knowledge of the possibility of the involvement of seniors in volunteering and whether the person has attained secondary or higher education (both cases with virtually the same influence, i.e. the education attained increases the odds ratio by approximately 2.5 times).

The remaining regressors depict a negative effect on the probability of choice 1 (= good life situation of the seniors). The most significant impact is then apparent in the X4 variable, i.e. the fact whether a person lives in a social facility (compared to their own home, with an odds ratio about 91% less than the odds ratio compared to the situation of seniors living in their own house) or in a rented flat (a 54% lower odds ratio than seniors living in their own home). The negative effects on the X116 variable categories indicate that the expectation of a change in the current situation reduces the satisfaction of seniors, both in cases of improvement and worsening.

Surprisingly, the growth of the perceived sufficiency of finances (X100) has a negative effect, as does the use of social security benefits (X101A). As expected, a person living alone (X5val4) has a negative effect on the probability of choice 1 for the explained variable (the odds ratio is roughly half that of cohabitation with a husband/wife).

The p-value of the Hosmer-Lemeshow test (0.432) indicates that the model matches the data well. The value of pseudo \( R^2 \) is 0.405 and the area under the ROC curve is 0.932, indicating the good classification capability of the model as a whole. However, given the significantly unbalanced share of the values of the explanatory variable, it is naturally desirable to pay attention to the exchange matrix (Tab. 2).

**Tab. 2: Exchange matrix**

<table>
<thead>
<tr>
<th></th>
<th>Observed</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>classified</td>
<td>1</td>
<td>2400</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>421</td>
<td>98</td>
</tr>
<tr>
<td>total</td>
<td>2821</td>
<td>110</td>
<td></td>
</tr>
</tbody>
</table>

Sensitivity 85.08% Specificity 89.09% Correctly classified (total) 85.23%

Source: (authors, own calculations, 2018)

The model as a whole is able to correctly classify a total of 85.2% of the cases (let us note, however, that given the uneven representation of values 0 and 1, this value is not very informative, because even the naive model always assuming choice 1 (i.e. with zero specificity!) will be able to classify the vast majority of observations correctly). The more accurate indicators, i.e. the sensitivity and specificity of the chosen model with a threshold value maximizing Youden's J-index, are relatively high (over 85%), which already signifies the very good classification ability of this model both for cases of the value 0 = "bad" and 1 = "good" explained variables ("What is your current life situation?").

If the logit model is supplemented by a simple descriptive analysis of the results of the questionnaire survey, it can be stated that most Czech seniors (52.23%) assess the
current life situation as good or very good (see the graph in Fig. 4), more than forty percent (43.86%) perceive the situation as acceptable, only a marginal part of the respondents evaluate their life situation as bad or very bad (3.91%) – note the consistency with the aforementioned statement that the satisfaction with the life situation is relatively high for seniors, as indicated, for example, by the assumption of the U-curve describing the relationship between satisfaction and age, with the bottom at middle-age.

4 Discussion and conclusion

The results of secondary data analysis show that Czech seniors are mostly satisfied with their life situation – the most satisfied are seniors aged between 60 and 65 years. Most seniors in the Czech Republic, however, expect their life situation to remain unchanged (about 46%) or worsen (about 20%). Discontent can be traced, according to EU-SILC data, especially to the area of the financial situation. The qualitative surveys showed that the seniors are generally satisfied with their life situation (it can even be observed that the expectation of a change in the current life situation is not desirable) and all the groups surveyed in the primary data survey indicate that their overall life situation will be determined by the development of their state of health. This is in line with the findings of Gabriel and Bowling (2008).

Good relationships in the family have a positive effect on the feelings of satisfaction. Similar results can be found in Bryla et al. (2013), who consider participation in family meetings as a factor that significantly contributes to the quality of life of seniors. This is consistent with our findings that a significant negative effect on the feeling of satisfaction is also manifested in the fact of whether a seniors citizen lives alone or in a social care home.

Analyzing quantitative primary data has made it possible to refine the perception of the current life situation of seniors and the prediction of their development. The results are in line with the findings based on EU SILC survey data. Most seniors (52.23%) assess their life situation as good or very good, while on a positive note 22.76% of those who perceive their life situation positively think that it will not change and only 12.34% of these seniors are expecting a worsening of the life situation. It is possible to declare that, among Czech seniors, it is not possible to prove the influence of gender on the perception of the current life situation, which is in line with results in Borg et al. (2008) and in contrast with Gaymu and Springer (2010), who argued that the factors that can most affect life satisfaction are not the same for men and women. For Czech seniors, however, only a relationship between gender and the assessment of the development of the life situation was identified, when men are clear that their life situation will not change.

Logit model was used to identify factors that influence the perception of the life situation in more detail.

The significant and positive impact of the health status of seniors is confirmed, this finding is also supported by e.g. the results of Gaymu and Springer (2010) and Berg et al. (2009).

The most striking negative effect on the life satisfaction is whether some seniors person lives in a home for seniors, in social facilities or in a rented apartment. This
finding is in line with the conclusions of Borg et al. (2008), who point to the higher satisfaction of respondents living in a regular home. The fact whether an individual lives in his/her home alone also negatively affects the satisfaction of Czech seniors. This finding is in line with assertion in Kucharova (2002), that the feeling of loneliness leads to the fact that the person does not feel safe, and if the need for safety is not met as one of the key needs, it will affect the perception of the overall life situation negatively.

Although it is quite difficult to generalize the results on a European or global scale, since according to Bourque et al. (2005), life satisfaction determinants may differ in cultural context, and Gaymu and Springer (2010) also point out that the factors that most affect life satisfaction are not the same for the European countries under consideration, there is some substantial consistency with the existing results, especially the fact that health determinants and family relationships (for which cohabitation with a partner and place of residence can be beneficial proxies) are the determining factors for seniors.

Thus, it may be questioned whether the functionalist approach of government policies, often oriented towards the construction of social facilities, or social benefits aimed at adjusting the income situation of seniors are indeed what will lead to the greater satisfaction of their intended recipients.

Acknowledgement

This contribution was supported by TAČR Beta project No. TB05MOSV004 "Survey on the Quality of Life of Elderly Citizens in the Czech Republic".

References


Appendix

Tab. 3: Variable names and encoding

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age</th>
<th>Family status</th>
<th>Housing</th>
<th>Who do you live with?</th>
<th>What is your highest attained education?</th>
<th>Are you currently employed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Less than 65</td>
<td>Widowed</td>
<td>Social home</td>
<td>Partner</td>
<td>Vocational education</td>
<td>No</td>
</tr>
<tr>
<td>Female</td>
<td>66-70</td>
<td>Divorced</td>
<td>Rented apartment</td>
<td>*Husband /wife</td>
<td>High school</td>
<td>Yes</td>
</tr>
</tbody>
</table>

1 Categorical variables: X3, X4, X5, X6, X10, X116, X117, note that * indicates the default category; Binary (dummy) variables: X1, X8, X11, X34, X35, X101, Ysafe, X115; Ordinal variables: X2, X39, X49, X100,
<table>
<thead>
<tr>
<th>Age</th>
<th>Marital Status</th>
<th>Living Arrangement</th>
<th>Type of Family/Next of Kin</th>
<th>University/College Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>71-75</td>
<td>Single</td>
<td>Rented house</td>
<td>Family/next of kin</td>
<td>University/college</td>
</tr>
<tr>
<td>76-80</td>
<td>*Married/registered partnership</td>
<td>Own apartment</td>
<td>Alone</td>
<td>*Elementary</td>
</tr>
<tr>
<td>81 or more</td>
<td>*Own house</td>
<td>Alone in social home</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alone in a rented place</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Type of settlement where you lived for the majority of your life?

<table>
<thead>
<tr>
<th>Do you consider moving?</th>
<th>Are you aware of the possibility of voluntary work participation?</th>
<th>Do you participate in voluntary work?</th>
<th>How is your health?</th>
<th>Do you have a health condition limiting your activities?</th>
<th>Financial sufficiency (higher is better)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X10</td>
<td>X11A</td>
<td>X34A</td>
<td>X35A</td>
<td>X39</td>
<td>X49</td>
</tr>
<tr>
<td>Capital city</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Very bad</td>
<td>No</td>
</tr>
<tr>
<td>NUTS3 (region) city center</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Bad</td>
<td>Yes, but it is not limiting</td>
</tr>
<tr>
<td>*City/town</td>
<td>Average</td>
<td></td>
<td></td>
<td>Yes and it is somewhat limiting</td>
<td>3</td>
</tr>
<tr>
<td>Village</td>
<td>Good</td>
<td></td>
<td></td>
<td>Yes and it is very limiting</td>
<td>4</td>
</tr>
<tr>
<td>Very good</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

Do you depend on social benefits?

<table>
<thead>
<tr>
<th>How do you expect your overall life situation will develop?</th>
<th>How did you perceive retirement?</th>
<th>How do you feel safe?</th>
<th>How do you perceive your overall life satisfaction?</th>
</tr>
</thead>
<tbody>
<tr>
<td>X101A</td>
<td>X116</td>
<td>X117</td>
<td>YsafeA</td>
</tr>
<tr>
<td>No</td>
<td>I cannot say</td>
<td>Good</td>
<td>No</td>
</tr>
<tr>
<td>Yes</td>
<td>*Will not change</td>
<td>I cannot identify with it so far</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>It will get worse</th>
<th>As a natural part of life</th>
</tr>
</thead>
<tbody>
<tr>
<td>It will get better</td>
<td>*Bad</td>
</tr>
</tbody>
</table>

Source: (authors, own calculations, 2018)
ELEKTRONIZACE VEŘEJNÉ SPRÁVY JAKO NÁSTROJ OMEZOVÁNÍ KORUPCE

ELECTRONIZATION OF PUBLIC ADMINISTRATION AS A TOOL FOR THE CORRUPTION REDUCTION

Veronika Linhartová, Veronika Tvrdíková

Abstract: The paper deals with the influence of electronization on the reduction of corruption in public administration. According to a number of studies, corruption in public administration has an impact on a wide range of taxpayers. They may feel the consequences of corrupt behaviour, for example in the form of tax and price increases or poor quality of service. For this reason, corruption is considered one of the most serious problems as it affects a large part of society. A number of empirical studies have shown that one of the ways to limit corruption is the electronization of public administration. For analysis, a group of 113 countries from all over the world were used, regardless of their geographical jurisdiction or political establishment. The time period is from 2003 to 2017. In order to fulfil the goal, the graphical interpretation of Bag plots and linear regression analysis is used to assess the impact of selected variables on the level of corruption. The multidimensional regression model has confirmed the positive effect of electronization. However, the most significant effect on the level of corruption in the country had the performance of the economy in the examined period and selected set of countries.

Keywords: Corruption, Electronization, Bag Plots, Regression Analysis, CPI, EGDI.

JEL Classification: D73, E6, H11.

Úvod


V obecném smyslu ovlivňuje možnost vzniku korupce řada socio-kuulturních, ekonomických i politických faktorů. Mezi jinými to jsou výše úplatku, systém sankcí, korupční tradice, sociální chaos, hodnotový žebříček společnosti, chudoba, korupční vzory, vliv médií, kvalita veřejné správy, výše platů státních úředníků či normativní systém fungování veřejné správy (Chmelík, 2003). Řada empirických studií prokázala, že jednou z možností, jak omezit korupci, je elektronizace veřejné správy, která může některé z výše uvedených faktorů eliminovat a tím pozitivně působit na míru korupce v zemi (například Kimbro, 2002; Andersen, Rand, 2006; Kim, 2007; Bhatnagar, 2008; Shim, 2008; Andersen, 2009; Mistry a Jalal, 2012; Elbahnasawy, 2014).

Příspěvek se věnuje elektronizaci veřejné správy z hlediska jejího využití v oblasti omezování korupce ve veřejné správě. Cílem příspěvku je ověřit vliv elektronizace veřejné správy na omezování míry korupce ve veřejné správě ve zvoleném souboru 113 zemí v časovém období let 2003 až 2017. Index rozvoje e-governmentu (EGDI),
který kvantifikuje míru elektronizace veřejné správy v zemi, byl sestaven poprvé v roce 2003 a naposledy publikován v roce 2017. S ohledem na využité indikátory kvantifikující míru korupce v zemi a úroveň elektronizace veřejné správy se tak jedná v současnosti o nejšířší dostupný datový soubor.

1 Vliv elektronizace na korupci ve veřejné správě


Elbahnasawy (2014) konkrétně uvádí, že při udržení ostatních faktorů na konstantní úrovni, zvýšení elektronizace o jednu standardní odchylku (0,2 bodové zvýšení indexu elektronizace) vede ke snížení vznícání korupce o 0,25 až 0,43 bodu. Autor dále uvádí i další faktory, které korupci také ovlivňují. Například se jedná o výkonnost ekonomiky (měřená pomocí HDP). Každé zvýšení HDP o jeden standardní vzestup (12 739 dolarů na obyvatele) snižuje korupci o 0,04 až 0,10 bodu. Vliv má také rozsah a kvalita online služeb, kdy zvýšení standardní odchylky (0,24 bodu) snižuje korupci o 0,15 bodu. Korupci výrazně ovlivňuje také kvalita právního prostředí, která zahrnuje úroveň práva nebo justici sloužící mocným k prosazování vlastních zájmů (Katsios, 2015). Zvýšení standardní odchylky rule-of-law indexu (o 1,01 bodu) snižuje korupci o 0,45 až 0,61 bodu (Elbahnasawy, 2014).

2 Metody

Cílem příspěvku je analyzovat vliv elektronizace veřejné správy na omezování korupce. Pro analýzu byla použita skupina 113 zemí celého světa bez ohledu na jejich geografickou příslušnost, politické zřízení či ekonomickou vyspělost. Seznam zemí zahrnutých do analýzy je obsahem tabulky v příloze 1 příspěvku. S ohledem na využité indikátory kvantifikující míru korupce v zemi a úroveň elektronizace veřejné správy se jedná v současnosti o nejdelší časovou řadu a nejšířší soubor zemí.
umožňující ověřit platnost hypotézy o pozitivním vlivu elektronizace veřejné správy na korupci ve veřejném sektoru.


Jako ukazatel hodnotící úroveň elektronizace v zemi byl zvolen *Index rozvoje e-governmentu (EGDI)*. EGDI byl sestaven poprvé v roce 2003 a nabývá intervalu <0;1>, kde hodnota 1 představuje vysokou úroveň využití metod e-governmentu a nulová hodnota Indexu značí naopak nízkou míru aplikace zmíněných metod v oblasti veřejné správy. Měření EGDI je založeno na průzkumech sestavených za spolupráce OSN-UNDESA (United nations Department of Economic and Social Affairs) a Civic Resource Group, poradenskou firmu poskytující technologická řešení v oblasti e-governmentu (UNITED NATIONS, 2016). Přestože korupce není primární složkou, kterou by E-Government Survey zkoumal, jak uvádí United Nations ve své zprávě z roku 2018, jednou z hlavních složek kvalitní digitální správy je „Odpovědnost (Accountability)“, která například kromě volného přístupu občanů k informacím či otevřené správy zahrnuje právě úroveň kontroly korupce v zemi.


Za účelem naplnění cíle příspěvku bude využita grafická interpretace tzv. Bag plots a lineární regresní analýza, s jejíž pomocí lze posoudit vliv vybraných proměnných na míru korupce. Všechna testování jsou prováděna s 5% hladinou významnosti. Využité odhady parametrů jsou vyvozeny z metody nejmenších čtverců.

Bag plots jsou generalizované dvoudimenzionální grafy, které slouží ke grafické interpretaci statistických dat. Kombinace závislé a nezávislé proměnné jednotlivých zemí představují body v grafu. Ve vnitřní tmavé části leží 50% pozorovaní (mezi prvním a třetím kvartilem) a medián zkoumaných pozorování, který je označen tmavým čtvercem. Vnější oblast bagu tvoří světlá část obsahující ostatní státy, které mají více odlišné hodnoty než státy v tmavé oblasti, nejsou to však odlehlé hodnoty.

Lineární regresní analýza je metoda, pomocí níž se odhaduje hodnota závislé proměnné na základě znalostí nezávislé proměnných. V případě jedné nezávislé proměnné se jedná o jednoduchou regresi, která popisuje vztah mezi závislé proměnnou a jednou nezávislé proměnnou (tzv. regresor). Vícenásobná regrese na rozdíl od jednoduché se využívá v případě více nezávislých proměnných, tedy když závislá proměnná závisí na dvou a více regresorech. Vzorec lineární regrese lze vyjádřit následovně (Víšek, 1998):

$$ y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n + \varepsilon $$  (1)

Parametry $y$ je závislá proměnná, parametry $x$ značí nezávislé proměnné. Alfa ($\alpha$) určuje vzdálenost průsečíku regresní přímky s osou $y$ od počátku souřadnic (hodnota regresní funkce pro $x = 0$). Beta ($\beta$) jsou regresní koeficienty, které udávají, o kolik se změní závislá proměnná, když se zvětší hodnota nezávislé proměnné o jednotku. Index $n$ značí počet nezávislých proměnných. Symbol $\varepsilon$ značí reziduální rozptyl. Jedná se o grafické znázornění vzdáleností bodů od přímky. Pro úspěšnou interpretaci vícenásobné regresní analýzy musí data splňovat základní předpoklady, které zajistí nezkreslené výsledky analýzy. (Víšek, 1998).

Odhad míry korupce v závislosti na hodnocení elektronizace pomocí jednoduché lineární regrese má tvar (Andersen, 2009; Andersen, Rand, 2006):

$$ CPI = \alpha + \beta * EGDI + \varepsilon, $$  (2)

kde CPI je hodnocení míry korupce v zemi a EGDI je hodnocení elektronizace země.

Odhad změny v míře korupce vyvolaný změnou elektronizace lze zapsat jako následující model:

$$ \Delta CPI = \alpha + \beta * \Delta EGDI + \varepsilon, $$  (3)

kde $\Delta CPI$ je změna v míře korupce a $\Delta EGDI$ je změna v hodnocení elektronizace.

3 Rozbor problému


Lepší schopnost využívání informačních technologií ve veřejné správě je vyjádřena vyššími hodnotami EGDI. Nižší míra korupce v zemi se naopak vyzaňuje vyššími hodnotami indexu CPI. Na první pohled viditelně pozitivní sklon bag plotu potvrzuje pozitivní vztah mezi mírou korupce a úrovní elektronizace v zvoleném souboru zemí v roce 2003. V bag plotu je několik odlehlých zemí, ať už z pohledu hodnocení míry korupce či využívání elektronizace. Nejvíce zaostávající zemí v oblasti korupce je Bangladéš, která v roce 2003 dosáhla v hodnocení míry korupce hodnoty jen 1,3
z možných 10. Dalšími zaostávajícími zeměmi jsou například Sierra Leone, Etiopie nebo Mali. Spojené státy americké předběhly ostatní země v hodnocení elektronizace veřejné správy. Za rok 2003 hodnocení elektronizace v této zemi dosáhlo s velkým náskokem hodnoty 0,927, druhá nejlepší země Švédsko má hodnotu 0,840. Dle hodnocení míry korupce předčilo ostatní Finsko, a to s nejvyšší hodnotou 9,7 z 10.

Obr. 2 zobrazuje Bag plot zvoleného souboru zemí, pro data z roku 2017. Na ose x je naneseno hodnocení elektronizace EGDI 2017 a na ose y hodnocení míry korupce CPI 2017. U proměnných pro rok 2017 byl rovněž prokázán pozitivní vztah mezi mírou korupce a elektronizace ve veřejné správě, který je zřejmý z pozitivního sklonu. Bag plot opět vykazuje několik odlehlých hodnot. Nejvíce odlehou zemí, co se týče využití elektronizace ve veřejné správě, je Bahrajn a Mali. I přes nízké hodnocení míry korupce dosahující hodnoty pouze 0,242. Dle hodnocení míry korupce je nejvíce odlehou zemi Súdán, a to s hodnotou Indexu vnímání korupce jen 1,6.

Obr. 1: Bag plot CPI 2003 vs. EGDI 2003  Obr. 2: Bag plot CPI 2017 vs. EGDI 2017

V příloze 2 je zobrazen lineární regresní model, který znázorňuje změny míry korupce a elektronizace ve zvoleném souboru zemí mezi lety 2003 a 2017. Na vodorovné ose je procentní změna EGDI mezi lety 2003 a 2017 a na svislé ose procentní změna CPI. Data jsou proložena lineární regresní přímou, která je doplněná o pás spolehlivosti. Zemí, která dosáhla největšího pokroku v obou analyzovaných proměnných, byla ve sledovaném období Bangladéš (č. 9). U Malajsie (č. 61) či Bahrajnu (č. 8) došlo i přes zvýšení využití IT v oblasti veřejné správy ke zhoršení hodnocení míry korupce v zemi. Z grafického lineárního regresního modelu je zřejmé, že vyšší využití IT v oblasti veřejné správy nešlo ve sledovaném období u všech zemí ruč v ruce s nižší mírou korupce. I přesto model prokázal, že při neměnných podmínkách jednoprocentní změna v hodnocení elektronizace veřejné správy vedla ve sledovaném období a analyzovaném souboru zemí k nárůstu hodnocení míry korupce o více než 0,2 %. Uvedený regresní model vykazuje nízkou hodnotu koeficientu determinace, \( R^2 = 0.079787 \). Na základě toho lze tvrdit, že variabilita vysvětlované proměnné (ΔCPI) je vysvětlena zmíněným modelem pouze z přibližně 8 %.

