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## **Utilization of Statistical Methods in the Evaluation of the Business Environment of Slovakia<sup>3</sup>**

### INTRODUCTION

The pursuit of prosperity and economic development is important for all nations of the world, so national effort to establish a secure market access for domestic and foreign subjects is considered as one of the main economic objectives [Cihelková, 2008]. A prerequisite for optimizing the business environment is knowledge of its state and development. The findings obtained are applicable not only for designing changes in legislation, but also for the preparation of supportive business environment programs when the market fails [*Competitiveness Strategy SR...*, ([http](#))].

The main objective of this paper is to provide a more comprehensive view of the status and development of the business environment (BE) in Slovakia from 2001 to 2013 and its impact on the business sector and the economic potential of Slovak regions using 4 methods of statistical analysis.

This objective corresponds with the structure of the research part of the paper: knowledge of the state and the development of BE in Slovakia is analyzed using *index analysis and time series analysis* (2.1); to identify the strengths and weaknesses of the business environment (BE) an *index analysis* is applied (2.2) *via* 3

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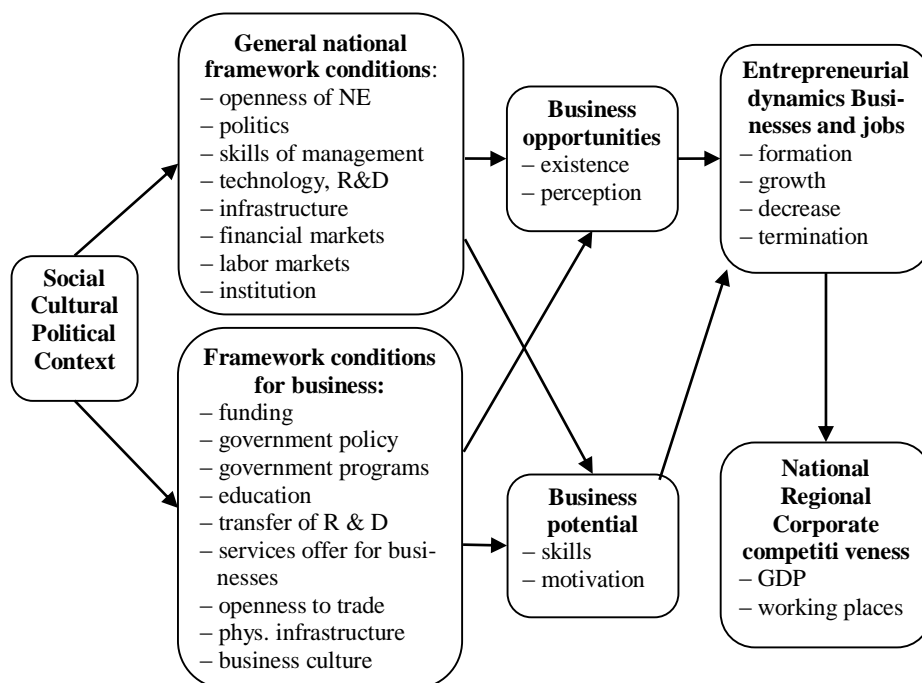
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*international indexes* (DBI, GCI, EFI); *regression and correlation analysis* (2.3) examines the relationship between business conditions (BE) and the status and development of the business sector (number of businesses); *cluster analysis* (2.4) is used in classifying the level of BE quality and growth potential of the regions of Slovakia.

## BUSINESS ENVIRONMENT

Based on the analysis, synthesis and generalization of the views of many domestic and foreign authors investigating this issue, business environment (BE) can be defined as a multidimensional socio-economic category, consisting of (Fig. 1):



**Figure 1. Business environment as a determinant of competitiveness**

Source: Author's proposition based on [Reynold et al., 2005 In: Lukeš–Jakl, 2006].

### A: Set of elements:

I. *organizations and institutions* = communal, national, international management and support business environment institutions; household; unions; [Rue a Holland, 1986; Johnson and Scholes, 2000; Eschenbach, 2000; Hill and Jones, 2006.]

## II. *factors / environmental conditions:*

- *Factors of internal environment:* products and services; technical equipment; logistics arrangement; supplies; finance; organizational structure; distribution channels; data files; incentive instruments; conduct, behaviour, performance of people [Veber, 2009]; technical and technological development; distribution processes [Slávik, 2005]; research and development base [Kupkovič a kol., 2002]; marketing [Juričková, 2006]; ability to provide services for problem solutions [Kita, 2002]; top management [Veber, 2009]; potential of executive capacity [Eschenbach, 2000]
- *Factors of external environment:*
  - a) microenvironment = specific elements that directly affect the operation of the business entity [Kupkovič, 2001; Veber, 2009; Baláž a kol., 2010];
  - b) macro environment: includes general factors, trends and influences: political, economic, social, technological, environmental, legal, infrastructural, cultural, demographic international conditions [Rue and Holland, 1986; Eschenbach, 2000; Johnson and Scholes, 2000; Kupkovič, 2001; Kováč, 2003; Hejda, 2003; Hill and Jones, 2006; Kassay, 2006; Baláž a kol., 2010;], instruments of monetary, fiscal, environmental, intervention policy, science and technology progress, changes in supply and demand [Kassay, 2008].