Odhadnutý model vysvětlující vztah mezi mírou korupce a elektronizaci ve veřejné správě má tvar:

\[
\Delta CPI = 4,2577 + 0,238 \times \Delta EGDI + \varepsilon
\]
Jednoduchá lineární regrese prokázala určitou závislost změny míry korupce na změně ve využití elektronizace ve veřejné správě, přičemž při zlepšení hodnocení elektronizace za pomocí indexu EGDI o 1 % se zlepšuje hodnocení míry korupce dle CPI průměrně o 0,238 %. Nízký podíl vysvětlené variability naznačuje, že na změnu CPI mají vliv rovněž další v analýze neuvažované faktory. Z tohoto důvodu je vhodné tento model rozšířit o další vysvětlující proměnné. Odhad koeficientu závislosti změny míry korupce na změně využívání elektronizace vyšel statisticky významný (nenulový), tudíž proměnná ΔEGDI má v modelu své opodstatnění. Na základě studií (Elbahnasawy, 2014, Katsios, 2015) byly pro další analýzy určeny další 2 faktory, u kterých byl prokázán vliv na míru korupce v zemi. Tyto faktory jsou výkonnost ekonomiky země a kvalita právního prostředí, měření pomocí HDP a rule-of-law indexu. V následující vícezměrné regresní analýze budou využity všechny tři nezávislé proměnné. Odhad změny v míře korupce (ΔCPI) vyvolaný změnami elektronizace (ΔEGDI), změnami výkonnosti ekonomiky (ΔHDP) a změnou stavu právního systému (Δrule-of-law index) v letech 2003 až 2017 lze zapsat jako následující model:

\[
\Delta CPI = \alpha + \beta_1 \times \Delta EGDI + \beta_2 \times \Delta HDP + \beta_3 \times \Delta rule-of-law + \varepsilon \tag{6}
\]

Následující Tab. 2 s výslednými hodnotami vícečlenné regrese pro roky 2003 až 2017 zobrazuje závislost procentní změny míry korupce na procentní změně výše uvedených vysvětlujících proměnných. Výsledky z tabulky ukazují, že ve sledovaném období byla míra korupce ovlivňována především stupněm elektronizace ve veřejné správě a výkonností ekonomiky. Změna kvality právního prostředí neměla v sledovaném období ve zvoleném souboru zemí zásadní vliv na míru korupce.

Tab. 2: Výsledky vícečlenné regrese pro ΔCPI vs. ΔEGDI, ΔHDP a Δrule-of-law index

<table>
<thead>
<tr>
<th></th>
<th>R = 0,476809102, R² = 0,227346919, p &lt; 0,000003</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b*</td>
</tr>
<tr>
<td>Abs.člen</td>
<td>-11,0513</td>
</tr>
<tr>
<td>ΔEGDI</td>
<td>0,149709</td>
</tr>
<tr>
<td>ΔHDP</td>
<td>0,404249</td>
</tr>
<tr>
<td>Δrule-of-law</td>
<td>0,021126</td>
</tr>
</tbody>
</table>

Zdroj: vlastní zpracování, Statistica 2012

Model vícečlenné regrese má následující tvar:

\[
\Delta CPI = -11,051 + 0,1263 \times \Delta EGDI + 0,2164 \times \Delta HDP + 0 \times \Delta rule-of-law + \varepsilon \tag{7}
\]

Z uvažovaných faktorů měla na míru korupce ve sledovaném období pro skupinu analyzovaných zemí největší vliv výkonnost ekonomiky. Při 1 % změně v hodnocení výkonnosti ekonomiky došlo k 0,21% nárůstu v hodnocení míry korupce. Jednoprocentní změna v hodnocení elektronizace ve veřejné správě vedla k 0,12% růstu míry korupce.

4 Diskuze

Výsledky výše provedených analýz se v řadě závěrů shodují s empirickými studiemi (např. Andersen, 2009; Bhatnagar, 2008; Shim, 2008; Department of

Již desítky let je zejména problematika vztahu korupce a ekonomické výkonnosti zemí předmětem řady teoretických a empirických studií. Z bag otů je zřejmé, že ekonomicky vyspělé státy zpravidla vykazují v hodnocení indexu CPI vyšších hodnot, rovněž tak jsou lépe hodnocené z hlediska využití IT technologií v oblasti veřejné správy. Výsledky víceasobné regrese pro celý soubor zkoumaných zemí pozitivní vliv výkonnosti ekonomiky na míru korupce ve zemi skutečně prokázaly. V případě vztahu mezi změnou mírou korupce a změnou kvality právního prostředí výsledky naznačují, že mezi těmito proměnnými neexistuje vztah a kvalita právního prostředí není vůbec ohodnocována prakticky."}


V provedené analýze však nejvýraznějšího zlepšení v míře korupce ve sledovaném období dosáhla především Bangladéš, která mezi ekonomicky vyspělé státy nepatří. Tu organizace Transparency International (2018b) pozitivně hodnotí zejména v souvislosti s přijetím antikorupční strategie, která se zaměřuje na „profesionální integritu a nestrannost veřejných služeb; robustní přístup k informacím; rychlejší, širší a hlubší digitalizaci veřejné správy; zvýšený prostor pro občany a jejich zapojování se do veřejných, svobody sdělovacích prostředků, občanskou společnost a podporu nevládních organizací."

Je naivní se domnívat, že pouhá digitalizace veřejné správy je všelékem v oblasti snižování míry korupce. Korupce má mnoho příčin, které se v jednotlivých zemích vyrazně liší v závislosti na historickém vývoji, geo-politické či ekonomické situaci. Zejména v oblasti korupce ve veřejné správě se však jedná o více než užitečný nástroj jejího omezování, který může fungovat bez ohledu na ekonomickou vyspělost či geografickou polohu zemí.

Závěr

Přestože korupce sužuje vlády jednotlivých zemí již odnepaměti, s bojem proti tomuto fenoménu si většina z nich stále příliš neví rady. Zejména korupce v oblasti
veřejné správy je z důvodu závažnosti svých důsledků i možné šíře poškozených subjektů předmětem bouřlivých diskuzí i aktivit v oblasti protikorupční politiky. V současnosti poměrně moderním nástrojem, který podle řady autorů může přispívat k omeozování korupce ve veřejné správě prostřednictvím regulace diskreční pravomoci úředníků, transparentního poskytování a uchovávání informací i vyšší efektivnosti probíhajících procesů, je zavádění informačních a komunikačních technologií do procesů veřejné správy.


Provedená analýza vlivu působení elektronizace veřejné správy na korupční prostředí v zemi tak navazuje na již existující studie (např. Andersen, 2009; Bhatnagar, 2008; Shim, 2008; Department of Economic and Social Affairs, 2016; Andersen, Rand, 2006; Mistry and Jalal, 2012; Kimbro, 2002; Kim, 2007) a potvrzuje možné snižování míry korupce v zemi za pomoci využití metod e-governmentu. S ohledem na zjištěné výstupy příspěvek poukazuje potenciál e-governmentu jako součásti protikorupční strategie.

Reference


Linhartová, V., Židová, E., 2016. The impact of corruption on economic growth in oecd countries. Scientific Papers of the University of Pardubice. Series D, Faculty of Economics & Administration, 23(37).

Lněnička, M., 2015. E-government Development Index and its Comparison in the EU Member States. Scientific Papers of the University of Pardubice, p.75.


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**Příloha č. 1: Seznam analyzovaných zemí**

| 2. Alžírsko | 31. Chile | 60. Maďarsko | 89. Senegal |
| 3. Angola | 32. Chorvatsko | 61. Malajsie | 90. Sierra Leone |
| 5. Arménie | 34. Indonésie | 63. Mali | 92. Slovensko |
| 6. Austrálie | 35. Írán | 64. Maroko | 93. Slovinsko |
| 13. Bosna a Hercegovina | 42. Jihoafrická republika | 71. Nigérie | 100. Španělsko |
| 15. Brazílie | 44. Kamerun | 73. Nizozemské | 102. Švýcarsko |
| 17. Česká republika | 46. Katar | 75. Nový Zéland | 104. Thajsko |
| 18. Čína | 47. Kazachstán | 76. Omán | 105. Trinidad a Tobago |
| 27. Francie | 56. Litva | 85. Rumunsko | |
| 28. Ghana | 57. Lotyšsko | 86. Rusko | |
| 29. Guatemala | 58. Lucembursko | 87. Řecko | |
Příloha č. 2: Bodový graf z ΔCPI proti ΔEGDI

Zdroj: vlastní zpracování, Statistica 2012

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Approved for publication: 26. 06. 2019
Abstract: The article at the outset conducted on the theoretical basis, incorporating relevant authors and theories, has pointed to a number of weaknesses of neoclassical theory, which would be hardly compatible with real management practice and manager behavior. Article critically evaluated theoretical background in management sciences and examined manager in behavioral and heuristic theories. Analysis offered an interpretation of managerial decision-making as a product of personal preferences and characteristics, limited rationality, lack of information, mental shortcut, and imitation. Analysis described practical behavior of managers and then correlated these to each other and to explanatory factors as well. The re-orientation towards recognition of managerial behavior is developed and illustrated. Conclusions were derived from the generalization of empirical observations. Empirical research is based on in-depth qualitative study and subsequently it derives from established theoretical patterns. It explores and explains the way managers make economic decisions. The emerging theory strongly emphasizes the strengthening of the human potential inside a manager.

Keywords: Management, Behavioral Management, Manager’s Decision-making, Heuristics, Qualitative Research.

JEL Classification: D81, D91, L2, M1.

Introduction

Management theory has taken various paths of development in recent years. Increasing number of discussions on management pivots around the ideas of manager’s competencies and capabilities, personal preferences and characteristics, limited rationality, lack of information, knowledge-creating and other managerial routines, decisions, and behavioral practices. Handling disadvantages and acquiring capabilities are crucial for the ability of a firm to function. New ideas featured in this article by investigating the behavioral patterns of managers can contribute to update the classical theories.

1 Theoretical background

1.1 Classical theory of the firm, its characteristics, biases

The neoclassical theory of the firm has grown on quite orthodox opinions on the functioning of firms and the role they play on the market. The traditional understanding of firm theory is based on the assumption that it is based on the profits maximization, and that it is the only and main goal. Hence, management of the firm is pursuing profits, this single goal. Therefore, it does not allow anyone in the firm management to pursue a different goal than the firm's profit.

It can be said that the theory meets the goals for which it was created. It serves to understand the behavior of the market as a whole, to explain the impact of certain factors like changes in market prices, to which this theory is sufficient, and its
shortcomings are not important. This simplified theory of the firm, represented by Drucker (2008), Koontz and Weihrich (2015), makes it easy to understand the economy as whole.

The neoclassical theory of the firm assumes that the owner of the business is also a manager at the same time. Theory unites the one who bears the risks of doing business and puts his money into it with the one who manages a firm. Owner and manager as one person signs for all contracts for the firm's activities and decides about its future business orientation. In the case of a one-man firm, it is possible that the owner itself will control the firm. However, merging of ownership and management of the firm is not a way of management in practice. Nowadays, it is quite common to own a firm but not to manage it at the same time.

Another factor that is not sufficiently taken into account by the neoclassical theory is the manager’s control and oversight of the firm's activities. Today dominate the kind of companies where ownership is separated from control. These are firms or entities in which control and management are entrusted to the firm's board of directors, which is composed of owners, but also of other management personnel.

Biases of the neoclassical theory can be summarized, that it looks at a firm purposely in a very specific way in order to explain easily various changes caused by multiple factors.

1.2 Classical versus behavioral theories

According to the classical theory of the firm, companies solve problems by identifying a given problem, then setting up different solutions, from which they then select and implement the best possible solution. Neoclassical theory is based on the assumption that managers have the maximum available information and all accurate and up-to-date calculations. However, this situation in today's market can hardly ever happen.

According to the behavioral theories, managers simplify their decision-making process. They set short-term goals and look for alternatives to solutions that would satisfy these goals, rather than focusing on finding one best possible solution. Rather, they achieve targets gradually, even with the risk of potential loss as a result of choosing the wrong alternative of choice. Above all, they try to make rational decisions, use human behavioral approach to follow decision-making processes.

The neoclassical theory is based on the fact, that all entities in the company pursue only one goal, maximizing profit, as an unchanging fact. The theory considers the assumption that there are many entities inside the firm with different, often conflicting interests. The neoclassical theory acknowledges the fact that managers may have their own private interests but at the same time, theory assumes that they will either voluntarily ignore them or that a possible conflict of interest between the firm and manager will be covered by employee contract.

Behavioral theories take the opposite view. They assume that there is a constant conflict of interest between the firm and other entities. The permanent conflicts of interests among owners and managers are subject to speculation and action in the firm. This conflict will never disappear and must be solved over and over again. It is therefore a major problem to identify an unambiguous firm goal as each side has a
different interest. According to behavioral theories, the coherence of the interests inside the firm is rarely achievable and difficult to sustain.

Behavioral theory takes into account the human factor that has according to Šebestová (2007) a major influence. It examines not only the behavior of the firm, but also the behavior of particular individuals like hired managers.

1.3 Behavioral theories

Behavioral theories are alternative theories of a firm that explain the behavior of individual firms. They look for the factors that affect the business, its management, the firms’ decision-making, and the goals it pursues. They were founded in the 1960s on the assumption that the maximization of business profits is not the only target function of the business. In 1963, Cyert and March, one of the earliest experts in economic research work on behavioral theories, defined the main ideas underlying behavioral theories, and the authors themselves led to their practical validation.

Theory of limited rationality comes from observation that rational factors in decision-making are significantly limited by the amount of information available. Businesses are run by managers, who have complex relationships with business owners, which may be individuals, a group of people, or other businesses. This creates a complex ownership and managerial structure, bringing together organizational and communication problems that complicate the transfer of information. This causes lack of information, as it is not always possible to decide and manage accurately and timely. To make calculations is often costing and time consuming.

Cyert and March (1963) set out the main goals of behavioral theory. They clearly defined what the behavioral theory serves for. Authors have validated theoretical background by comparing theoretical assumptions with observations in different companies.

Behavioral theories display and explain how the firms and their management decides. It seeks to specify a set of rules and motivation assumptions that could be used to describe the manager's individual decisions.

Based on this, behavioral theories try to identify the possibilities for individual manager to make decisions. Based on the firm’s goals, the theory specifies a set of management decision-making rules related to production, price, customers, costs, suppliers, and location. Management decision-making takes account of firm process optimization, but at the same time puts emphasis on set goals.

2 Statement of a problem

Neoclassical theory is insufficient and does not give a true picture of the reality surrounding the firms, it does not explain nature and principles of their management operation. The neoclassical theory does not take into account the factors like an ownership form, performance of control, decision making and managing under uncertainty conditions. The theory was not set in order to investigate and explain the behavior of individual firms or managers and to deal with their internal processes.

Because the neoclassical theory of the firm does not correspond with the reality, more and more theorists gradually began to present various alternative theories dealing
with the behavior and nature of the existence and management of the firm. One of these theories is the theory of behavioral management.

Managerial theories are based on the principle that a firm managed by hired managers can have a different goal than to maximize their profits. When the firm owner is not present in the firm and the person who manages and controls the firm has all powers, he can pursue alternative interests. These interests are different then the business owners have. Thus, the two sides in the firm are often in mutual conflict. They follow the interests important to them from their point of view. Neoclassical theories are in conflict with reality and therefore it is necessary to amend theories by empirical research and evaluate theory consequently.

The main aim of the study is to verify the adequacy of behavioral management theory by examining it in companies and compare the results achieved with other management approaches.

3 Methods

Behaviorists proceed inductively, they do not examine how managers should behave, but rather how they really do. Conclusions are derived from the generalization of empirical observations. Behavioral method describes the behavior of managers and then correlates these to explanatory factors. Hence, this is the method of presented study when outcome hypotheses are created in the end of research.

Manager’s behavioral variables are in large part about subjective perceptions and not precise measurements. Accordingly, behavioral variables are used. Managerial action variables are defined as follows: transaction costs, competitiveness, limited rationality, imitation, size, suppliers’ availability, human resources, finance availability and location.

3.1 Measurements

Behavioral variables are based on the qualitative and quantitative research of entrepreneurs, micro and small firms, their behavior and their management. For some variables, it is difficult to express them numerically, so in these cases a scale of score we determined according to analysis of the qualitative sources, which is requirement for used statistical methods. (Yasai-Ardekani, 1986)

To that end study chooses a qualitative research method, which involves the collection and analysis of qualitative data.

Qualitative research proceeds inductively and statements are generated only during the research as part of trying to understand a new problem. The reason for choosing the qualitative method here is that this issue is quite complex. The main benefit of the method is to provide in-depth insight into 54 enterprises.

3.2 Data collection

The investigated 54 firms come from the Pardubice region. The numbers of SMEs in the Czech Republic and in the Pardubice region (Zpráva o vývoji malého a středního podnikání a jeho podpoře, 2018) were identified. The research was carried out over the past five years, mapping 20 years of history of the individual business. Interviewed managers are a versatile group of people, all with valuable and
comprehensive insights of their firm’s genesis, development and daily problems. Direct personal confrontation with the examined object and repeated long term research is an argument for the reliability.

Managers and entrepreneurs were proud of the results they have reached and they were willing to share their experience in empirical research. They have described how they started the business and how it developed, mentioning environmental obstacles they had to face as well as inner processes and inner doubts they had to go through. Six of them were women, two of which were wholesalers and four hair salon owners. The sample fits with NACE structure, hence major proportion is metal production. Although at the beginning managers have lacked technical skills, know-how, business experience, and capital, they proved exceptional flexibility and hard work.

Respondents were recorded and then the text was literally transcribed. The framework of the interview was established, and questions were directed to crystallize the situations that evoked a need for a managerial decision and subsequent choice of action. Their dynamics and causal mechanisms were emphasized.

The interviews searched for links and moments that particularly affected the managerial decision. Case study text was analyzed and integrated properly by prevailing assumptions and their meaning taking into account theoretical background. Data were combined in order to identify links and lastly use the processed material to amend existing theory. Processed data were connected to relevant theories finding a match or mismatch to be in accordance with main one.

3.3 Statistical methods

This measure was developed by Yasai-Ardekani (1989) and Kutner et al., (2005), used mathematical measuring analysis. In order to test effects of the management style and manager’s behavior, a correlation is used.

A Pearson’s correlation coefficient is used. A number displayed in a Tab. n. 1 indicates the extent to which two variables are linearly related. (Bryman, Lewis-Beck, 2003).

**Variables:**

As the representational variables for manager’s behavior and his individual perception were chosen indicators following method of Soofi et al. (2000). These variables were analyzed, in order to explain and confirm basic correlations. Variables are dichotomous (except Size variable) and represent the factors as managers themselves perceive them. Qualitative managers’ statements related to this topic were analyzed and for each firm there was set value 0 for NO answer or a value 1 for YES answer.

Variable Profit maximization represents management style where value 0 is aiming towards maximum profit and value 1 is aiming towards satisfactory profit level.

Variable Location represents the factor of the location choice, as the managers themselves perceive it. There was set value 0 for disadvantageous location or value 1 for advantageous location.
Variable Competitiveness expresses the ability of the manager to successfully identify, grasp and use the right opportunity for growth, to expand and improve and strengthen the market position of the firm towards competitors (Starzyczna, 2015). Value 0 is for weak competitiveness and value 1 is for strongly perceived competitiveness.

Variable Imitation comes when behavior of peer firms are mindlessly imitated by managers of other firms no matter how wrong they may be. For instance if the recent evidence suggest that competitors have made money by choosing certain possibility, others will do exactly the same, managers simply imitate. Value 0 is for no imitation practice, value 1 is for active imitation practice.

Variable Size was measured as the logarithm of the number of employees.

Variable Transaction costs is a cost in making an economic transaction, especially cost to get information. Many theorists like De Nisi (2011) define transaction costs as cost of time spent on contracting, etc. Value 0 is for perceived low cost and value 1 is for perceived high cost.

Variable Suppliers availability is also a dummy variable and shows limited availability of convenient suppliers in the region. For 0 there is a good availability, entrepreneur does not need to create supra-regional ties of suppliers; for 1 the businesses experience the lack of suitable suppliers and they have to look for them in the more distant environments or even abroad.

Variable Human resources displays limited availability of qualified employees in the region (Augier, Teece, 2006), (Dvouletý, 2017). For every firm there is determined value 0 or 1. Value 1 means that firm is not able to find enough qualified employees in the surrounding region and is forced to search for human resources at the supra-regional level while on the other hand value 0 confirmed that entrepreneur could hire all the employees only within the region.

Variable Finance availability represents rate of limited availability of the finance in the region. It is measured from the point of view of the entrepreneurs, who indicate the circumstances and the rate of availability of the various finance resources in the region. For better interpretation of the results of the analysis, this variable is as well expressed with dummy variable 0 and 1. Value 0 means that availability of finance is not limited and the level of available finance resources in region is satisfying while value 1 confirmed statement that the availability of finance resources if limited for the specific entrepreneur.

Variable decision under Limited rationality expresses the limited ability of manager to choose the optimal possibility out of several possibilities and decision making under uncertainty. Task optimization is taken into consideration. Value 0 is for perceived weak task optimization and value 1 is for strong task optimization.
4 Outcomes and results

Relationships between all the variables are displayed in the Tab. 1 through correlation coefficients, which express positive or negative deviation via plus or minus signs of the coefficient. There are also means and standard deviations. (Kutner, et al., 2005).

To replicate the procedure of Yasai-Ardekani (1989), his proposed research model was tested via correlation analysis. Correlations were calculated together with means and standard deviations are portrayed in Tab. 1. Higher means shows Size, lower means show Finance availability, Human resources, Transaction costs and Limited rationality.

As can be seen in Tab. 1, variables tested on bivariate correlations under 0,39 are bellow critical values. Higher correlations show variables Profit – Competitiveness, Size – Competitiveness, Suppliers availability – Imitation practices, Human resource management – Competitiveness, Limited rationality – Transaction costs.

Tab. 1: Means, Standard Deviations, and correlations for all variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Means</th>
<th>Standard Deviations</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Profit maximization</td>
<td>1.80</td>
<td>0.89</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Location</td>
<td>1.48</td>
<td>0.64</td>
<td>.10</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Competitiveness</td>
<td>1.84</td>
<td>0.83</td>
<td>.39</td>
<td>.29</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Imitation</td>
<td>0.84</td>
<td>0.37</td>
<td>-.22</td>
<td>.16</td>
<td>-.08</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Size</td>
<td>2.60</td>
<td>1.83</td>
<td>.01</td>
<td>.00</td>
<td>.40</td>
<td>.01</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Transaction costs</td>
<td>0.56</td>
<td>0.50</td>
<td>-.02</td>
<td>.16</td>
<td>.31</td>
<td>.05</td>
<td>.12</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Suppliers availability</td>
<td>0.88</td>
<td>0.32</td>
<td>.06</td>
<td>.08</td>
<td>.08</td>
<td>.51</td>
<td>-.10</td>
<td>-.08</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Human resources</td>
<td>0.60</td>
<td>0.49</td>
<td>.37</td>
<td>.23</td>
<td>.43</td>
<td>.09</td>
<td>.13</td>
<td>.10</td>
<td>.20</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Finance availability</td>
<td>0.40</td>
<td>0.49</td>
<td>-.18</td>
<td>.15</td>
<td>.06</td>
<td>.13</td>
<td>-.20</td>
<td>-.10</td>
<td>.30</td>
<td>.17</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10. Limited rationality</td>
<td>0.52</td>
<td>0.50</td>
<td>.32</td>
<td>-.03</td>
<td>-.09</td>
<td>-.20</td>
<td>.28</td>
<td>.48</td>
<td>-.11</td>
<td>.20</td>
<td>-.20</td>
<td>1</td>
</tr>
</tbody>
</table>

All correlations above 0,30 are significant at p < 0,05 and all correlations above 0,39 are significant at p < 0,01. The number of observation is 54.

Significance allowed to state outcome hypotheses:

H1 The more manager seeks to maximize profit, the more competitive is the firm.

H2 Bigger firm reaches better competitiveness.

H3 Suppliers’ availability is high for firm with imitation practices.

H4 The firm that is able to manage relevant human resources is more competitive.

H5 With limited rationality of manager the transaction cost are growing.

5 Evaluation and discussion

The theory accuracy was verified examining the observed firms, deciding on management strategies, and subsequently compared with the original theories. Behavioral theory served as a tool for analyzing decision-making among several alternatives of business strategy. A large number of recommendations in the field of long-term management strategy are designed to influence decision-making principles.
in various ways. On this basis, the theory is also used to deduce the likely consequences of alternative management strategies.

Evaluation comes from using the basic statements of the behavioral theory for describing the certain style of a management of individual manager (Cyert, March, 1963) and deducing behavior of a manager. Supposed behavior compared with actual observed manager’s behavior allowed to create outcome hypotheses based on correlations (Mandysová, 2017).

Empirical research has proved that decision-making under conditions of uncertainty is a very common situation for every manager today. However, the neoclassical theory of the firm does not consider this, it assumes the perfect awareness of all market players. Every manager of every firm on the market searches for the most accurate information about their internal and external environment as a basis for their management decision-making. Internal information, such as business performance data, can be obtained relatively easily, while the availability of external information is not always easy. Research proved that it is largely dependent on the manager's ability to decide under limited rationality, to apply different methods and tools, such as imitation, postponing suppliers’ payments, suppliers’ quality diversification, market research, competition analysis, and customer analysis future trends estimates, etc.

According to research outputs managerial decision-making is enriched by new goal setting. Firm size influences its competitiveness. In a big firm, the profit maximization is the main goal. In smaller firm, for example, maximizing profit, production, rewards, etc., is replaced by an attempt to achieve a satisfactorily level with all objectives (Vodák and Strišš, 2005). Thus, there is some explanation of satisfactory levels for the managerial objectives, reducing and influencing managerial decisions made under limited rationality and causing transaction costs growth. Outcomes showed that company size and its growth enables to maximize profit, to deal more effectively with competitive pressures (Myšková and Doupalová, 2015) and to reach higher competitiveness. In supplier’s policy, managers’ behavior depends on personal preferences and imitation practices. This will ensure greater flexibility in dealing with perceived pressures.

At present, managers are forced to tackle increasing amount of new and complex challenges and tasks associated with market globalization, IT technologies, innovation, environmental requirements, advanced and high-level competition, and so on. Managers have to solve several problems at the same time and must therefore look for a comprehensive and original solution. The ordinary management procedures used before are inefficient, outdated, and are not suited to addressing the situation that the business is currently facing. One of the possible ways to tackle these new challenges is the heuristic approach. Managers decide following their personal preferences, decision-making according to Kahneman (2012) is a product of personal preferences and characteristics, limited rationality, risk perception. In accordance with Killingsworth et. al. (2016), managers use heuristics, they often meet satisfactory level and due to lack of information imitate and decide by mental shortcut.
Conclusion

The method of analysis undertaken in this research allowed examining the management style as impact of individual characteristics and preferences. The analysis first conducted at the theoretical basis including relevant authors and theories, has pointed to a number of weaknesses of neoclassical theory, which would be hardly compatible with real practice and management’ behavior.

The article linked manager’s individual perceptions and actions to his specific response. It allowed greater precision. Attention in the research of manager’s behaviour and decision-making was focused on actions and practices under limited rationality and insufficient information. It was proved that managers react sometimes in an inadequate way. Surprisingly, many choices of the decision can be used to mitigate the situation (Koráb, 2016). Managers’ behavior as the frequency of changing ties is directly affected by the limited determinants such as availability of suppliers, human resources and finance sources.

The research integrated social and human factors, including values such as confidence, prestige, a feeling of home, insecurity, fear. Identifying the actual behavior and daily work, it creates a description of a manager’s decision in terms of a specific series of semi-decisions used to reach a choice. It discovers inner mechanisms as well as their genesis and incorporates them into the classical behavioral theory of the firm.

References


Vodák, J., Strišš, J. (2005). Corporate identity as one of the important management activity. *Scientific papers of the University of Pardubice*, No. 3 Series B, 11


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THE PROBLEM OF DIFFERENT PAIRWISE COMPARISONS SCALES IN THE AHP FRAMEWORK

Jiří Mazurek

Abstract: In pairwise comparisons, several scales are used to compare objects. Perhaps the most known is Saaty’s fundamental scale for the AHP/ANP from 1 to 9 (with reciprocals), but other scales with 3, 5 or 10 items are also used in practice. Since the AHP/ANP is scale invariant, the following problem arises: for example, a preference of one object over another object expressed by the value 2 means something else for the scale from 1 to 3 (it expresses the medium preference) and the scale from 1 to 100 (in this case the preference is almost negligible). Therefore, the need of a normalization for pairwise comparison scales arises. The aim of the article is to propose a suitable transformation of a general linear scale for pairwise comparisons to a unit real interval that preserves several natural and desirable properties.

Keywords: AHP, Normalization, Pairwise Comparisons, Comparison Scale.

JEL classification: D81, D83.

Introduction

Pairwise comparisons (PCs) belong among the most common tools for multiple criteria decision making since the introduction of the analytic hierarchy process (AHP) and the analytic network process (ANP) by T. L. Saaty in 1977 and 1980 respectively, see Saaty (1977 and 1980). The list of successful AHP/ANP applications is rapidly growing, see e. g. Vaidya and Kumar (2006), Subramanian and Ramanathan (2012), Kramulová and Jablonský (2016), or Lidinská and Jablonský (2018). It should be noted that PCs method has a long history predating the papers by T. L. Saaty, with the first mention of the PCs method dating back to the work of the Catalan scholar and monk Ramon Lull in the 13th century, while the first modern work on PCs can be attributed to L. L. Thurstone and his Law of Comparative Judgments, see Thurstone (1927).

In the AHP/ANP, the so called fundamental (linear) scale from 1 to 9 (with reciprocals) is used for pairwise comparisons. However, other linear scales with 3, 5, 7, 8 or 10 items were also proposed, see Koczkodaj (1993) or Koczkodaj et al. (2016). In particular, Fülop et al. (2010) and Koczkodaj et al. (2016) provide strong arguments to use the scale only up to three. Variety of other studies suggested the use of non-linear scales such as logarithmic scales, exponential scales, or scales based on a logistic function, see for example Lootsma (1993), Donegan et al. (1992), Ma and Zheng (1991) or Salo and Hämäläinen (1997). Ishizaka and Labib (2011) provide a comprehensive review of scales of pairwise comparisons up to year 2010.

Studies on scale comparisons are rather seldom, see Dong et al. (2008), Elliot (2010), Triantaphyllou et al. (1994), or Starczewski (2017). Dong et al. (2008) provided comparisons on several scales for pairwise comparisons, and concluded that with respect to their algorithms the best scale was the geometrical one. Elliot (2010) experimentally compared three different scales with the result that none of the scales captured accurately the preferences of all individuals. Triantaphyllou et al. (1994)
compared 78 scales to conclude that no single scale could outperform all the other scales. Starczewski (2017) examined the effect of a scale (he compared the fundamental scale, extension scale and geometric scale) on a priority vector, and found that scales with more options lead to a better (more precise) evaluation of a priority vector. Franek and Kresta (2014) compared Saaty’s scale to other scales for both consistent and inconsistent pairwise comparison matrices. According to the authors, Saaty’s scale is still favorable, but if a decision maker demands higher consistency, he/she should use root square or logarithmic scales.

The AHP/ANP is scale invariant, which means that the result (a priority vector) does not depend on a scale used. However, when using different scales for PCs, the same value from a given scale has a different meaning. This problem was explicitly expressed by Koczkodaj (2015) and dubbed the “pairwise comparisons rating scale paradox”. Koczkodaj (2015) also offered a solution to this paradox, a normalization of a rating scale via linear transform. However, the proposed linear transformation in Koczkodaj (2015) has a main drawback as it does not preserve consistency of PCs.

Therefore, the aim of this paper is to introduce a new (power) transform of a (linear) rating scale to a unit interval that has several desirable properties, namely it preserves consistency of PCs, the ranking of objects and the most inconsistent triad.

The paper is organized as follows: section 1 provides brief introduction to pairwise comparisons and the problem with different scales, in section 2 the normalization is proposed along with several of its properties, section 3 provides a numerical example and several aspects of the paper are discussed in section 4. Conclusions close the article.

1 Statement of a problem

1.1 Preliminaries

Let $C = \{c_1, \ldots, c_n\}$, $n \in \mathbb{N}, n \geq 2$, be a set of compared objects (concepts, entities). Let $a_{ij} \in [1/m, m]$ denotes the relative importance of an object $c_i$ over object $c_j$. Then the (square) matrix $A(a_{ij})_{n \times n}, i, j \in \{1, \ldots, n\}$ is called a pairwise comparison matrix (PCM).

The matrix $A$ is reciprocal if and only if:

$$a_{ij} = 1/a_{ji}, \ \forall i, j \in \{1, \ldots, n\}$$  \hspace{1cm} (1)

The matrix $A$ is consistent (or, alternatively, pairwise comparisons are said to be consistent) if and only if:

$$a_{ij} \cdot a_{ji} = a_{il} \ \forall i, j, l \in \{1, \ldots, n\}$$  \hspace{1cm} (2)

The final weights of objects (priority vector) $w$ in the AHP/ANP, which were pairwise compared, is derived by the eigenvalue method, and satisfies the following condition:

$$A w = \lambda_{\text{max}} w$$

where $\lambda_{\text{max}}$ is the maximum (positive) eigenvalue of the matrix $A$.

As pairwise comparison matrices are often inconsistent, various inconsistency indices were proposed. Perhaps the most known are Saaty’s consistency index C.I. and

In this paper Koczkodaj’s inconsistency index (KII) is used to measure PCM inconsistency, which is defined as follows:

**Definition 1.** Koczkodaj’s inconsistency index (KII), Koczkodaj (1993, 2014): Let \( T(n) \) be the set of all ordered triples (“triads”) \( (a_{ij}, a_{jk}, a_{ik}) \) satisfying (2) for \( \forall i, j, k \in \{1, 2, ..., n\} \). Then:

\[
KII = \max_{T(n)} \left\{ \min \left( \left| 1 - \frac{a_{ik}}{a_{ij}a_{jk}} \right|, \left| 1 - \frac{a_{ik}a_{jk}}{a_{ij}} \right| \right) \right\}
\]  

(3)

The KII expresses inconsistency of a pairwise comparison matrix in terms of the most inconsistent triad, and \( KII \in [0, 1] \).

Let \([1, m] \) with reciprocals (which will be further omitted in the text) denote alternative scales for pairwise comparisons, where \( m \in \mathbb{R}, m \geq 2 \). In the context of this study whether the scale is discrete or continuous is not important. For Saaty’s scale \( m = 9 \).

### 1.2 The problem of different scales

Originally, T. L. Saaty proposed to use the linear scale from 1 to 9 for the pairwise comparisons, see Saaty (1977). The strength of preference or importance for the Saaty’s scale is shown in Tab. 1.

However, when at least two different scales are used for pairwise comparisons, the following problem emerges.

Let’s consider two pairwise comparisons scales, \( S_s = \{1, 2, 3\} \) , and \( S_{100} = \{1, 2, ..., 100\} \). If, for instance \( a_{ij} = 2 \), then its meaning for the scale \( S_s = \{1, 2, 3\} \) and the scale \( S_{100} = \{1, 2, ..., 100\} \) is different. In the former case, the preference \( a_{ij} = 2 \) means medium preference of the object \( i \) to the object \( j \), while in the latter case the preference is almost negligible, see Fig. 1. Therefore, the scale for pairwise comparisons cannot be neglected. This is true especially in situations when different scales are used simultaneously, or, when results of pairwise comparisons of the same set of objects with different scales need to be compared. In such cases, scale normalization is necessary.

**Fig. 1.** A comparison of two different scales

![A comparison of two different scales](source: author)
Tab. 1. Saaty’s fundamental scale.

<table>
<thead>
<tr>
<th>Intensity of importance</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equal importance</td>
</tr>
<tr>
<td>2</td>
<td>Weak or slight</td>
</tr>
<tr>
<td>3</td>
<td>Moderate importance</td>
</tr>
<tr>
<td>4</td>
<td>Moderate plus</td>
</tr>
<tr>
<td>5</td>
<td>Strong importance</td>
</tr>
<tr>
<td>6</td>
<td>Strong plus</td>
</tr>
<tr>
<td>7</td>
<td>Very strong importance</td>
</tr>
<tr>
<td>8</td>
<td>Very, very strong importance</td>
</tr>
<tr>
<td>9</td>
<td>Extreme importance</td>
</tr>
</tbody>
</table>


2 Methods

2.1 Normalization of a pairwise comparison scale

To avoid the problem described in the previous section, normalization of the comparison scale is applied.

Let the general pairwise comparison scale $GS = [1, m], m \in R, m \geq 2$. Then, by the normalization, this scale is transformed into the $[1, 2]$ unit interval of real numbers.

The transformation $f$ (the normalization) should satisfy the following (obvious) conditions:

i) $f : [1, m] \rightarrow [1, 2]$,

ii) $f$ is strictly increasing.

iii) $f(1) = 1$ and $f(m) = 2$.

In Koczkodaj (2015), a linear transform $f$ is proposed for normalization:

$$f(x) = \frac{1}{m-1} x + \frac{m-2}{m-1}$$ (4)

However, the linear transform (4) has a serious drawback: it does not preserve consistency of pairwise comparisons.

Consider for example the consistent triad $(2, 3, 6)$, and let $m = 9$. Then, after the linear transform, the triad $(9/8, 10/8, 13/8)$ is not consistent, because $\frac{9}{8} \cdot \frac{10}{8} \neq \frac{13}{8}$.

2.2 Properties of the proposed power normalization

Definition 2. Let $A(a_{ij})$ be a pairwise comparison matrix, $a_{ij} \in [1 / m, m], m \in R, m \geq 2$.

Let $f$ be the power transform:

$$f(a_{ij}) = a_{ij}^k, k = \frac{\ln 2}{\ln m}$$ (5)

Proposition 1: The power transform (5) satisfies conditions i)-iii).

Proof is obvious.
Proposition 2: The power transform (5) preserves consistency: if \( a_{ij} \cdot a_{jl} = a_{il} \), then also \( f(a_{ij}) \cdot f(a_{jl}) = f(a_{il}) \).

Proof: Let \( a_{ij} \cdot a_{jl} = a_{il} \). Then \( f(a_{ij}) \cdot f(a_{jl}) = a_{ij}^k \cdot a_{jl}^k = (a_{ij} \cdot a_{jl})^k = a_{il}^k = f(a_{il}) \).

Proposition 3: Let \( A \) be a PCM of the order \( n \). Let \( T_0(x_0, y_0, z_0) \) be a triad (from \( A \)) with maximum \( KII \). Let \( A^* \) be the matrix \( A \) transformed by (5). Then the \( KII \) of the transformed triad \( T_0'(x_0, y_0, z_0) \) (from \( A^* \)) is also maximal.

Proof: For a triad \( T_0(x_0, y_0, z_0) \) one of two possible cases holds: either \( \frac{x_0 \cdot y_0}{z_0} \geq 1 \), or \( \frac{x_0 \cdot y_0}{z_0} \leq 1 \). Without loss of generality suppose that \( \frac{x_0 \cdot y_0}{z_0} \geq 1 \). Also, because \( KII \) is maximal for \( T_0 \), \( \frac{x_0 \cdot y_0}{z_0} \geq \frac{x \cdot y}{z} \) holds for all triads \( (x, y, z) \). After transformation (5), where \( k > 0 \), we get: \( \frac{x_0^k \cdot y_0^k}{z_0^k} = \left( \frac{x_0 \cdot y_0}{z_0} \right)^k \geq \frac{x^k \cdot y^k}{z^k} = \left( \frac{x \cdot y}{z} \right)^k \), which is true for any positive \( k \).

Proposition 3 allows to show that if a pairwise comparison matrix \( A \) is more inconsistent than a pairwise comparison matrix \( B \) (with respect to \( KII \)), this relation is preserved by the power transform (5).

Proposition 4. Let \( A(a_{ij}) \) and \( B(b_{ij}) \) be inconsistent pairwise comparison matrices of the order \( n \). Let \( KII \) be the Koczkodaj’s inconsistency index (3) and let \( KII(A) > KII(B) \). Let \( A^*(a_{ij}) \) and \( B^*(b_{ij}) \) be transformed pairwise comparison matrices by the transform (5), where \( p = \frac{\ln 2}{\ln m} \). Then \( KII(A^*) > KII(B^*) \).

Proof: Let the most inconsistent triad of the matrix \( A \) be \( (a_{ik}, a_{ij}, a_{jk}) \) and the most inconsistent triad of \( B(b_{ik}, b_{ij}, b_{jk}) \). Then, either \( \frac{a_{ik}}{a_{ij} \cdot a_{jk}} > 1 \) and \( \frac{b_{ik}}{b_{ij} \cdot b_{jk}} > 1 \), or \( \frac{a_{ik}}{a_{ij} \cdot a_{jk}} < 1 \) and \( \frac{b_{ik}}{b_{ij} \cdot b_{jk}} < 1 \). Without loss of generality assume the latter.