### **B: Relationship between the elements**

Knowledge of the multidimensional phenomenon of the business environment is challenging but vital for success of business.

## STATISTICAL ANALYSIS OF SLOVAK BUSINESS ENVIRONMENT

For measurement and evaluation of the quality and thus the competitiveness of business environment various, techniques are used especially statistical methods. Through the use of methods of statistical analysis we try to understand the *mechanics* of the studied systems *behaviour* (processes, events) and to *understand and know the laws of their development* [Souček, 2007].

The results of the analysis are a potential source of information for creating corporate, regional and national development strategies and programs.

### **Index analysis and time series analysis**

Different indices are used to measure the quality of the business environment. These indices use different information and have different structures. A selected index can be unique – original or can be derived from existing surveys. Important for the measurement of the business environment with respect to its quality are: criteria of the index, the nature of the data and data sources [Jenčíková, 2007, p. 135].

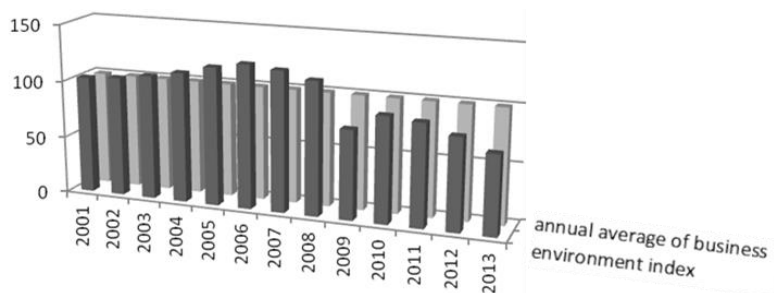
We will use *the business environment index* (BEI) established by Business Alliance of Slovakia (PAS) for the analysis of the past business environment development in Slovakia. This index has three evaluation categories (table 1). Each of the 33 items of the BEI has its own weight, so the index represents a weighted average of changes in individual items. Base period for calculating the BEI was July 1<sup>st</sup> 2001 with the benchmark index of 100 points.

**Table 1. Evaluation Categories of business environment index**

The first category	The second category	The third category
12 items monitor the development of legislative and regulatory environment in Slovakia	11 items summarize the impact of other macroeconomic factors external on business	10 items takes into account the contribution of enterprises to the development of BUSINESS ENVIRONMENT
E.g.: Com. legislation, legislation on taxes, levies and investment, law enforcement, market regulation, and so on.	E.g.: price stability, exchange rate movements, fiscal policy, infrastructure level	

Source: <http://www.profini.sk/hodnotenie-podnikatelskeho-prostredia-index-business-environment>.

Fig. 2 shows the time series scoring of BEI in Slovakia from 2001 to 2013. Time series enable us to see the historical development and on this basis to identify the cause of a positive or negative development [Hindls, 2006].



**Figure 2. Development of annual average of business environment index in Slovak Republic 2001–2013.**

Source: self-processed.

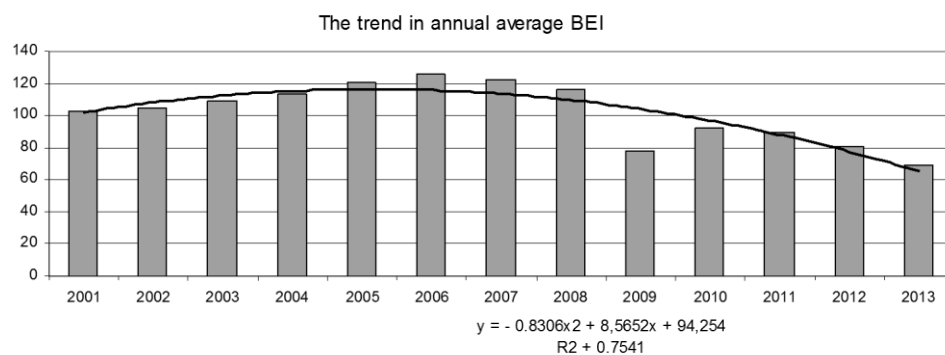
Business conditions between 2001 and 2006 improved. The break-even period when business environment fell below 100 points, are years 2008–2009. In 2010, there was a slight improvement. Since 2008 business conditions are worse than they were in 2001. *Annual changes* in quality of Slovak business environment are quantified by basic statistical characteristics of the business environment time series in table 2.