Since \( KII(A) \geq KII(B) \), we have \( 1 - \frac{a_{ik}}{a_{ij} \cdot a_{jk}} > 1 - \frac{b_{ik}}{b_{ij} \cdot b_{jk}} \), hence \( \frac{a_{ik}}{a_{ij} \cdot a_{jk}} < \frac{b_{ik}}{b_{ij} \cdot b_{jk}} \).

From Proposition 3 it follows that the most inconsistent triad is preserved by the transform (5). Hence, for the transformed matrices \( A^* \) and \( B^* \) the most inconsistent triads are \( (a^*_{ik}, a^*_{ij}, a^*_{jk}) \) and \( (b^*_{ik}, b^*_{ij}, b^*_{jk}) \) respectively. As above, without loss of generality we assume \( \frac{a^*_{ik}}{a^*_{ij} \cdot a^*_{jk}} = \frac{a^p_{ik}}{a^p_{ij} \cdot a^p_{jk}} < 1 \) and \( \frac{b^*_{ik}}{b^*_{ij} \cdot b^*_{jk}} = \frac{b^p_{ik}}{b^p_{ij} \cdot b^p_{jk}} < 1 \).
Then we have: \[
\frac{a_{ik}}{a_{ij} \cdot a_{jk}} < \frac{b_{ik}}{b_{ij} \cdot b_{jk}} \Rightarrow \left( \frac{a_{ik}}{a_{ij} \cdot a_{jk}} \right)^p < \left( \frac{b_{ik}}{b_{ij} \cdot b_{jk}} \right)^p \Rightarrow \frac{a_{ik}^p}{a_{ij}^p \cdot a_{jk}^p} < \frac{b_{ik}^p}{b_{ij}^p \cdot b_{jk}^p} \]
\[
\frac{a^*_{ik}}{a^*_{ij} \cdot a^*_{jk}} < \frac{b^*_{ik}}{b^*_{ij} \cdot b^*_{jk}} \Rightarrow 1 - \frac{a^*_{ik}}{a^*_{ij} \cdot a^*_{jk}} > 1 - \frac{b^*_{ik}}{b^*_{ij} \cdot b^*_{jk}} \Rightarrow K_{II}(A^*) > K_{II}(B^*) .
\]

**Proposition 5:** Let \( A \) be a PCM of the order \( n \). The transformation (5) does not change ranking of all alternatives if the weights of all alternatives are determined by the geometric mean method.

**Proof:** Let \( w_i, \; i \in \{1, 2, ..., n\}, \) be the weights of alternatives derived form a pairwise comparison matrix \( A(a_{ij}) \) by the geometric mean method:

\[
w_i = \left( \prod_{j=1}^{n} a_{ij} \right)^{1/n} \]

Without loss of generality it suffices to show that the relation “to be less or equal than” is preserved for an arbitrary pair of weights. Hence, let \( w_i \geq w_2 \), and let \( w_i^* \) and \( w_2^* \) be the transformed weights respectively, then \( w_i^* \geq w_2^* \) should hold. When comparing weights given by relation (6), the denominator is the same, so it can be omitted. Also, \( n \)-th square can be omitted. Hence, \( w_i \geq w_2 \) means that \( \prod_{j=1}^{n} a_{ij} \geq \prod_{j=1}^{n} a_{ij} \).

After transform (5) we get:

\[
\prod_{j=1}^{n} a^*_{ij} = \left( \prod_{j=1}^{n} a_{ij} \right)^k \geq \left( \prod_{j=1}^{n} a^*_{ij} \right)^k = \prod_{j=1}^{n} a^*_{ij} , \; \text{hence} \; w_i^* \geq w_2^* .
\]

Because the proof for any other pair of weights is analogous, the Proposition 5 is proved.

**Remark 1.** It is well-known that priority vectors derived from a pairwise comparison matrix of the order \( n = 3 \) by the eigenvalue method and the geometric mean method are identical. Therefore, Proposition 5 is also valid for the eigenvalue method and a pairwise comparison matrix of the order \( n = 3 \). However, whether Proposition 5 is valid for the eigenvalue method and \( n > 3 \) remains an open question.

### 3 Problem solving

#### 3.1 Numerical example

In this section the use of the proposed normalization (5) is demonstrated on an example.

**Example 1.** Let the pairwise comparison matrix of four objects be given as follows:
Tab. 2. The input PCM.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>0.33333</td>
<td>0.5</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>0.2</td>
<td>0.25</td>
<td>0.3333</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Source: own.

By the GM method, the vector of weights (the priority vector) is: 

\[ w = (0.47, 0.29, 0.17, 0.07) \]

The first object has the highest weight which means it is the most preferred or important entity, the second object follows on the second place, etc. Further, there are four triads: (T1) \( a_{12} \cdot a_{23} = a_{13}, \) (T2) \( a_{12} \cdot a_{24} = a_{14}, \) (T3) \( a_{13} \cdot a_{34} = a_{14} \) and (T4) \( a_{23} \cdot a_{34} = a_{24}. \) It can be easily checked that all four triads are inconsistent, and the most inconsistent triad is (T3).

Now suppose that \( m \) is 5, 7, 9 and 20 respectively, or in other words, consider four scales: \([1,5]\), \([1,7]\), \([1,9]\), and \([1,20]\) (with reciprocals).

Then, after the transformation (5) of the PCM given in Tab. 2, normalized pairwise comparison matrices are shown in Tab. 3 along with inconsistency of all four triads and weights of alternatives (priority vectors) on the right hand side of the table. The maximal values are highlighted in blue.

As can be seen, both the maximum inconsistency and objects’ rankings are ‘invariant’ for all scales, the triad (T3) is still the most inconsistent one, and the ordering of objects remains unchanged.

Tab. 3. Four PCMs after transformation (5).

<table>
<thead>
<tr>
<th>scale</th>
<th>PCM</th>
<th>KII weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>( m = 5 )</td>
<td>1 ( \begin{array}{cccc} 1.347866 &amp; 1.6050366 &amp; 2 &amp; 0.11653 \ 0.741914 &amp; 1 &amp; 1.3478652 &amp; 1.816741 &amp; 0.183248 \ 0.623039 &amp; 0.741914 &amp; 1 &amp; 1.605037 &amp; 0.314114 \ 0.5 &amp; 0.550436 &amp; 0.62303875 &amp; 1 &amp; 0.160228 \end{array} )</td>
<td>( \begin{array}{cccc} 0.345465 \ 0.278091 \ 0.222306 \ 0.154139 \end{array} )</td>
</tr>
<tr>
<td>( m = 7 )</td>
<td>1 ( \begin{array}{cccc} 1.280056 &amp; 1.4789518 &amp; 1.7741 &amp; 0.097399 \ 0.781216 &amp; 1 &amp; 1.2805623 &amp; 1.638544 &amp; 0.154155 \ 0.676155 &amp; 0.781216 &amp; 1 &amp; 1.478952 &amp; 0.267907 \ 0.563666 &amp; 0.610298 &amp; 0.67615456 &amp; 1 &amp; 0.134484 \end{array} )</td>
<td>( \begin{array}{cccc} 0.328601 \ 0.274627 \ 0.228203 \ 0.16857 \end{array} )</td>
</tr>
<tr>
<td>( m = 9 )</td>
<td>1 ( \begin{array}{cccc} 1.244413 &amp; 1.41421356 &amp; 1.661501 &amp; 0.086757 \ 0.803592 &amp; 1 &amp; 1.24441257 &amp; 1.548563 &amp; 0.137801 \ 0.707107 &amp; 0.803592 &amp; 1 &amp; 1.414214 &amp; 0.241323 \ 0.601866 &amp; 0.64576 &amp; 0.70710678 &amp; 1 &amp; 0.120067 \end{array} )</td>
<td>( \begin{array}{cccc} 0.319406 \ 0.272477 \ 0.231264 \ 0.176853 \end{array} )</td>
</tr>
<tr>
<td>( m = 20 )</td>
<td>1 ( \begin{array}{cccc} 1.173956 &amp; 1.28942315 &amp; 1.451197 &amp; 0.064396 \ 0.851821 &amp; 1 &amp; 1.1739559 &amp; 1.378172 &amp; 0.103044 \ 0.775541 &amp; 0.851821 &amp; 1 &amp; 1.289423 &amp; 0.183366 \ 0.689086 &amp; 0.725599 &amp; 0.7755406 &amp; 1 &amp; 0.08955 \end{array} )</td>
<td>( \begin{array}{cccc} 0.300545 \ 0.26748 \end{array} )</td>
</tr>
</tbody>
</table>

Source: own
Also, it’s worth noting that with the growing upper boundary \( m \), the weights of all objects are becoming more and more uniform (closer to each other).

## 4 Discussion

In the previous two sections the normalization (the power transform) of the scale for pairwise comparisons was introduced, and several natural and desirable properties of this transformations with respect to the geometrical mean (GM) method and Koczkodaj’s inconsistency index \( KII \) were shown and proved. The simplicity of the proposed normalization and its nice properties might provide incentive for its practical use.

Nevertheless, the use of the GM method and \( KII \) could be considered limitations of this study. The eigenvalue method for the derivation of a priority vector can be used instead of GM method, and there are many other inconsistency indices than \( KII \) proposed in the literature, such as Pelaez-Lamata \( PLI \) index, Golden-Wang \( GWI \) index, Aguaron and Moreno-Jimenez \( GCI \) index, and so on, see e.g. Brunelli and Fedrizzi (2015), which might be examined with regard to the proposed normalization. If pursued, this direction of research might prove to be interesting as well, though there is no certainty that similar results can be obtained for other inconsistency indices than \( KII \), since \( KII \) is a maximum-based index of inconsistency unlike other, rather mean-based inconsistency indices. Yet, this research direction certainly deserves attention of experts in the field.

## Conclusions

The aim of the paper was to propose a normalization of the scale for pairwise comparisons in the multiplicative AHP/ANP framework, as the AHP/ANP is scale invariant. This leads to undesired effects regarding the intensity of preference, which is, actually, dependent on the upper bound of an applied scale.

The proposed solution to the problem is a normalization in the form of a simple power transforms. The transform has several virtues, see Propositions 1-5 in section 2, namely it preserves consistency of pairwise comparisons, the most inconsistent triad, relation of inconsistency between two arbitrary inconsistent matrices, and last, but not least, it also preserves objects’ rankings when the inconsistency is expressed in terms of Koczkodaj’s inconsistency index.

The proposed approach, the scale normalization, is recommended as an additional step of AHP/ANP when different scales for pairwise comparisons are employed simultaneously, or, when results of pairwise comparisons obtained with different scales are to be compared.

Further research might focus on a scale problem in the context of additive AHP/ANP or fuzzy AHP/ANP. Also, the research of the effect of the proposed normalization on inconsistent pairwise comparison matrices with respect to other inconsistency indices would be desirable.

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References


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DETERMINANTS OF INNOVATION ACTIVITIES AND SME ABSORPTION – CASE STUDY OF GERMANY

Viktor Prokop, Jan Stejskal

Abstract: SME’s are integral pillars in ladder of innovation. Due to their proximity to end users and their flexibility, they are credited with the creation of ground level product and process innovations in their local and world markets. SMEs absorption of innovations is significantly assisted by the entrepreneurial environment, globalization tendencies, rapidly changing technological issues of the environment as well as other determinants. However, depending on the industry, determinants of innovation affects each firm differently depending on the type of innovation considered. The goal of this research is therefore, to analyse what determinants influence the innovation activities of small and medium enterprises across three different German industries, namely, in the Electrical, Chemical and Pharmaceutical and the Metal Industry. Results from the SMEs were compared against themselves as well as SMEs from the three considered industries. This paper used data from the Community Innovation Survey (2010-2012) which employed stratified sampling technique with surveys. Logistic regression tool was used to analyse the impact of certain activities and expenditures, information and competitive strategies on product on process innovation. The research eventually discovered that the determinants influencing product and process innovations in selected enterprises varied according to the size of enterprise analysed. It was proposed that small enterprises should primarily focus on In-house R&D and acquisition of capital assets whilst medium size enterprises would be best served in concentrating on training for innovative activities.

Keywords: Innovation Activities, Determinant, Innovation Capacity, Germany

JEL Classification: O38, O47, H50, C33.

Introduction

Many studies present that the innovation capacity of businesses determines economic growth, both in the company itself and in the entire industry and hence in the economic growth of the country (Jorgenson, Gollop & Fraumeni, 2016; Leigh & Blakely, 2016). It has been shown that innovation is created by the involvement of various internal and external sources (production factors), but also knowledge and interaction between economic subjects (West & Bogers, 2014; Doloreux, 2015). The favorable business environment and the openness of the economy are two important components (Belás, Demjan, Habánik, Hudáková & Sipko, 2015). The open innovation concept highlights importance of the business and innovation environment. Open innovation is currently an interesting interconnected concept (Chesbrough et al., 2014). This concept primarily emphasises the role of external technological sources, which helps to create a competitive advantage (mainly by reducing the time needed to create innovation and market it; Feniser, Lungu & Bilbao, 2017). Another advantage is the orientation of the open innovation concept to small and medium- sized enterprises (SME). SME use cost sharing, experience sharing, and often the risk sharing associated with the production of an innovative products or services (West, Salter, Vanhaverbeke & Chesbrough, 2014). SME does not have sufficient resources to cover
increased technology or innovation costs. Some scholars add that SME occupy small positions in the space of knowledge (Feniser, Lungu & Bilbao, 2017), which is due to several factors: the first is the unavailability of investment funds. The second is the lower number of workers, especially those in research and development (again linked to the inability of SMEs to pay really high experts). The third relates to the business innovation strategy, particularly in the CEE region (Malerba et al., 2015). It is still evident that the only SME strategy is to compete with price and possibly with small innovation changes. The innovation production is not a major business strategy for SMEs in many European countries.

SMEs are a very specific group of enterprises, notwithstanding their location in advanced or developing countries, they have very similar characteristics and, above all, behavioural patterns (Ates, Garengo, Cocca & Bititci, 2013). Due to the situation in national and even more in international markets, they are forced to use their production capabilities and in-house knowledge very efficiently. The market situation forces them to be more flexible and dynamic, which often requires a change in business strategy or an increase in specialization on those products that the SME firms are able to produce and sell within the market at the moment with the available resources (Arend, 2014).

Therefore, the collaboration in cooperation-based or knowledge-based networks is much more frequent (McCann & Ortega-Argilés, 2015; Hájek & Stejskal, 2018). SMEs are part of cooperative chains and regional innovation systems in many developed European countries. It helps to increase the innovative absorption of SMEs, use spill-over effects (not only knowledge spill-over effects) and realize the technology transfer (Hajek, Henriques & Hajkova, 2014). All of these abilities strengthen their competitive advantage.

The remainder of this paper is structured as follows. In the next section, the theoretical background on the determinants of innovation activities and the goal of this paper is presented. Section 2 will provide the characteristics of the dataset and the research methodology. Section 3 will list the experimental results and in Section 4, the discussion, conclusion, limitations and future research areas are presented.

1 Theoretical background

High-quality R&D activities are an essential prerequisite for creating innovative outputs. They also significantly influence innovation activities and innovative absorption. As mentioned by Rammer, Czarnitzki & Spielkamp (2009), there are several features of R&D that are likely to result in systematic differences between small and large firms with respect to conducting in-house R&D. They include, for example: (a) R&D in SMEs is determined by a number of projects whose scope can be financed and bring at least reasonable returns on the scale. Research costs are very often fixed, thus reducing the profitability of the business; (b) similarly, R&D in SMEs is associated with high initial investment whose return-on-investment need not be positive in the early years; (c) research activities increase the business risk of the business and therefore it is possible often to encounter so-called ad hoc research, which is of a temporary nature and is usually associated with the realization of a research project. These and other characteristics of the SMEs lead to their less
willingness to systematically support their innovation activities and increase innovative absorption (Prokop, Stejskal & Kuvíková, 2017).

Innovative absorption is also often associated (and unfortunately sometimes severely demotivated) by determinants that affect the total competitiveness of individual outputs and the whole of the enterprise. These determinants to competitive advantage protecting are patents, utility patents, design trademarks, copyrights etc. By them, it is possible to ensure (in a globalized world for a relatively short time) the uniqueness of the product on the market. There are a number of studies that agree on the importance of patents and their impact on maintaining a competitive advantage. Bottazzi & Peri (2003) add that patents and protection features can generate the effect of research externalities across space, in generating innovation. They found that innovation is dependent on spill-over effects (and they are given by tacit knowledge in regions). Acs, Anselin & Varga (2002) have similar results. The role of geographically mediated knowledge externalities in regional innovation systems they perceived as a major issue in the research policy.

SMEs are forced to search for additional resources that can overcome the shortcomings given by the nature of SMEs. One option is to accept the public support or other R&D support activities most often from public sector organizations, in Europe, especially from the EU Structural Funds (Klímová, Žítek & Králová, 2019). This has been particularly massive in recent years and is directed, in particular, towards the acquisition of high-quality staff, the creation of innovative capacities, and often the encouragement of innovation cooperation or technology transfer. Some scholars disagree with the effectiveness of such public support, because of a high level of bureaucracy and production inefficiency. Likewise, SMEs are threatened by the effects of the so-called "low-emission fruit", i.e. the dependence on public funds. This is confirmed by a number of studies. For example: Almus & Czarnitzki (2003) analysed the effects of public R&D policy schemes on innovation activities of firms located in Eastern Germany. They also addressed the issue of whether public support stimulates R&D activities in their businesses. They found that enterprises (that did not benefit from public support) expanded innovation activities more than those who used the public support. Kang & Park (2012) examined the effects of inter-firm collaborations as well as the direct and indirect effects of government R&D support on innovation outputs of SMEs in Korea. They concluded that government support through project funding directly and indirectly affects firms' innovation by stimulating internal R&D and domestic upstream and downstream collaborations. Clausen (2009) analysed whether "research" and "development" subsidies influence private R&D activity. The results show that "research" subsidies stimulate private R&D activity, mainly by increasing research spending, while "development" subsidies in substitute private R&D activity, mainly by decreasing development expenditure. Given the results of various studies, it is necessary to state that the effectiveness of public support for innovation activities also depends on the quality of the business environment and public policies.

Many SMEs, which do not realize permanent in-house R&D but want to innovate, use external resources and available technologies from elsewhere. Engaging a SME enterprise into certain cooperative relationships and using network sharing is a way how to get the necessary information sources or knowledge, or access to external
resources needed to create innovation. The most common is to use of resources and incentives from customers, suppliers or collaborating organizations, including competitors and the public. Many studies show that these information sources are very effective and provide the necessary impetus for innovation. In addition, thanks to the willingness to share information, experience and knowledge, it is possible to get a synergistically larger amount of information for your own needs back. Some studies show that it is necessary to have certain capabilities and often internal research to use external knowledge (Nilakanta & Scamell, 1990). Balancing between internal R&D efforts and external knowledge acquisition is therefore another major concern of innovation management (Rammer, Czarnitzki & Spielkamp, 2009). Amara & Landry (2005) analysed the information sources as determinants of innovation in manufacturing firms in Canada. Innovation-based enterprises (absolute novelty for the domestic or international market) use a wider range of sources of information and use a wider range of sources of research resources to develop or improve their outputs. Varis & Littunen (2010) examined the information sourcing practices of SMEs related to the development of different types of innovation (product / process / market / organizational). They (unlike other studies) find that the introduction of innovation is associated with the use of rather free (without any consideration) accessible information resources. Analysed enterprises have introduced innovation as their business objective and therefore none of the above innovations have significantly increased the profits of the firm in first years.

It is clear that the results of many published studies differ thanks to the different business environments and the unpredictable behaviour of businesses in different industries. Therefore, it is still necessary to realize the research to help determine which determinants have a significant impact on the innovation capacity of SMEs in the industrial branches. The ideal option is to use a benchmarking approach that can be applied in economies that are linked to each other. Therefore, the goal of this paper is to analyse what determinants influence the innovation activities of small and medium enterprises across three different German industries in comparison with the results obtained for the whole industries. Industrial branches (electrical, chemical and pharmaceutical, and metal) are representing most of the manufacturing industry in Germany. Therefore, the results can be considered significant for other industries in Germany.

2 Data and methodology

To perform the empirical analysis, Eurostat collected and pre-processed the data from the Community Innovation Survey 2010-2012 (CIS). CIS uses harmonized questionnaire created for all EU Member States by Eurostat and combines stratified random sampling with exhaustive surveys. In agreement with previous related studies (e.g. see Archer & Lemeshow, 2006; Coad & Rao, 2008; Schneider & Spieth, 2013), a logistic regression model was fitted. According to previous parts and CIS dataset, we selected following three groups of independent variables (all independent variables are listed in Tab. 1.):

a) activities and expenditures for product and process innovations which include, in particular, research and development. R&D usually helps firms to create new
knowledge, solve scientific or technical problems and fuels firms’ innovation, knowledge stock, technology and productivity (Prokop, Odei & Stejskal, 2018);

b) sources of information and co-operation for product and process innovation. Accessing a greater number of knowledge, information and cooperation sources improve firms probability of obtaining knowledge that will lead to a valuable innovation outcomes (Leiponen & Helfat, 2010);

c) methods for maintaining or increasing the competitiveness of product and process innovations. These methods usually help firms to protect their products, processes, and brand (Brem, Maier & Wimschneider, 2016) as well as their internal knowhow and innovations.

We analyse how these variables influence firms’ product and process innovations (dependent variables) within selected German industries. The effects within small and medium enterprises as well as within the whole industries (including small, medium and large enterprises together) are compared and the comparison is presented. In total, the study analysed 474 Electrical (NACE 26-27), 473 Chemical and Pharmaceutical (NACE 19-22) and 465 Metal (NACE 24-25) firms within these industries.

To analyse whether CIS data are not correlated, Spearman's test was used. The hypothesis that the data are correlated with a level of significance at p<0.05 were rejected. Subsequently, the collinearity among the independent variables by Variance Inflation Factor (VIF) for each regression model was tested. Multicollinearity was rejected in the models (VIF<5). All calculations were made using the statistical software SPSS.

**Tab. 1: Independent variables**

<table>
<thead>
<tr>
<th>Activities and expenditures for product and process innovations</th>
</tr>
</thead>
<tbody>
<tr>
<td>RRDIN</td>
</tr>
<tr>
<td>RRDEX</td>
</tr>
<tr>
<td>RMAC</td>
</tr>
<tr>
<td>ROEK</td>
</tr>
<tr>
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</tr>
<tr>
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<table>
<thead>
<tr>
<th>Sources of information and co-operation for product and process innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCON</td>
</tr>
<tr>
<td>SJOU</td>
</tr>
<tr>
<td>SPRO</td>
</tr>
<tr>
<td>SENTG</td>
</tr>
<tr>
<td>SSUP</td>
</tr>
</tbody>
</table>

¹ Other in-house or contracted out activities to implement new or significantly improved products and processes such as feasibility studies, testing, tooling up, industrial engineering, etc.
In the following part, results of binary logistic models that analysed the influence of several independent variables – determinants of innovation activities (grouped into three groups, see above) on the product and process innovations in small and medium enterprises as well as on the product and process innovations within whole industries were presented. Generally, most of significant results were obtained during analyses of the entire industries. However, numbers of important results were also obtained from analyses within SME’s.

3 Results

Tab. 2 presents results for the firms in German Electrical industry. Factors that influenced firms’ innovation activities differ according to the size of enterprise. Research and development activities undertaken by enterprises (RRDIN) to create new knowledge or to solve scientific or technical problems significantly influenced product innovations in small enterprises and within the whole industry. Internal sources of information and co-operation for innovations (SENTG) played an important role within the whole German Electrical industry. Other in-house or contracted out activities to implement new or significantly improved products and processes such as feasibility studies, testing, tooling up, industrial engineering (RPRE), Training for innovative activities (RTR) and Lead time advantages (CMLTAD) most significantly influenced innovation activities within medium enterprises.

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCLPR</td>
<td>Clients or customers from the private sector</td>
</tr>
<tr>
<td>SCLPU</td>
<td>Clients or customers from the public sector</td>
</tr>
<tr>
<td>SCOM</td>
<td>Competitors or other enterprises in industry</td>
</tr>
<tr>
<td>SINS</td>
<td>Consultants and commercial labs</td>
</tr>
<tr>
<td>SUNI</td>
<td>Universities or other higher education institutions</td>
</tr>
<tr>
<td>SGMT</td>
<td>Government, public or private research institutes</td>
</tr>
<tr>
<td>SCON</td>
<td>Conferences, trade fairs, exhibitions</td>
</tr>
<tr>
<td>SJOU</td>
<td>Scientific journals and trade/technical publications</td>
</tr>
<tr>
<td>SPRO</td>
<td>Professional and industry associations</td>
</tr>
<tr>
<td>CMPAT</td>
<td>Patents</td>
</tr>
<tr>
<td>CMUPAT</td>
<td>Utility patents</td>
</tr>
<tr>
<td>CMRCRD</td>
<td>Design registration</td>
</tr>
<tr>
<td>CMCO</td>
<td>Copyright</td>
</tr>
<tr>
<td>CMCTM</td>
<td>Trademarks</td>
</tr>
<tr>
<td>CMLTAD</td>
<td>Lead time advantages</td>
</tr>
<tr>
<td>CMCPX</td>
<td>Complexity of goods or services</td>
</tr>
<tr>
<td>CMSEC</td>
<td>Secrecy (include non-disclosure agreements)</td>
</tr>
</tbody>
</table>

Source: (CIS 2012, Eurostat)
Tab. 2: German Electrical industry

<table>
<thead>
<tr>
<th></th>
<th>Small (under 50 employees)</th>
<th>Medium (50-249 employees)</th>
<th>Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Product Sig. (Beta)</td>
<td>Process Sig. (Beta)</td>
<td>Product Sig. (Beta)</td>
</tr>
<tr>
<td>RRDIN</td>
<td>.000(2.172)**</td>
<td>.811(-1.32)</td>
<td>.380(772)</td>
</tr>
<tr>
<td>RRDUX</td>
<td>.630(246)</td>
<td>.818(088)</td>
<td>.076(1.330)*</td>
</tr>
<tr>
<td>RMAC</td>
<td>.431(398)</td>
<td>.022(949)**</td>
<td>.504(510)</td>
</tr>
<tr>
<td>ROEK</td>
<td>.544(-396)</td>
<td>.272(501)</td>
<td>.603(-363)</td>
</tr>
<tr>
<td>RTR</td>
<td>.781(139)</td>
<td>.076(683)*</td>
<td>.813(158)</td>
</tr>
<tr>
<td>RMAR</td>
<td>.007(1439)**</td>
<td>.109(-667)</td>
<td>.764(-234)</td>
</tr>
<tr>
<td>RDSG</td>
<td>.139(846)</td>
<td>.559(236)</td>
<td>.037(1696)**</td>
</tr>
<tr>
<td>RPRE</td>
<td>.102(910)</td>
<td>.049(1097)**</td>
<td>.007(2149)**</td>
</tr>
<tr>
<td>SENTG</td>
<td>.000(1791)**</td>
<td>.011(2109)**</td>
<td>.071(1130)**</td>
</tr>
<tr>
<td>SSUP</td>
<td>.988(-009)</td>
<td>.001(1314)***</td>
<td>.063(1061)*</td>
</tr>
<tr>
<td>SCLPR</td>
<td>.001(1474)***</td>
<td>.453(281)</td>
<td>.228(660)</td>
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<tr>
<td>SCLPU</td>
<td>.013(1529)**</td>
<td>.839(085)</td>
<td>.281(804)</td>
</tr>
<tr>
<td>SCOM</td>
<td>.851(-091)</td>
<td>.048(-765)**</td>
<td>.430(447)</td>
</tr>
<tr>
<td>SINS</td>
<td>.992(-007)</td>
<td>.816(-151)</td>
<td>.872(-151)</td>
</tr>
<tr>
<td>SUNI</td>
<td>.134(773)</td>
<td>.322(391)</td>
<td>.973(-019)</td>
</tr>
<tr>
<td>SCON</td>
<td>.103(897)</td>
<td>.864(073)</td>
<td>.124(947)</td>
</tr>
<tr>
<td>SJOU</td>
<td>.627(264)</td>
<td>.663(182)</td>
<td>.672(-275)</td>
</tr>
<tr>
<td>SPRO</td>
<td>.020(-601)**</td>
<td>.448(421)</td>
<td>.949(047)</td>
</tr>
<tr>
<td>CMPAT</td>
<td>.096(851)*</td>
<td>.450(-338)</td>
<td>.698(319)</td>
</tr>
<tr>
<td>CMUPAT</td>
<td>.874(120)</td>
<td>.563(293)</td>
<td>.567(489)</td>
</tr>
<tr>
<td>CMRCD</td>
<td>.035(-1710)**</td>
<td>.650(250)</td>
<td>.831(286)</td>
</tr>
<tr>
<td>CMCO</td>
<td>.241(762)</td>
<td>.857(079)</td>
<td>.845(-168)</td>
</tr>
<tr>
<td>CMCTM</td>
<td>.295(552)</td>
<td>.797(-107)</td>
<td>.020(1939)**</td>
</tr>
<tr>
<td>CMLTAD</td>
<td>.081(1860)*</td>
<td>.127(780)</td>
<td>.008(1755)**</td>
</tr>
<tr>
<td>CMCPX</td>
<td>.007(1354)**</td>
<td>.780(123)</td>
<td>.381(-669)</td>
</tr>
<tr>
<td>CMSEC</td>
<td>.816(108)</td>
<td>.055(808)*</td>
<td>.091(1237)*</td>
</tr>
</tbody>
</table>

Source: own

Tab. 3 shows that in-house and external R&D activities and expenditures for product and process innovations most significantly influenced small firms’ innovation activities in German Chemical and Pharmaceutical industries. Results also show that R&D activities play an important role in small and medium enterprises as well as in the whole industry. Similarly, to the results in Tab. 3, internal sources of information and co-operation for innovations had positive impact on the firms’ product and process innovations. Patents, trademarks and lead-time advantages most significantly supported firms’ competitiveness of product and process innovations.

Tab. 3: German Chemical and Pharmaceutical industries

<table>
<thead>
<tr>
<th></th>
<th>Small (under 50 employees)</th>
<th>Medium (50-249 employees)</th>
<th>Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Product Sig. (Beta)</td>
<td>Process Sig. (Beta)</td>
<td>Product Sig. (Beta)</td>
</tr>
<tr>
<td>RRDIN</td>
<td>.000(2341)***</td>
<td>.004(1885)***</td>
<td>.166(870)</td>
</tr>
<tr>
<td>RRDUX</td>
<td>.012(-1979)**</td>
<td>.033(-1287)**</td>
<td>.614(305)</td>
</tr>
<tr>
<td>RMAC</td>
<td>.012(1376)**</td>
<td>.000(2635)***</td>
<td>.857(-120)</td>
</tr>
<tr>
<td>ROEK</td>
<td>.045(1602)**</td>
<td>.634(291)</td>
<td>.772(-172)</td>
</tr>
<tr>
<td>RTR</td>
<td>.527(-401)</td>
<td>.112(818)</td>
<td>.004(1690)***</td>
</tr>
</tbody>
</table>

Tab. 3: German Chemical and Pharmaceutical industries
In Metal industry (see Tab. 4), internal R&D activities, acquisition of machinery, equipment, software & buildings influenced small enterprises’ innovation activities. Internal and some external (e.g. clients and suppliers) sources of information and cooperation also led to the support of small firms innovation activities. Medium firms’ innovation activities were most significantly influenced by other in-house or contracted out activities to implement new or significantly improved products and processes such as feasibility studies, testing, tooling up, industrial engineering (RPRE), design activities (RDSG) and selected methods for maintaining or increasing the competitiveness (e.g. complexity of goods or services, trademarks, lead time advantages). Within the whole industry, number of activities and expenditures for product and process innovations and sources of information and co-operation for product and process innovation played important role. These, for example, are in-house R&D, acquisition of machinery, equipment, software & buildings, training for innovative activities, internal sources of information and co-operation for innovations, universities or other higher education institutions.

Tab. 4: German Metal industry

| Source: own |
Results of the analyses showed that determinants influencing enterprises product and process innovations differ according to the size of enterprises. Therefore, there is a need for subsequent analyses because relationship between innovations and firms size represents an important factor (see e.g. Hwang et al., 2015). On the other hand, some factors are the same across industries and across small and medium enterprises as well as across whole industries. These factors are, mainly, research and development activities undertaken by enterprises to create new knowledge or to solve scientific or technical problems (include software development in-house that meets this requirement) – in-house R&D. These results are in agreement with previous analyses that stated the importance of in-house R&D expenditures in the process of creating innovation outputs (Catozzella & Vivarelli, 2014), also within SMEs (Newman et al., 2015). In addition, selected information and co-operation sources, specifically internal (within enterprise or enterprise group) and selected external (e.g. clients, customers, and suppliers) influenced enterprises’ innovation activities. Clients and customers and their important role are pointed, e.g., by the Lead-user theory (Franke et al., 2006). Patents, lead-time advantages, complexity of goods or services and trademarks represent most significant methods for maintaining or increasing the competitiveness of product and process innovations in this study.

The authors proposed some practical implications both for enterprises within different industries and for policy makers on general level. In Electrical industry, it is possible to recommend support of firms’ R&D activities, specifically internal activities and expenditures undertaken by enterprises to create new knowledge or to solve scientific or technical problems. Firms should properly choose their sources of information and co-operation for product and process innovation (e.g. suppliers, clients or customers) and use trademarks, complexity of goods or services and lead-
time activities. Similarly, the diversification of public aid and public finance schemes by enterprise size should be recommended. It is obvious that in this industry the problems vary according to the size of the enterprise. Especially in the case of medium-sized enterprises, there were unspecific problems in financing the scientific and research activities of their product and process innovations. Similarly, these businesses are unable to use their capabilities in new knowledge and information. Public incentives to co-operate with the knowledge industry, or incentives for new knowledge-based projects, can help.

In Chemical and Pharmaceutical industries, R&D activities and expenditures play an important role in the process of influencing product and process innovations – mainly, market introduction of innovations and acquisition of machinery, equipment, software & buildings. Enterprises’ internal sources (within enterprise or enterprise group) should be supported. Patent activities, copyrights and lead-time activities represent important factors supporting innovation activities. The results have shown that in the industrial sector (unlike the electrical industry), businesses (irrespective of size) can use their research and development capacities. This area appears to be fully saturated and does not require modification. On the contrary, it was found that all sizes of the enterprises were unable to use the sources of information. Again, it is probably the specificity of this industry. Authors encourage more public policy makers to work with the academic sector.

In Metal industry, similarly to other industries, enterprises should primarily focus on the activities and expenditures for product and process innovations and on proper finding of sources of information and co-operation. In this industry, the biggest differences between small and medium-sized enterprises are again seen. There is a diversification of input variables into production chains. This is due in particular to the specificities of this industry, which must also be reflected in future public policies that will aim to restructure the entire sector due to its small competitive advantage in a globalized world. Public sector attention must be focused primarily on workers and their qualifications for potential industrial change.

**Conclusion**

The practices of the European countries, as well as the practice of the whole EU, confirm the importance of SMEs for the local, European as well as the global markets. SMEs are an important employer, a creator of added value and GDP. Innovation makers as they are, SMEs absorption of innovation are significantly assisted by the entrepreneurial environment, globalization tendencies, rapidly changing technological issues of the environment as well as other determinants. That is why Governments offer to SMEs some subsidies or benefits to enable them to gain the basic attributes that are necessary for innovation activities. Two fundamental questions remain: (a) whether public policies are focused on the right segment of SMEs and their innovation activities and whether policies are able to help to create innovation, (b) whether firms consider public support to be beneficial and they are interested in despite the connected bureaucracy.

Generally, authors proposed implications for SMEs across industries and point out the factors that are same and influence enterprises’ innovation activities. Small
enterprises should primarily focus on the activities and expenditures for product and process innovations, specifically: a) in-house R&D; b) acquisition of machinery, equipment, software & buildings. Within medium size enterprises, training for innovative activities represent most important determinant of product and process innovation activities. Authors showed that different determinants have different influences on both product and process innovations. Analysed determinants have a much stronger effect on product innovations. An interesting result is that the determinants of small businesses seem to be consistent with the major determinants of the entire industry. Medium enterprises are clearly influenced by other determinants (these must be the subject of further research). This result has to be taken into account in practical implications, or taken into account in the country's industrial policy focus. The results of our study should be seen in the context of the German economy. On the other hand, benchmarking can be used as a basis for international comparison.

Finally, it should be remembered the limitations of this study. We work with obsolete data that does not allow defining implications, conclusions, and recommendations for the current present. On the other hand, analogy can be used as a scientific method that builds on the knowledge of the past in order to define more effective measures in the future. Defined conclusions, in the author's opinion, are generally valid and occur to a similar extent in other EU countries even today.

Acknowledgement

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References


breadth, Strategic Management Journal, 31(2), 224-236.


Clausen, T. H. (2009). Do subsidies have positive impacts on RandD and innovation activities at the firm level?. *Structural Change and Economic Dynamics*, 20(4), 239-253. DOI: http://dx.doi.org/10.1016/j.strueco.2009.09.004


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Abstract: This research explains about the way the stakeholder power can affect the implementation of sustainability reporting and the corporate governance at a manufacturing industry in Indonesia listed on Indonesia’s Stock Exchange. The results of this study are expected to provide an overview to prospective foreign investors who are interested in investing in Indonesia public companies which related to organizational behavior and governance style. However, there was less company that reported sustainability reporting continuously from 2007 up to 2016. This becomes a special and interesting concern to be investigated as the awareness phenomenon for the industries in Indonesia. With specified criteria found 60 observation data for 10 years and used multiple linear regression. The result showed that Government Control and Audit Control affected the implementation of Sustainability Reporting while the Internal control and shareholder control had no effect. The special note for shareholder control had a negative coefficient and it became a phenomenon for future research. Another finding was that the implementation of Sustainability Reporting and Government Control had an effect on good corporate governance.

Keywords: Stakeholder Power, Sustainability Reporting, Corporate Governance, Government Control, Audit Control.

JEL Classification: G30, G34, M14, M420.

Introduction

In the last three years, Indonesia has made a great achievement in economic development by changing the consumptive policy into the productive policies in the period of Jokowi-JK Working Cabinet (Schwarz, 2015). Along with the economic growth from 2012 to 2017, some problems in the manufacturing industry such as infrastructure, certainly the workforce and labor problems, even though the company continues to grow. Until the research finding was done by United Nations Industrial Development Organization (UNIDO) showed that the global manufacturing industry at quartal III in 2012 grew only 0.2 percent compared to the previous years (Lestari and WSU, 2017).

At present many companies in countries such as France, Germany, Japan, the United Kingdom, and the United States, report environmental and social issues related to the company's commercial activities to their stakeholders (Burhan and Rahmanti, 2012; Ogundare, 2013) Likewise for manufacturing companies in Indonesia (Deswanto and Siregar, 2017). Global Reporting Initiative (GRI), as it provides a common ground for sustainability reporting, Brown, de Jong, and Levy, (2009) and has been very successful in terms of the adoption rate, comprehensiveness, prestige, and visibility (Loh, Thomas, and Wang, 2017). In Indonesia, one of the reporting models is Sustainability Reporting based on the Global Reporting Initiative (GRI)
This awareness makes the role of the company very important in every progress towards sustainability (Gray, 1996). In 2005 there were only 10 companies, but in 2016 it had risen above 120 companies. Awareness of reporting on Sustainability Reports needs to be appreciated because it is not mandatory but still voluntary disclosure (Quick, 2008). This awareness can be caused by internal pressure such as company shareholders or the company's internal control system while external pressure can also occur and be carried out by the government and external auditors (Lu and Abeysekera, 2014; Agyei-mensah, 2016).

In the last three years, Indonesia has made a great achievement in economic development by changing the consumptive policy into the productive policies in the period of Jokowi-JK Working Cabinet (Schwarz, 2015). Along with the economic growth from 2012 to 2017, some problems in manufacturing industry such as infrastructure, certainly the workforce and labor problems, even though the company continues to grow. Until the research finding done by United Nations Industrial Development Organization (UNIDO) showed that the global manufacturing industry at quartal III in 2012 grew only 0.2 percent compared to the previous years (Lestari and WSU, 2017).

The impact of this pressure, investors reacted positively to the environmental performance achieved by the company reported in the Sustainability Report as part of the implementation of good corporate governance and able to increase company value. This is an interesting question, is it possible for manufacturing companies in Indonesia, that internal and external pressure through control activities can affect the reporting process or SR that they make voluntarily and whether it also has an influence on the implementation of Good Corporate Governance in the company. That was to answer if good corporate governance for all stakeholders cannot be underestimated (Lu & Abeysekera, 2014). A good company’s system will ensure some vital points; they are openness and transparency to the shareholders and the regulator on risk management in a company (Elliott and Elliott, 2007). Openness and transparency to the shareholders will be made minimizing the asymmetry of information (Agyei-mensah, 2016).

1 Statement of a problem

The sustainable company’s growth is reported through the voluntary disclosure done by a company in Indonesia; year by year, it becomes a trend for a company to inform the economic, social, and environmental performances, Deswanto & Siregar, (2017) and it becomes an awareness and a compliant for all stakeholders (Ball and Bebbington, 2008). For example, a company in China informs the economic, social, and environmental performances that had been done by the public company in 2008 after the issuance of social responsibility guidance or sustainability reporting from Shanghai Stock Exchange (SSE) in 2006 (Qiu, 2017). The sustainability reporting guidance also grows gradually such as a guidance from GRI (General Reporting Index) as suggested by Loh, Thomas, & Wang, (2017) also (Li et al., 2018).

Disclosure of Sustainability Reporting in Indonesia is based on regulations relating to environmental and social responsibility in Law Number 40 of 2007 concerning Limited Liability Companies and until 2016 only 120 companies published Sustainability Reporting (Kurniawan, Sofyani and Rahmawati, 2018). In its
development, it has not been consistent in terms of publication of reports. Is it possible for company stakeholders in Indonesia to have an influence on disclosure of sustainability reports, as has been revealed in research conducted on companies in China by (Lu and Abeysekera, 2014).

Auditors are professionally influential in guiding their clients in initiating and promoting new accounting practices (e.g., social responsibility accounting) (Ahmad, Hassan and Mohammad, 2003). Although, Lu and Abeysekera (2014) found that audit control could not affect the sustainability reporting disclosure. Nevertheless, according to Barrett (2005), the sustainability reporting disclosure could be well-arranged if there was an independent auditor who participated in the composition. The ownership of control in a company is the most important factor for the information of environmental disclosure (Haladu and Haliru Beri, 2016). However, the study in China revealed that the stakeholder power from the government had an impact on the sustainability reporting disclosure (Lu and Abeysekera, 2014).

Stakeholder perspective, which recognizes the ability of the government to influence corporate strategy and performance via regulations (Freeman, Wicks and Parmar, 2004). The results of the research conducted by Liu and V. Anbumozhi, (2009) found that the Chinese government had positive and significant influence on environmental disclosures. Meanwhile government control via regulations has no effect on voluntary disclosures on companies in Indonesia (Basuki and Patrioty, 2011).

Dispersed corporate ownership increases pressure for management to disclose voluntary information (Ullmann, 1985). Previous studies have examined the power of shareholders to influence corporate social and environmental disclosure as part of Sustainability Reporting (Lu and Abeysekera, 2014). Government share ownership has an influence on voluntary disclosures for companies in Malaysia (Said, Zainuddin and Haron, 2009). Although voluntary disclosure for companies in Malaysia is still categorized as weak (Zain, Mustaffa and Tarni, 2006). In Indonesia, publication of sustainability report has started to become a trend, and has become from the interests of shareholders. Other factors are driven by the annual award of sustainability reports initiated by the National Center for Sustainability Reporting (NCSR) (Tarigan and Semuel, 2015).

This reflects that the stakeholder power lacks intervention or lacks control for company’s internal party. It is important to be noted that corporate governance has a relation to the internal control (Agyei-mensah, 2016). Lack of good corporate governance in a country, such as the companies listed on Ghana’s Stock Exchange, has resulted in a bad performance and a failure in a company (Agyemang and Castellini, 2015). Meanwhile, (Tristiarini1, Utomo1 and Setiawant1, 2019) have found that the corporate reputation measured by using corporate responsibility and corporate governance has a significant influence to market value.

The research on the relationship between sustainability reporting and corporate governance or corporate governance and the disclosure of sustainability reporting had been done by Mahmood, Kouser, Ali, Ahmad, & Salman (2018). They stated that the elements of corporate governance specifically were the size of the Board of directors, professionalism of the board of directors; even, the female director could affect and
increase the disclosure of sustainability reporting). However, Said, Zainuddin and Haron.,(2009) did not find such relationship at the company in Malaysia.

The disclosure of company’s internal information and the company’s elements is expected to give a motivation in achieving good company’s performance for the attainment of good corporate governance (Lu and Abeysekera, 2014). By the existence of the problems occurred in manufacturing industries, the research gap found in this research, and the phenomena happened in international setting, then interested in investigating the empirical test on the stakeholder power toward the implementation of sustainability reporting and good corporate governance in the manufacturing industry listed on Indonesia’s Stock Exchange that has reported their Sustainability Reporting transparently.

2 Methods

This research was conducted in several manufacturing companies listed on Indonesia’s Stock Exchange within a period of 2007-2016. This research model used two models. The first model was aimed at testing the direct impact of Government Control, Auditor Control, Shareholder Control, and Internal Control toward Sustainability Reporting. Meanwhile, the second model was aimed at observing the implementation of Sustainability Reporting and Government Control toward corporate governance.

The control variable used here was the company size by considering that larger companies has implemented the principles of good corporate governance and disclosed the sustainability reporting. The company size in this research was measured by using natural logarithm from the company’s total asset (Lu and Abeysekera, 2014; Mahmood et al., 2018). The stakeholder theory focuses on the expectation of a certain interest group and the company that is persistent to widely serve the interest group will create a better value time by time (Harrison and Wicks, 2013)

This group has a variable characteristic and an impact level toward the company’s activity (Lu and Abeysekera, 2014). According to Ullmann (1985), the characteristic and the impact level can be manifested as the stakeholder power and they have a capacity to affect the managerial decision strategy in form of control for resources needed by the company. Therefore, the strength of stakeholders consists of government control, auditor control, shareholder control and internal control that are considered capable of influencing the implementation of sustainability reporting and good corporate governance practices.
Tab. 1 : Measurement for each variable

<table>
<thead>
<tr>
<th>No</th>
<th>Variable</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Audit control*,** (independent variable)</td>
<td>1 for companies audited by big four and 0 for the opposite</td>
</tr>
<tr>
<td>2</td>
<td>Internal control** (independent variable)</td>
<td>(Actual disclosure / Total possible disclosure)</td>
</tr>
<tr>
<td>3</td>
<td>Government Control* (independent variable)</td>
<td>1 for companies owned by the government and 0 otherwise</td>
</tr>
<tr>
<td>4</td>
<td>Shareholder control* (independent variable)</td>
<td>Percentage of shares owned by the largest shareholder at the end of the year</td>
</tr>
<tr>
<td>5</td>
<td>Sustainability Reporting* (dependent/independent variable)</td>
<td>Disclosure Quantity in SR</td>
</tr>
<tr>
<td>6</td>
<td>Corporate Governance***(dependent variable)</td>
<td>Percentage of Managerial Ownerships</td>
</tr>
<tr>
<td>7</td>
<td>Firm Size* (control variable)</td>
<td>Natural logarithm of total assets</td>
</tr>
</tbody>
</table>


Based on the measurement of the variables in Tab. 1 above, the research model developed consisted of two models with the following equation:

\[
ISR = \beta_0 + \beta_1GC + \beta_2AC + \beta_3SC + \beta_4IC + \epsilon \quad \text{(Model I)}
\]

\[
CG = \beta_0 + \beta_5ISR + \beta_6GC + \epsilon \quad \text{(Model II)}
\]

A research done by Freeman (2004) stating that a perspective from the stakeholders admits the government’s capability to affect the company’s strategy and the performance through a regulation and also (Lu and Abeysekera, 2014). Government control has an effect on the disclosure implementation done by the company (Liu and Anbumozhi, 2009). So, the hypothesis as follows:

H1: Government control can affect the implementation of sustainability reporting.

As a research was done by Taylor (1992), proving that the existence of a positive relationship between the auditor and the company’s disclosure in a gas and oil industry in Australia. In a study done in Malaysia, Ahmad, Hassan and Mohammad (2003) also found that the company audited by Big-5 auditor disclosed more environmental information in their annual report. Thereby, the hypothesis as follows:

H2: Auditor control can affect the implementation of sustainability reporting.

Keim (1978) states that the distribution of the company’s ownership becomes less concentrated; if the demand is put in a company by the shareholders, it becomes more. Disperse corporate ownership increases the pressure to disclose information on social responsibility (Ullmann, 1985b). Thereby, the hypothesis as follows:

H3: Shareholder control can affect the implementation of sustainability reporting.

The agency conflict is explained in the agency theory and it is proposed by Jensen and Meckling (1976) also believe that the agency theory also explains the reason why the manager discloses the internal control information voluntarily, and reported
through sustainability reporting so the stakeholders will understand the internal control of a company. Therefore, the hypothesis as follows:

H4: Internal control can affect the implementation of sustainability reporting.

The previous study also stated that corporate governance had a relationship to the disclosure or the implementation of sustainability reporting Mahmood, et al (2018). Theoretical arguments alone cannot unambiguously predict the relationship between management ownership (as corporate governance driver) and market valuation (Morck, Shleifer and Vishny, 1988). So, the hypothesis as below:

H5: The implementation of sustainability reporting can affect corporate governance.

A government will provide an intervention to the company’s internal party if the company’s internal party does an action that can damage the stakeholders as a case happened in China (Lu and Abeysekera, 2014). It is not only happened in China, but it is also happened in both developed countries and developing countries. Theoretically, the hypothesis as follows:

H6: Government control can affect corporate governance.

3 Problem solving

The classical assumption test referred to a definition proposed by Ghozali (2016) can be seen in Tab. 2.

<table>
<thead>
<tr>
<th>No</th>
<th>Variabel</th>
<th>Model I</th>
<th>Model II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>VIF</td>
<td>Tolerance</td>
</tr>
<tr>
<td>1</td>
<td>GC</td>
<td>1,094</td>
<td>0,914</td>
</tr>
<tr>
<td>2</td>
<td>IC</td>
<td>1,049</td>
<td>0,953</td>
</tr>
<tr>
<td>3</td>
<td>AC</td>
<td>1,063</td>
<td>0,941</td>
</tr>
<tr>
<td>4</td>
<td>SC</td>
<td>1,094</td>
<td>0,905</td>
</tr>
<tr>
<td>5</td>
<td>ISR</td>
<td>1,028</td>
<td>0,973</td>
</tr>
<tr>
<td>6</td>
<td>CG</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*, > 0,05;

Source: (Author’s Result)

Based on Tab. 2, the significance value in the ANOVA table obtained a value of 0.000 that can be concluded that the two models used in this research were good. The value for the Kolmogorov-Smirnov normality test was 0.444 in the first model and 0.177 in the second model. It showed that both values exceeded a value of 0.05 and indicating that the data were normally distributed and appropriate to be used. Other classical assumption tests such as multicollinearity test If the VIF value is less than 10 and or the Tolerance value is more than 0.01 then it can be conclusively concluded that no multicollinearity problem has been proven from the VIF table column and Tolerance. Heteroscedasticity, if the significance value (Sig.)> 0.05 (glasjer collum) then there are no symptoms of heteroscedasticity, based on the table above the government control variable (GC) and shareholder control (SC) are still experiencing problems and are part of the limitations in this study.
Based on Tab. 3, the significance value in the Model Fit of ANOVA\textsuperscript{a} table obtained a value of 0.000 both for model I and model II, it can be concluded that the two models used in this study were good. To know whether an independent variable can affect the dependent variable positively or negatively, it can be seen from the t-test as follows:

<table>
<thead>
<tr>
<th>Tab. 3. Model Fit of ANOVA\textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model I</td>
</tr>
<tr>
<td>Regression</td>
</tr>
<tr>
<td>Source : (Author’s Result )</td>
</tr>
</tbody>
</table>

Based on Tab. 4, it can be explained that the first hypothesis can be accepted. It had been obtained a UCB value of 0.679, the t-statistic value of 2.282, at significance value below of 5%. The second hypothesis can be accepted since it had a UCB value of 2.235, the t-statistic value of 5.494, at significance value below of 1%. The third hypothesis could not be accepted since it had a UCB value of -0.002 and the t-statistic value of -0.222 with significance value above 10%. The fourth hypothesis could not be accepted since it had a UCB value of 0.216, the t-statistical value of 0.534 at significance value above 10%. The fifth hypothesis can be accepted since it had a UCB value of 0.571, a t-statistical t value of 13.623, and significance value below of 1%. The sixth hypothesis can be accepted since it had a UCB value of 1.491, the t-statistical t value of 4.267, and significance value below of 1%.

<table>
<thead>
<tr>
<th>Tab. 4 : Regression Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variabel</td>
</tr>
<tr>
<td>(Constant)</td>
</tr>
<tr>
<td>GC</td>
</tr>
<tr>
<td>IC</td>
</tr>
<tr>
<td>AC</td>
</tr>
<tr>
<td>SC</td>
</tr>
<tr>
<td>LnA</td>
</tr>
<tr>
<td>ISR</td>
</tr>
<tr>
<td>CG</td>
</tr>
<tr>
<td>Source : (Author’s Result )</td>
</tr>
</tbody>
</table>

Noted : *** Significant 1%; ** Significant 5%; * Significant 10%;
UCB = Unstandardized Coefficients Beta

From the adjusted R Square at tabel 5 can be explained that the influence of Governer Control (GC), Internal Control (IC), Auditor Control (AC) and Shareholder Control (SC) as model I, gives a value of 0.343 which can be interpreted

<table>
<thead>
<tr>
<th>Tab. 5. Determinant Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
</tr>
<tr>
<td>Model I (Y1)</td>
</tr>
<tr>
<td>Model II (Y2)</td>
</tr>
<tr>
<td>Source : (Author’s Result )</td>
</tr>
</tbody>
</table>
that Dependent latent variables can be explained by independent latent variables of 34.3%, while 65.7% is explained by other variables outside the study. And also at model II adjusted R Square gives a value of 0.764 which can be interpreted that Dependent latent variables can be explained by independent latent variables such as Government Control (GC) and Sustainability Reporting (ISR) of 76.4%, while 23.3% is explained by other variables outside the study.

4 Discussion

First hypothesis of this research accepted and finding is in line with a statement by Freeman, Wicks, & Parmar (2004), stating that the perspective of the stakeholders who admit the government capability in affecting the company’s strategy and performance through a regulation. In addition, this research finding is relevant to the finding by Liu and Anbumozhi (2009), stating that China’s government can affect the disclosure of sustainability in form of accountability report toward their environment. Second hypothesis Cannot accepted, but the result is not relevant to the construction of the hypothesis as stated by Ahmad, Hassan and Mohammad (2003) which finding that a company audited by Big-5 auditor discloses mode environmental information in their annual report and the society tends to see that a bigger audit company such as Big Four can be fairer and more independent (Choi and Kim, 2010).

Third hypothesis could not be accepted, it means that the corporation pays full attention to social responsibility (Qian and Xing, 2016). Even though the company’s owners receive the information on the regulation of social responsibility disclosure, they could not perform the regulation optimally. Fourth hypothesis could not be accepted, it can be stated limitedly on the company sample that the effectiveness of internal control based on the perspective of stakeholder theory X. Li et al.,(2018) in the manufacturing companies in Indonesia was not able to be a good and optimal way in the process of sustainability reporting. Although the company’s management had more freedom in choosing the method of accounting estimation (Hogan and Wilkins, 2008).

Fifth hypothesis can be accepted, it can be concluded that the implementation of sustainability reporting strongly affects the GCG dominantly. Since there are compulsory principles to be disclosed in the sustainability reporting such as equity, comparable, accurate, sequential based on appropriate time, and accountable, an entity that discloses the sustainability reporting can reflect that the entity implements good corporate governance (Lu and Abeysekera, 2014; Janggu et al., 2014; Mahmood et al., 2018). Sixth hypothesis can be accepted, it can be concluded if a governance control increases, GCG will also increase. It is because of the performance of an entity gives an effect to the economic performance in a country (Mantarian and Nuryasman, 2017). Thereby, the company’s internal party should be demanded to implement a correct and good corporate governance based on the principles of good corporate governance.

Conclusion

This study presents the current investigation towards the implementation of the issuer’s sustainability reporting in the framework of legitimacy and the stakeholders in the companies existed Indonesia. The empirical findings provided an important perception of the effect of stakeholder power toward the sustainability reporting and GCG. Audit control Choi and Kim (2010) and governance control (Liu and
Anbumozhi, 2009; Freeman, 2004) were the variables that could affect the implementation of sustainability reporting and governance control (Lu and Abeysekera, 2014; Mantari and Nuryasman, 2017). In addition, the implementation of sustainability reporting was the factor that could affect good corporate governance. This research finding is strongly consistent with the legitimacy theory due to the tendency of a company to comply the public supervision, such as a big company owned by the government and the company audited by the famous public accountant such as an auditor that belongs to the big four auditor.

This research also provides some unexpected yet thorough findings. As an example, the involvement of Big Four in financial audit also makes a substantial difference in the implementation of sustainability reporting. These findings provide a practical implication for the policymaker and other relevant stakeholders. When the Indonesian government and its institutions, as both a regulator or a facilitator, have not issued the regulation and the guidance yet in the process of composing the sustainability reporting, only several companies listed on Indonesia’s Stock Exchange that have a willingness to voluntarily disclose the process of company’s sustainability. Therefore, the Indonesian government needs to perform the sustainability attempt by providing guidance for the regulation and detailed guidance on the content and the level of sustainability reporting implementation. It aims to help the company in order to be able to communicate their social and environmental actions to the regulatory agency and other stakeholders.

This study provides a contribution in the literature about social and environmental accounting by enlarging the scope of the research that still exists at the social and environmental disclosure in the company’s sustainability reporting for developing countries context i.e. Indonesia. Continuous evolution and increasing importance of sustainability concepts and practices among individuals, organizations and communities around the world it seems that it needs development conceptual approach to the theory of sustainability management for management applications, especially for public companies in Indonesia (Starik and Kanashiro, 2013).

However, this research finding should be interpreted by considering some limitations in this research. First, there were few numbers of the sample used in this research are limited. It can limit the finding implementation to the company that is not listed in this research. Secondly, even though the extensive attempt on the determinant choice and the accurate proxy development for various variables had been done, subjectivity could not be avoided. Thirdly, it was due to inadequacy number of companies that disclosed the sustainability reporting periodically year by year. The future research can consider other determinant factors that have more potency and uses a greater number of samples.

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References


Janggu, T. et al. (2014) ‘Does Good Corporate Governance Lead to Better Sustainability Reporting?'


Special Open Forum with Adam Schwarz Co-Founding Partner and Chief Executive Officer-Asia, Adam Schwarz ’ s Remarks Executive Officer-Asia, Adam Schwarz ’ s Remarks, February,(The United States – Indonesia Society usindo.org).


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FACTORS AFFECTING CHOICE OF EMPLOYMENT BY UNIVERSITY GRADUATES

Markéta Šnýdrová, Lucie Vnoučková, Ivana Šnýdrová

Abstract: The article focuses on factors influencing employer selection from the perspective of graduates of the University of Economics and Management. The aim of the article is to identify factors affecting attractiveness of organization and to determine the impact of these factors on the choice of employer in terms of the different focus of the applicants. Primary research included a questionnaire (n = 238 respondents), 4 focus groups and two individual interviews. The results of primary research have shown that the most important areas are: a prestigious and respected company, a purely Czech company, a stable established company with tradition, TOP employer, a socially responsible company, possibility of career growth, possibility of further development, the opportunity to participate in corporate goals, participation in decision making and management of the company, the possibility to apply creativity, innovation and ideas, individual work, interesting work, challenge work, ambitious project, financial remuneration, corporate benefits and geographic availability of the organization. The research also showed that preferences can be divided into factors that indicate whether an organization becomes a selected (attractive) employer based on the candidate's specific focus. Factor analysis has shown that different factors are important for identified types of candidates. The output of the article is a recommendation on what factors organization should focus on to address a particular type of candidate.

Keywords: Employer Attractiveness, Factors Influencing Employer Selection, Organization, Applicant, Employee, University Graduate.

JEL Classification J20,M51.

Introduction

The article deals with factors affecting employer selection from the perspective of graduates of the University of Economics and Management.

The data of the Czech Statistical Office show that the general unemployment rate in the Czech Republic is very low (CZSO, 2019), thus organizations must increasingly strive to become an attractive employer, attract the interest of potential job seekers while retaining existing employees (Unger, Myśliwcová, 2018; Punjairisi, Wilson, and Evanschitzky, 2008). Working with human resources is a critical factor in the success of an organization (Novotný, Mikulecký, 2011; Edwards, Edwards, 2013; Martin, Gollan, Grigg, 2011). For this reason, the importance of scientific discipline known as Personnel Marketing (Unger, Myśliwcová, 2018) is currently growing. It is a combination of classical marketing and personnel management, or the application of marketing elements to individual personnel activities. Unger and Myśliwcová (2018) emphasize that this approach focuses on employment as a customer, his expectations and the satisfaction of these expectations, needs and ideas from the employer. The difficult labor market situation forces organizations to respond to labor market demands, to compare themselves with competitors in response to the identified
needs of potential job seekers and existing employees. Thus, the employer has to build his employer brand. An organization that offers employees better benefits, greater flexibility in terms of job and time, development or career opportunities, diversity and other opportunities will ensure a competitive position. Applicants choose employers in their essence according to their ability to respond to factors that affect employer selection. The organization is thus directly dependent on whether these factors can be identified and adapted to their offer. It should also be mentioned that each candidate is different and hence his needs may differ from others. For this reason, the situation of organizations is very difficult, because what may be very important for one candidate is irrelevant to another.

The aim of the article is to identify factors affecting the attractiveness of the organization and to determine the extent of influence of these factors on the choice of employer in terms of the different focus of the applicants.

Within the introduction and the first chapter “Statement of a problem”, the researched issue is elaborated in a broader framework. Current articles and publications are used to describe the issue. The methods show how to obtain primary data and how to process it. The chapter "Problem Solving" summarizes the primary data obtained through the questionnaire, focus groups and individual interviews. Data is further investigated and analyzed. In the discussion and conclusion of the article, the key findings from primary research are summarized and compared with the already conducted research within the researched issue.

1 Statement of a problem

The labor market situation shows that employers, if they want to succeed, are forced to build their employer brand attractiveness (Edwards, Edwards, 2013; Martin, Gollan, Grigg, 2011).

1.1 Factors affecting employer selection

There are number of factors influencing employer selection and it is important to organizations be aware of them and focus on work in compliance with them (Twenge et al., 2010). If an organization has difficulty retaining existing workers and successfully reaching potential job seekers, it should analyze these factors (Armstrong, 2007, p.347).

Love and Singh (2011) point out that the attractiveness of an organization for potential candidates as well as for existing employees increases when the organization is directly ranked among the top employers within the area as part of the employer assessment.

The employer's attractiveness is closely linked to its reputation. If the organization's reputation is good, jobseekers offer themselves and existing employees are proud to work for such an attractive organization (Armstrong, 2007, p. 347; Horváthová, Bláha, Čopíková, 2016, p. 39; Vlková, Urbancova, 2017). Employee pride of employer prestige also has a positive impact on his work performance and behavior (Wilden, Gudergan, Lings, 2010).

Applicants consider employer quality by working conditions, salary and benefit levels (Armstrong, 2007, p.347, Maxwell, Knox, 2009; Urbancová, Šnýdrová, 2017;
Kumar, 2018). In their research, Vlková and Urbancová (2017) also confirm that the most important factors influencing employer selection include the amount of wages. Daly (2011) states that wages are an indicator of employees' willingness to invest in employees, coupled with a wide range of benefits. Vimrová (2016) then deals with the importance of providing various employee benefits. However, Vnoučková and Čejka (2013) emphasize that the preference of potential applicants is currently changing and shifting to free time.

Vlková and Urbancová (2017) further add that the scope of the organization close to the residence is also a significant factor. The importance of the organization's local operations is also mentioned in Rampl (2014).

Other factors influencing the employer's attractiveness include education and development opportunities (Dabirian, Kietzmann and Diba, 2017; Wilden et al., 2010). Age-centered and employer-driven research shows that job seekers, young people, employees, and graduates put emphasis on work, opportunity for education and development, a positive workplace atmosphere, while older workers emphasize job security (Šnýdrová et al., 2014; Malik, Subramanian, 2015). Also Aziri (2011) and Rampl (2014) mention the importance of the nature and content of the work. Sibson (2011) emphasizes the importance of making work interesting and delighting. Chalofsky and Krishna (2009) stress that it is essential that the employee or the candidate perceive the work as meaningful, which is then the strongest internal motivator.

Another important factor affecting attractiveness of the organization for candidates and existing employees is the possibility of career advancement within the organization (Wilden et al., 2010; Sibson, 2011; Snydrova, 2014; Dabirian, Kietzmann and Diba, 2017). Tüzünger and Yuksel (2009) added that the existence of an international career option is an important factor. Doherty, Richardson, and Thorn (2013) directly point out that the possibility of leaving the country and working abroad is an important factor for employer selection for a particular group of workers.

A significant influence on the attractiveness of an organization as an employer is when an organization is committed to social responsibility. Corporate social responsibility affects both the attitude and commitment of existing employees and attracts potential candidates (Jones, Willness, MacNeil, 2009; Rupp et al., 2013, Jones, Willness, Madey, 2014; Donia, Tetrault Sirsly, 2016).

Recently, job seekers have been given the opportunity to apply their own ideas and innovations to the organization (Berthon et al, 2005; Tuzunger and Yuksel, 2009), leading to a subsequent increase in employee engagement and willingness to participate in decision making (Berthon et al., 2005; Jones, Willness, MacNeil, 2009; Graeme, Gollan, Grigg, 2011; Rupp et al., 2013, Jones, Willness, Madey, 2014; Donia, Tetrault Sirsly, 2016).

Mondy, Noe and Premeaux (2002) add that flexibility is an essential factor in attracting an organization as an employer.

Tüzünger and Yuksel (2009) summarize almost all of these factors mentioned that the expectations and requirements of potential candidates for a selected employer of "employer of first choice" include both corporate data (age and location of the company) and components increasing the attractiveness of the employer (work tasks
that are challenging), innovation, competitive working environment, work-life balance, career development, international career opportunities, education and development, time flexibility, marketing success and organization reputation; as confirmed by Minchington (2010) and Sutherland, Torricelli and Karg (2002).

Based on the theoretical overview, the main factors influencing the selection of the employer were identified, including: the prestige of the organization, stability and tradition of an organization, an organization known as a top employer, a socially responsible organization, the possibility to work abroad, the possibility of a career growth, the possibility of further development, the opportunity to participate in company goals, the possibility of participation in decision-making, the possibility to apply ideas - creativity, independent work, interesting work, work that is a challenge, the amount of wages / salaries, corporate benefits, geographical proximity to the organization - easy availability.

These factors will be subject to factor analysis.

2 Methods

The data for this article were obtained as part of the content analysis of primary and secondary literary sources published in relevant databases, such as Web of Science and primary quantitative research, which focused on graduates of selected business university.

Quantitative research

Quantitative research included a questionnaire survey (238 respondents). The questionnaire survey was carried out using the CAWI method, i.e. using an electronic on-line questionnaire (Computer Assisted Web Interviewing). The questionnaire was placed on Google and respondents were approached by e-mail. By filling in the questionnaire via the link, the absolute anonymity of the respondents was ensured (the respondent did not have to provide information that could identify him / her before filling out the questionnaire) when completing the questionnaire. All graduates of the University of Economics and Management, who completed their studies in 2012-2017, were approached. In total, 870 graduates were addressed in the survey, with a questionnaire return of 283 questionnaires (i.e. 27.4% of the total number of questionnaire applications). Data collection took place from May 2017 to November 2017). The questionnaire contained a total of 31 questions (24 questions with answer options, 6 open questions and 1 question using the scale in the range from 1 - absolutely agree to 5 - absolutely disagree). The questionnaire focused on the factors that influence employer choice and included socio-demographic questions (gender, age, type of studied program). All questions enabled respondents to follow up their own answers or comments.

The obtained data were then statistically processed using software (Excel and SPSS statistics).

As stated above, a total of 238 respondents participated in the questionnaire, of which 157 were women (66%) and 81 (34%) men. This percentage is equal to the division of gender of students and graduates of the university under investigation. In terms of educational attainment, the distribution of respondents is as follows: 122
graduates had a bachelor's degree (51.3%), 70 graduates had a master's degree (29.4%), 32 respondents have achieved both master's and bachelor's degrees at the University (13.5%), 12 graduated in MBA program (5%), 1 respondent completed 3 month study module program (0.4%) and 1 respondent, did not complete the form of education (0.4%).

**Data Processing**

The first stage of processing the questionnaire data focused on the preparation of a data matrix. The data was then sorted and then it was coded and sorted according to the type of variables, qualitative or quantitative. During this phase, the data was also cleaned, and its quality was checked in order to uncover any extreme (eccentric) or deviating observations which could significantly influence the results of analyses. There were no missing values because all questions were mandatory. The last part of the data matrix involved the transformation of the variables which was necessary for several reasons. When processing a multidimensional data file, the reason for this is usually the requirement for the fulfilment of the analyses of a certain statistical method. The process of calculation and interpretation of results was used according to Hebák et al. (2014). The basic conditions of attributes to enter the analysis were fulfilled according to Hendl (2006).

The processing of the results was based on analysis of the data focused on investigating the important properties and the typical features of the statistical file. The statistical evaluation of the data was undertaken firstly by a one-dimensional analysis based on the frequency distribution, the calculation of point and interval estimates and the testing of hypotheses about the frequency of the categories of individual variable values. Secondly, a two-dimensional analysis was used based on an investigation into the dependence of two selected variables. The goal of the comprehensive analysis of several variables was to uncover any relations between data structures and to find an interpretation for these structures. The retrieval of the information in the data file was realized using the classic Pearson hypothesis testing. Pearson’s and Spearman’s correlation were applied. If the p–value calculated by means of the test was lower than the selected level of significance $\alpha = 0.05$. Only resultant values of the correlation coefficient with an absolute value of more than 0.3 were selected as being significant.

Factor analysis was used to evaluate the results and specifically to identify groups of responses of students regarding their perceptions. The goal was to find groups of variables with significant appearance and consistent content and at the same time to reveal main orientation of coherent groups of graduates. The results of analyses and formed factors may help to reveal the current desired areas of orientation on labour market and preferences of graduates. The higher level of generalization of results by factor analysis helps to focus on the most important and highly recommended areas with filtering out inconsistencies, which may be studied separately as outstanding values which in turn, may also be inspiring for development.

The method of analysis used in this paper is often used in social sciences studies (Palát, 2012). Also in the area of learning and development research, this method is used quite often and favoured by researchers (Anderson, 2009). The levels of correlation coefficients were sufficient according to Anderson (2009) and Hendl (2006) to enter factor analysis. Moreover, over 85% of correlations in the correlation
The KMO (Kaiser-Meyer-Olkin test) value reached 0.7 which is considered as meritorious and thus adequate for factor analysis.

The number of monitored variables (factors) was reduced using the Varimax method. For the selection of substantial factors the Kaiser-Guttman rule was applied (i.e. substantial factors having a value within the range higher than 1) and subsequently Sutin test was applied. The correlation coefficients are in the interval from <-1; 1>. If the correlation coefficient is positive, it is a direct proportion (negative – indirect proportion). For the evaluation, the value of variable correlation higher than 0.3 (moderate correlation) according to Anderson (2009) was used. To evaluate the results, SPSS statistics was used. All procedures were followed in accordance with the ethical standards and Czech law relating to the use of sensitive information.

3 Problem solving

The results of primary research have shown that a significant areas affecting graduates’ choice of preferred employer are: a prestigious and respected company, a purely Czech company, a stable established company with traditions, a TOP employer, a possibility to be part of decision-making and management, the possibility to apply creativity, innovation, resp. new ideas, individual work, meaningful work, challengeable work, new ambitious project, above-standard financial proposal, corporate benefits, and geographical availability of the organization.

The obtained data were tested by multidimensional statistics, factor analysis described in Methods. The results identified 7 significant factors meeting the criteria identified down in the methodology. Tab. 1 shows the significance of the individual examined factors describing expected outcomes of students’ university studies. In total, the two identified variables explain 61% of the sample behaviour or of the possible resultant characteristics, with the specific values of factor analysis.
Tab. 1: Factors affecting choice of employer

<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prestigious and respected company</td>
<td>0.109</td>
<td>0.075</td>
<td>-0.013</td>
<td>-0.161</td>
<td>0.727</td>
<td>0.266</td>
<td>-0.111</td>
</tr>
<tr>
<td>A purely Czech company</td>
<td>0.067</td>
<td>-0.180</td>
<td>0.121</td>
<td>-0.043</td>
<td>0.013</td>
<td>0.080</td>
<td>0.645</td>
</tr>
<tr>
<td>Established company with tradition</td>
<td>0.031</td>
<td>-0.139</td>
<td>0.021</td>
<td>0.197</td>
<td>0.569</td>
<td>0.007</td>
<td>0.241</td>
</tr>
<tr>
<td>TOP employer</td>
<td>-0.052</td>
<td>0.186</td>
<td>0.255</td>
<td>0.111</td>
<td>0.653</td>
<td>-0.138</td>
<td>-0.092</td>
</tr>
<tr>
<td>Socially responsible company</td>
<td>0.284</td>
<td>0.072</td>
<td>0.133</td>
<td>0.129</td>
<td>0.209</td>
<td>0.036</td>
<td>0.375</td>
</tr>
<tr>
<td>Possibility to work abroad</td>
<td>0.184</td>
<td>0.678</td>
<td>0.155</td>
<td>-0.116</td>
<td>0.026</td>
<td>-0.046</td>
<td>0.062</td>
</tr>
<tr>
<td>Possibility of career growth</td>
<td>-0.039</td>
<td>0.096</td>
<td>0.070</td>
<td>0.100</td>
<td>0.122</td>
<td>0.840</td>
<td>0.061</td>
</tr>
<tr>
<td>Possibility of further development</td>
<td>0.239</td>
<td>-0.025</td>
<td>0.202</td>
<td>0.141</td>
<td>0.036</td>
<td>0.730</td>
<td>-0.019</td>
</tr>
<tr>
<td>Possibility to participate in company goals</td>
<td>0.687</td>
<td>0.099</td>
<td>0.173</td>
<td>-0.051</td>
<td>0.018</td>
<td>0.167</td>
<td>0.147</td>
</tr>
<tr>
<td>Participation in decision making</td>
<td>0.544</td>
<td>0.261</td>
<td>-0.274</td>
<td>-0.080</td>
<td>-0.015</td>
<td>0.178</td>
<td>0.060</td>
</tr>
<tr>
<td>Possibility to apply new ideas</td>
<td>0.684</td>
<td>-0.044</td>
<td>0.030</td>
<td>0.139</td>
<td>-0.024</td>
<td>0.132</td>
<td>0.026</td>
</tr>
<tr>
<td>Independent work</td>
<td>0.103</td>
<td>-0.015</td>
<td>-0.119</td>
<td>0.723</td>
<td>0.169</td>
<td>0.017</td>
<td>0.115</td>
</tr>
<tr>
<td>Work that I like</td>
<td>0.003</td>
<td>-0.010</td>
<td>0.274</td>
<td>0.635</td>
<td>-0.172</td>
<td>0.097</td>
<td>0.129</td>
</tr>
<tr>
<td>Work that is a challenge</td>
<td>0.352</td>
<td>0.215</td>
<td>-0.161</td>
<td>0.344</td>
<td>0.103</td>
<td>0.118</td>
<td>0.223</td>
</tr>
<tr>
<td>New ambitious project</td>
<td>0.571</td>
<td>0.068</td>
<td>-0.084</td>
<td>0.105</td>
<td>0.057</td>
<td>-0.180</td>
<td>-0.080</td>
</tr>
<tr>
<td>Financial rewards</td>
<td>-0.289</td>
<td>0.202</td>
<td>0.516</td>
<td>0.211</td>
<td>0.010</td>
<td>0.218</td>
<td>-0.001</td>
</tr>
<tr>
<td>Remuneration benefits</td>
<td>0.029</td>
<td>0.076</td>
<td>0.643</td>
<td>0.043</td>
<td>0.265</td>
<td>0.163</td>
<td>0.181</td>
</tr>
<tr>
<td>The proximity of company</td>
<td>0.030</td>
<td>0.032</td>
<td>0.724</td>
<td>0.055</td>
<td>-0.042</td>
<td>0.037</td>
<td>-0.041</td>
</tr>
<tr>
<td>Name of factor</td>
<td>Leader</td>
<td>Expat</td>
<td>Certainty</td>
<td>Independence</td>
<td>Prestige</td>
<td>Development</td>
<td>Patriot</td>
</tr>
</tbody>
</table>

Source: Authors processing

The factor analysis grouped responses of surveyed graduates from selected university into seven main factors. Respondents are seeking their preferred employer in different ways, which are described by the factors listed in Tab. 1. They are either interested in being part of company decision making process, creating goals, experience challenging work and projects, and development and thus being in a leadership position (factor 1; Leader), or they are interested mainly in the possibility to work abroad (factor 2; Expat). Thirdly, group of respondents orient themselves in searching for employment mainly based on high of offered salary and benefits and geographical proximity and accessibility of job position or company. Those job applicants does not any other specifics than remuneration and thus security (factor 3; Certainty). Fourthly, group of graduates orient themselves based on their personal preferences and independence of their work – they need to like the work or job (factor 4; Independence). Fifthly, graduates are looking for sound name of their employer and wishing to work for stable, long established company with tradition, they prefer if their employer is listed within TOP companies or top employers and the name and brand is well recognized. Those job applicants expects the best from the brand ranking and looking for prestigious company (factor 5; Prestige). Sixth way of graduates’ orientation is their search for employer where they can be further developed and where they expect or have possibility for career growth (factor 6; Development). Finally, respondents when looking for preferred employer are looking for typical Czech/national company; together with socially responsible orientation of an company. Those job applicants can be thus attracted to ads focusing on development of values in the national society (factor 7; Patriot).
It is possible to summarize that respondent graduates are not focusing only on remuneration or top employers but also based on the possibility to be part of the decision-making process in a company, or to have a possibility for development, to work abroad or to work independently. Those are the main ways how companies can promote their job positions focusing on graduates.

4 Discussion

The attractiveness of employer is a key issue for organizations, as its efficiency is affecting further functioning of the organization because of its ability to reach and attract suitable candidates and transform them into employees. The primary data collection demonstrated the significance of all factors examined in accordance with the authors' findings in the theoretical basis of the article (e.g. Armstrong, 2007, p.347, Maxwell, Knox, 2009; Tüzünger and Yuksel, 2009; Donia, Tetraut Tirsly, 2016; Snydrova, 2017; Kumar, 2018). However, the subsequent factor analysis identified the main groups of factors with regard to the different focus of the candidates: Leader, Expat, Certainty, Independence, Prestige, Development and Patriot. Within the framework of the factor analysis, it was found that the most important factor for a group of factors called Expat is the possibility to work outside the country. This is in line with what Doherty, Richardson and Thorn (2013) who say that the most crucial aspect of employer selection is to gain experience and career opportunities for a particular type of jobseeker. Ceric and Crawford (2016) confirm the same. Security is another important factor that plays a role in finding an employer, job seekers expect the employer to provide them with the appropriate financial background and benefits, and to be within driving distance, but at the same time being able to pay them wages and not to be giving them notice without logical reason (Malik, Subramanian, 2012); this is often the primary focus for older age groups (Freese, 2007) while the other identified main factor (within group of factors) named Development is mainly preferred by younger applicants (Sibson, 2001; Šnýdrová, 2014). Xie, Bagozzi and Meland (2015) report that employer's reputation and prestige play a significant role in the recruitment process. This is in line with the results of primary research, which showed that the identified main factor Prestige focuses primarily on the employer's reputation, and employer placement in various polls.

A group of factors known as the Leader hides expectations, especially for young, ambitious candidates from the Millennium generation, i.e. the possibility of creatinality, decision-making, which is consistent with Berthon et al. (2005), Jones, Willness, MacNeil (2009), Graeme,ollah, Grigg (2011), Rupp et al. (2013), Jones, Willness, Madey (2014), Donia, Tetraut Tirsly (2016). Another major factor has been identified as Independence, which primarily associates expectations of interest and labor intensity. This finding is in line with Aziri's research, which highlights the importance of work. The last factor in Patriot emphasizes the relationship between employment in the Czech organization and social responsibility. This area has not been adequately described in the literature yet and is a new approach that can be addressed both in terms of research and theory, but also in the practical focus of employers on this group of job seekers.
Conclusion

The article focused on analysis of factors influencing the choice of employer from the perspective of graduates of the University of Economics and Management. The research included graduates who completed the educational process in 2012-2017 and already have experience with finding an employer and selection process.

In line with research by Rampl (2014), the results show that if an organization wants to become competitive on the market and an attractive employer for potential candidates and existing employees, it is necessary to respond to their demands and expectations. The results of primary research show that all factors mentioned in the theoretical part of the article are important in terms of employer attractiveness. However, the significance of individual factors varies according to the applicant's focus. Thus it can be stated that if organizations want to become a preferred employer in general, they should focus on the above-mentioned factors (prestige of the organization, its stability, placement in Top Employer research, possibility to work abroad or possibility to work in a purely Czech company, possibility of career growth, possibility of further development, opportunity to participate in corporate goals, opportunity to participate in decision-making and leadership, opportunity to apply ideas, work autonomy, work environment, work as a challenge, opportunity to work in an ambitious project, wages structure, and proximity of organization.

Based on the factor analysis, 7 groups of factors were identified: Leader, Expat, Security, Independence, Prestige, Development and Patriot. It can be stated that individual groups indicate different types of applicants / employees according to their preference. A group described by factor labelled Leader refers to candidates preferring to participate in decision-making and leadership in organisation and seeking the opportunity to apply their creativity. Those applicants are also interested in participating in projects, and preferring a job that is challenging them. The factor named Expat is a candidate who prefers the opportunity to work abroad. While the Patriot factor refers to candidates preferring to work in a purely Czech company that is also socially responsible. For candidates choosing a group of factors labelled Independence the interest in work tasks and self-reliance is the most important of all respondents within this group. For candidates choosing a group of factors labelled Certainty is the amount of wage / salary, the broadness of benefits and the geographical distance of the company. Factor named Development describes a group of candidates who is looking especially for career growth and the possibility of further development. Finally, a group characterized by factor called Prestige describes type of job seeker expecting an employer to be a prestigious and respected company, a stable established company with a tradition or an organization ranked high in Top Employer ranking.

However, if an organization wants to focus on candidates preferring only one of the identified groups of factors, it is only possible to focus on those areas that have been identified as significant within the group of applicants or employees which the organization prefers.

The limit of this article is that research contained only graduates of one studies business university. The limiting factor may also be the fact that it is a university of economic focus and therefore the preferences of its graduates may be different from
the preferences of graduates of technical, humanities and other fields. The final limit of the article may also be the fact that the completion of the questionnaire was voluntary and therefore the results do not include the opinions of graduates who refused to participate in the research. Despite these limits, it can be assumed that the results of the research carried out can be considered as significant, as the number of respondents is representative sample with respect to the total number of graduates examined within the university for the given period.

Further research can be extended to other universities and also the difference in the preferences of factors important for the selection of the employer according to the specialization of the graduates or the gender and age of the job seekers can be compared.

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References


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DOPADY SYSTÉMU OBCHODOVÁNÍ S EMISNÍMI POVOLENKAMI V ZEMÍCH EU28

IMPACTS OF EMISSION TRADING SYSTEM IN EU28 COUNTRIES

Jarmila Zimmermannová, Vít Pászto, Ondřej Vícha

Abstract: European Union Emission Trading Scheme (EU ETS) was introduced in EU countries in the year 2005. Currently, the EU ETS is in operation for more than a decade; moreover, the European Commission adopted rules for the next 4th trading period in March 2018. The main goal of this article is to evaluate possible environmental impacts of EU ETS, mainly the impact of emission allowance price on the amount of greenhouse gas emissions in the EU28 countries as a whole. For this goal, (geo)visual analysis of spatial data, correlation and regression analysis are used. The results of the analysis show that the EU ETS contributes to the reduction of the amount of greenhouse gas emissions in the EU-28 countries as a whole, due to emission allowances price and period. Nevertheless, the influence of the way of emission allowances distribution is crucial for the desirable environmental impact. The extension of auctioning represents our key recommendation for the EU ETS.

Keywords: EU ETS, Environmental Impact, Carbon Emissions, Economic Indicators, Geovisual Analysis.

JEL Classification: H23, K32, Q58, R12.

Úvod

Evropský systém obchodování s povolenkami na emise skleníkových plynů (European Union Emissions Trading Scheme, dále jen „EU ETS“) je hlavním nástrojem k plnění cílů EU v oblasti ochrany klimatu s cílem podpořit snižování emisí skleníkových plynů nákladově efektivním a ekonomicky účinným způsobem.

Systém EU ETS byl zřízen směrnicí Evropského parlamentu a Rady 2003/87/ES ze dne 13. října 2003 o vytvoření systému pro obchodování s povolenkami na emise skleníkových plynů ve Společenství a o změně směrnice Rady 96/61/ES. V současnosti se jedná o největší obchodní systém pro emise skleníkových plynů na světě. Setkáme se rovněž s označením systému jako „cap-and-trade“, který obecně funguje tak, že stanoví stropy pro celkové emise z odvětví, která produkují velké objemy emisí. V systému EU ETS strop omezuje emise více než 11 000 energeticky náročných podniků v celé EU a zahrnuje zhruba polovinu všech emisí skleníkových plynů. Na evropské úrovni není cílem systému EU ETS pouze snížit emise skleníkových plynů na stanovený strop, ale také nastavit tržní cenu uhlíku a finančně podporit každou tonu ušetřeného CO2ekv. Provozovatelé emisí by tak měli být motivováni k uplatňování nákladově efektivních opatření na snížení emisí, přičemž tržní cena povolenky by měla podporovat investice do nízkouhlíkových technologií.

Klíčovými otázkami v souvislosti se systémem EU ETS a zejména jeho účinností jsou: „Jaký je ve skutečnosti dopad celého systému? Má EU ETS opravdu vliv na emise CO2?“ Na uvedené otázky odpovídá tento článek.

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Hlavním cílem článku je provést vyhodnocení vlivu systému emisních obchodovatelných povolenek EU ETS na množství emisí skleníkových plynů v zemích EU28. Nejprve bude představen systém EU ETS a jeho specifika, včetně legislativního vývoje a vědeckých studií. Jelikož je EU ETS nástroj vztázený ke konkrétnímu území, tj. ohraničuje prostor pro tzv. cap, bude následně provedena geovizuální analýsa s využitím dat Eurostatu. Klíčovou částí je provedení regresní analýzy, která nám umožní nástínit možné souvislosti mezi vývojem emisí CO₂ a vybranými indikátory. Zjištěné výsledky budou diskutovány s ohledem na širší souvislosti a aktuální legislativní změny v oblasti EU ETS.

1 Formulace problematiky

1.1 Historie a současnost systému EU ETS


1.2 Vědecké studie v oblasti EU ETS

U vědeckých studií analyzujících systém EU ETS je důležité rozlišit jednotlivá obchodovací období EU ETS, zejména z důvodu odlišných institucionálních podmínek a pravidel v jednotlivých obdobích. Odlišná pravidla mohou jiné ovlivňovat také environmentální dopad EU ETS (Segura et al., 2018). Studie analyzující první pilotní obchodovací období (2005-2007) a druhé obchodovací období, tzv. Kjótskou fázi EU ETS (2008–2012) se zaměřovaly zejména na analýzu tržních cen obchodovatelných emisních povolenek, jejich dopady na chování stakeholderů na trhu s emisními povolenkami i na chování samotných znečišťovatelů. Problematicce modelování a predikcí cen obchodovatelných emisních povolenek se věnovali například studie Li et al.(2011), García-Martos et al. (2013), Lecuyer a Quirion (2013), další studie analyzovaly incidenci variantních cen uhlíku (Grainger a Kolstad, 2010), zkoumaly faktory ovlivňující cenu povolenky (Aatola et al., 2013; Lutz et al., 2013), mezní náklady energeticky náročných odvětví (Chernyavska a Gulli, 2008), vliv obchodování s emisemi na výrobce elektřiny (Falbo et al., 2013) nebo inovační dopady systému EU ETS (Rogge et al., 2011; Rentizelas et al., 2012).


Z hlediska dopadů EU ETS na environmentální parametry a chování podniků jsou zajímavé empirické studie analyzující druhé obchodovací období založené na oficiálních datech, dotazníkových šetřeních a interview. Studie se zaměřují na dopady EU ETS na environmentální inovace a investice v Německu (Rogge et al., 2011), ve Švédsku (Lofgren et al., 2014) nebo v Evropské unii jako celku (Feng et al., 2012; Lovell et al., 2013; Martin et al., 2014).

Vědecké studie zkoumající třetí obchodovací fázi se vyznačují v daleko větší míře analýzou vlivů zásahů regulátora na fungování systému EU ETS a jeho parametry. Studie francouzských vědců (Creti a Jöets, 2017) se zaměřuje na cenové bubliny, spekulace a analýzu vývoj ceny emisní povolenky EUA na burze. Autoři dospěli k závěru, že největší výkyvy v ceně jsou důsledkem oznámení změn v politice ochrany klímatu nebo energetické politice. Obdobným tématem se zabývá i studie Fan et al.


Pokud se zaměříme na environmentální účinnost EU ETS, můžeme najít převážně ex post analýzy chování firem a změn jejich environmentálních parametrů v důsledku EU ETS, ať už jsou to výše zmíněné studie zaměřené na environmentální inovace a investice (Rogge et al., 2011; Lofgren et al., 2014; Feng et al., 2012; Lovell et al., 2013; Martin et al., 2014; Zimmermannová, 2015) nebo studie zkoumající vztah mezi environmentálními a ekonomickými parametry firem v jednotlivých obchodovacích obdobích EU ETS (Marin et al., 2018; Segura et al., 2018). V oblasti ex post hodnocení dopadů systému EU ETS na celkové množství emisí skleníkových plynů v zemích EU28 se autorům nepodařilo v době psaní článku najít relevantní studie, zahrnující všechna obchodovací období. To je také hlavním důvodem pro provedení následující analýzy.

2 Metody

2.1 Data

Za účelem provedení geovizuální analýzy byla použita data z databáze Eurostat (Eurostat, 2018), konkrétně vývoj emisí CO₂ celkem. Jedná se o roční data dostupné za země EU28, a to časové řady za období 1995–2016. Z databáze Eurostatu, respektive z její podřízené složky pro správu geografických dat (Geographic Information System of the Commission, zkráceně GISC0), byla také použita geografická data, konkrétně se jednalo o referenční prostorová data administrativních jednotek států EU k roku 2014.

Za účelem provedení regresní analýzy byla dále použita data z burzy EEX (2019), konkrétně vývoj ceny obchodovatelných emisních povolenek EUA prodaných v aukci, kdy aukční ceny jsou k dispozici třikrát týdně (EEX, 2019). Z těchto cen byl vypočítán pro účely analýzy roční průměr; v rámci analýzy byly nejprve použity i průměrné ceny povolenek za první a druhé obchodovací období, nicméně vzhledem k velké volatilitě nebyly tyto ceny vhodné pro regresní analýzu. Pro účely analýzy byla použita rovněž data od českého Operátora trhu s elektřinou (OTE, 018), konkrétně průměrná roční

2.2 Metody


Následně byl prostřednictvím regresní analýzy zjištěn možný vliv systému EU ETS na snížení emisí skleníkových plynů ve státech EU28 jako celku. Za tímto účelem byla použita metoda lineární regrese a vytvořeny samostatné regresní modely. Rovnice obecného regresního modelu má tvar:

\[ Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + u \] (1)

V této rovnici jsou parametry \( \beta_0...\beta_5 \) regresní koeficienty, které vyjadřují vliv nezávislé proměnné na závislou proměnnou. Závislou proměnnou \( Y \) jsou emise skleníkových plynů v zemích EU28 vyjádřené v milionech tun ekvivalentu CO₂. Parametr \( u \) představuje náhodnou složku modelu. Nezávislé proměnné v regresní rovnici jsou následující: \( X_1 \) – průměrná roční cena povolenky EUA v aukci, \( X_2 \) – roční HDP v zemích EU28 v běžných cenách, \( X_3 \) – roční objem investic v zemích EU28 v běžných cenách, \( X_4 \) – průměrná roční cena povolenky EUA na všech trzích (OTE, 2018), \( X_5 \) – čas. Jednotlivé proměnné jsou popsány v následující Tab. 1.

<table>
<thead>
<tr>
<th>Tab. 1: Proměnné v regresním modelu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proměnná</td>
</tr>
<tr>
<td>Emise skleníkových plynů t/CO₂ ekv.</td>
</tr>
<tr>
<td>Průměrná roční cena EUA v aukci, běžné ceny EUR/povolenka</td>
</tr>
<tr>
<td>Roční HDP v zemích EU28, běžné ceny mil. EUR</td>
</tr>
<tr>
<td>Roční objem investic v zemích EU28, běžné ceny mil. EUR</td>
</tr>
<tr>
<td>Průměrná roční cena EUA na všech trzích, běžné ceny EUR/povolenka</td>
</tr>
<tr>
<td>Čas 1 rok</td>
</tr>
</tbody>
</table>

Zdroj: vlastní zpracování
Jednotlivé vysvětlující proměnné byly zvoleny z důvodu teoretického/očekávaného dopadu na množství emisí skleníkových plynů. Průměrná roční cena emisní povolenky EUA v aukci (klíčová vysvětlující proměnná) byla zvolena na základě teoretického konceptu environmentálních ekonomů (více např. Kolstad, 2010), kde zvyšující se cena obchodovatelné emisní povolenky působí adekvátní snížení emisí skleníkových plynů. Jako kontrolní vysvětlující proměnná potom byla zvolena průměrná cena emisní povolenky na všech trzích, která vychází ze stejného teoretického konceptu a očekává se u ní rovněž negativní vliv. S ohledem na přidělování emisních povolenek v prvních fázích obchodování zdarma (tzv. grandfathering) lze očekávat slabší motivační efekt než v případě, kdy si firmy povolenky kupují v aukci.

Proměnná roční HDP v zemích EU28 vyjadřuje ekonomický vývoj zemí EU28 a období ekonomické expanze, stagnace či recese. Ekonomický růst/stagnace/pokles je na základě teorie provázen odpovídajícím růstem/stagnací/poklesem produkce a souvisejícím množstvím emisí znečišťujících látek do ovzduší (Samuelson a Nordhaus, 2010; Kolstad, 2011).


V souvislosti s hlavním cílem výzkumu, uvedeným výše, je stanovena výzkumná otázka „Systém EU ETS (prostřednictvím ceny povolenky EUA v aukci) má vliv na množství emisí skleníkových plynů v EU28, tj. tento ekonomický nástroj je environmentálně účinný v EU28 jako celku“.

3 Rozbor problému
3.1 Geovizuální analýza prostorových dat


Otázku tedy je, zda pozorovaný pokles emisí CO₂ souvisí se snižováním dopadu ekonomiky na životní prostředí, zaváděním šetrnějších technologií a energetickými úsporami či zda je spíše způsoben poklesem investiční aktivity a snižováním produkce ve sledovaných zemích. K alespoň částečnému objasnění tohoto problému nám může pomoci regresní analýza a regresní model pro země EU28.

3.2 Korelační a regresní analýza EU28

Tab. 2 obsahuje popisnou statistiku k regresním modelům. U proměnné EUA aukce byla v období, kdy aukce ještě neprobíhaly, použita nula vyjadřující nulovou cenu v aukci. Rovněž u proměnné EUA průměr byla v období, kdy ještě nebyl zaveden systém EU ETS, použita nula vyjadřující nulovou cenu tuny uhlíku na burze.
### Tab. 2: Popisná statistika

<table>
<thead>
<tr>
<th>Proměnná</th>
<th>Max</th>
<th>Min</th>
<th>Průměr</th>
<th>Medián</th>
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</thead>
<tbody>
<tr>
<td>Emise CO₂ (tuny)</td>
<td>5096987,48</td>
<td>3970581,22</td>
<td>4642231,33</td>
<td>4853406,98</td>
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<tr>
<td>EUA aukce (EUR)</td>
<td>7,61</td>
<td>4,40</td>
<td>1,05</td>
<td>0</td>
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<tr>
<td>HDP (mil. EUR)</td>
<td>14855223</td>
<td>7346248,80</td>
<td>11427945,30</td>
<td>11923366,20</td>
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<tr>
<td>Investice (mil. EUR)</td>
<td>3023653,40</td>
<td>1586410,20</td>
<td>2410834,67</td>
<td>2464648,85</td>
</tr>
<tr>
<td>EUA průměr (Kč)</td>
<td>613,46</td>
<td>41,64</td>
<td>156,48</td>
<td>80,14</td>
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**Zdroj:** Eurostat, 2018; EEX, 2019; OTE, 2018; vlastní zpracování


### Tab. 3: Korelační analýza

<table>
<thead>
<tr>
<th>Emise</th>
<th>Aukce</th>
<th>HDP</th>
<th>Investice</th>
<th>EUA vše</th>
<th>Čas</th>
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<td>Emise</td>
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<td>HDP</td>
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<td>EUA vše</td>
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<td>0,57</td>
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<td>Čas</td>
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<td>0,65</td>
<td>0,98</td>
<td>0,89</td>
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</table>

**Zdroj:** vlastní zpracování


### Tab. 4: Regresní analýza EU28

<table>
<thead>
<tr>
<th></th>
<th></th>
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<td>0,01</td>
<td>-64454,79</td>
<td>0,04</td>
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<td>HDP</td>
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<td>414949650,80</td>
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<td>4404171,39</td>
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<td>292705036,30</td>
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<td>R2</td>
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<td>0,98</td>
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<tr>
<td>N</td>
<td>22</td>
<td>9</td>
<td></td>
<td></td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Význam.F</td>
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<td>0,01</td>
<td></td>
<td></td>
<td>0,00</td>
<td></td>
</tr>
<tr>
<td>DW</td>
<td>1,69</td>
<td>1,51</td>
<td></td>
<td></td>
<td>1,13</td>
<td></td>
</tr>
<tr>
<td>dL; dU</td>
<td>0,67;1,69</td>
<td>0,55;0,99</td>
<td></td>
<td></td>
<td>0,83;1,40</td>
<td></td>
</tr>
</tbody>
</table>

**Zdroj:** vlastní zpracování; hladina významnosti 0,05; DW – hodnota Durbin-Watsonova testu; dL,dU hranice u Durbin-Watsonova testu
Z hlediska statistické významnosti jsou všechny testované modely statisticky významné, u prvního MOD1 – VŠE ovšem nejsou statisticky významné všechy proměnné. Hodnota Durbin-Watsonova testu na autokorelací 1,69 odpovídá hraniční hodnotě pro zamítnutí hypotézy o autokorelací. Model MOD3 – EKONOM vychází jako statisticky významný včetně jednotlivých proměnných a jejich indikátorů. Problematický se zde ovšem jeví test autokorelace (Durbin-Watson), kde hodnota 1,13 ještě spadá do oblasti s nejednoznačným rozhodnutím (interval 0,83 – 1,40). Poslední z modelů se zaměřuje pouze na samotné emisní povolenky prodávané v aukci a jejich vliv na emise CO₂. Tento model pracuje s kratším časovým obdobím zahrnujícím druhu a třetí fázi EU ETS (od roku 2008). Je zřejmé, že model je statisticky významný a hodnota Durbin-Watsonova testu prokázala, že zde není autokorelace.

Na základě výsledků regresní analýzy lze konstatovat, že v zemích EU28 systém EU ETS přispívá ke snížení emisí skleníkových plynů. Z analýzy ovšem vyplývá, že vliv různých způsobů obchodování povolenek má různý vliv na snižování emisí. U emisních povolenek, které byly nejprve přidělovány zdarma a následně obchodovány, není možné potvrdit jejich environmentální dopad. Naopak u emisních povolenek prodávaných v aukci je jejich vliv na znečišťovatele daleko výraznější, a to jak samostatně (model MOD2 - VŠE), tak v kombinaci s vývojem ekonomiky a časem (MOD3 - EKONOM).

4 Diskuze

Pokud se zaměříme na vyhodnocení dosažených výsledků s ohledem na výzkumnou otázkou „Systém EU ETS (prostřednictvím ceny povolenky EUA v aukci) má vliv na množství emisí skleníkových plynů v EU28, tj. tento ekonomický nástroj je environmentálně účinný v EU28 jako celku“, můžeme konstatovat, že cena emisní povolenky EUA v aukci je environmentálně účinná. Množství emisí skleníkových plynů v zemích EU28 ve zvoleném regresním modelu ovlivňují negativně konkrétně dvě proměnné - cena obchodovatelné emisní povolenky EUA v aukci a čas (zahrnující období EU ETS). Proměnná HDP ovlivňuje sledované množství emisí pozitivně. Ostatní ekonomické indikátory nejsou v rámci regresního modelu statisticky významné.


V regresních modelech se také projevil jako významný faktor čas, což může souviset s celkovým tlakem společnosti na environmentální parametry firem a environmentální inovace; z pohledu nástrojů hospodářské politiky je systém EU ETS nejen ekonomickým nástrojem spojeným s emisním obchodováním, ale rovněž
představuje přísnou legislativu – administrativní nástroj, který se v čase rovněž „přiostřuje“, což vyplývá i z nově schválené legislativy ke čtvrtému období systému EU ETS. Směrnice 2018/410/EU pro čtvrtou fázi EU ETS (2021-2030) se soustředí zejména na zvýšení podílu povolenek dražených v aukci (57 %) a přísnější pravidla pro přidělování bezplatných povolenek.

S ohledem na výsledky analýzy prezentované v tomto článku doporučují autoři tvůrčím hospodářské politiky prosazovat další zvýšení množství emisních povolenek prodávaných v aukci, které je žádoucí, pokud má mít systém EU ETS výraznější environmentální dopad.

Závěr


V souvislosti s dalším obchodovacím obdobím EU ETS bude potřeba v průběhu roku 2021 vyhodnotit třetí obdobová období 2013–2020 a jeho ekonomickou a environmentální účinnost. Předmětem dalšího výzkumu v oblasti obchodovatelných emisních povolenek by proto, s ohledem na prostorový charakter tohoto ekonomického nástroje, měla být komplexnější prostorová analýza zaměřená na možné rozdílné působení EU ETS v jednotlivých členských zemích a související prostorová analýza nákladů na zamezení.

Poděkování

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