**Table 2. Statistical characteristics  
of the business environment index time series in 2001–2013**

business environment of slovakia	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
average	102.8	104.7	108.6	113.6	120.8	126	123	116	78	92.2	89.4	80.5	69.3
first-order differential	x	2.0	3.9	5.0	7.2	4.8	-2.9	-6.3	-38	14.2	-2.8	-8.9	11.2
second-order differential	x	x	1.9	1.1	2.2	-2.4	-7.7	-3.4	-32	52.6	-17	-6.1	-2.3
chain indices %	x	101.9	103.7	104.6	106.3	104	0.98	0.95	0.67	1.18	0.97	0.90	0.86
basic indices %	x	101.9	105.7	110.6	117.6	122	0.98	0.93	0.62	0.73	0.71	0.64	0.55

Source: self-processed.

Average annual absolute decline of business environment index was  $-0.76$  points per year. The business environment index for 13 years fell to 55% of the baseline. The future development trend of the business environment index ( $R^2=75,41\%$ ) is best described by the polynomial function, it means that business environment will continue to have an oscillating character (fig. 3).



**Figure 3. The development trend of business environment index  
(annual average) in Slovakia**

Source: self-processed.

### Index analysis using international indices

To evaluate the strengths and weaknesses of business environment in the Slovak Republic (SR) we will use three international indices (Table 3). In the world there are many international organizations and institutions concerned with measuring and evaluating the success of both businesses and entire countries according to their competitiveness, as well as measuring quality and competitive capabilities

of their business environment, for which multi-criteria evaluations are used [Kuzmišin a kol., 2008].

**Table 3. Summary of selected business environment international evaluation indices**

Institution	Index	Areas of evaluation
World Bank (WB)	DBI – Doing business index focuses on business and produces an picture, about the conditions in the country for business. The index is the result of different criteria and indicators on the overall functioning of business connected with starting a business, property registration, termination of business and other aspects related to business.	10 areas
World Economies Forum (WEF) Global Competitiveness Report	GCI – Global competitiveness index creates a complete picture of the countries' business environment. It combines data taken from WB, WHO (World Health Organization), WTO (World Trade Organization) and other organizations, and data generated by WF (World Forum) combined to the final evaluation index of the country. The variables in this index are both objective and subjective.	12 areas/pillars of evaluation
Heritage Foundation	EFI – Economy Freedom index	10 areas

Source: self-processed based on: <http://www.doingbusiness.org>; [www.weforum.org](http://www.weforum.org); [www.HeritageFoundation.org](http://www.HeritageFoundation.org).

Changes in the rank of Slovakia in the context of business environment's quality in 2008–2012, between evaluated countries of the world according to the three international indices, are shown in Table 4.

**Table 4. Location of Slovakia in the evaluation of business environment according to international indices**

Rank of SR	2008	2009	2010	2011	2012	Change of rank 2012 and 2008
DBI	32	36	42	41	48	-16
EFI	70	69,4	69,7	69,5	67	-3
GCI	46	47	60	69	71	-28

Source: self-processed based on: <http://www.doingbusiness.org>; [www.weforum.org](http://www.weforum.org); [www.HeritageFoundation.org](http://www.HeritageFoundation.org).

Overall, Slovakia's position in the rankings of world institutions has decreased, which means that the quality and competitiveness of Slovakia's business environment deteriorated for five years.

Table 5 shows the 3 best rated and 3 worst rated areas based on the analysis of the investigated areas (pillars) of the individual international indices of business environment.

**Table 5. Best and worst rated areas of business environment in 2008–2012**

		DB	EFI	GCI
best rated	11	registration of real property	(international) trade freedom	technological readiness
	22	access to loans	tax freedom (tax burden)	development of financial markets
	23	business closure	monetary freedom (stability)	health and primary education
	4	labour law	financial freedom	goods market efficiency
worst rated	11	taxation of companies	level of corruption	institutions (legislative, judiciary, public administration, law enforcement, corruption and clientelism)
	22	investor protection	proprietary rights	innovations
	33	cross-border (international) trading	size of government intervention (government spending)	infrastructure
	4	business start	freedom to work	market size

Source: self-processed based on: <http://www.doingbusiness.org>; [www.weforum.org](http://www.weforum.org); [www.Heritage Foundation.org](http://www.HeritageFoundation.org).

Although the business environment's areas studied and evaluated by individual international indices are not clearly identical, there can be found common/disturbing areas, although they are not named the same in any of the indices, but the content is more or less identical or linked, allowing some comparison of business environment's quality.

*The strongest areas of Slovakia's business environment* can be identified as:

1. financial area (access to loans financing, financial freedom, development of financial markets),
2. area (international) of trade (freedom of trade, Slovak openness towards foreign owned firms, low tariff barriers, legislation promoting inflow of foreign investment),
3. technological readiness (maturity of investors coming into the SR).

*The weakest areas of Slovak's business environment* under international assessments are:

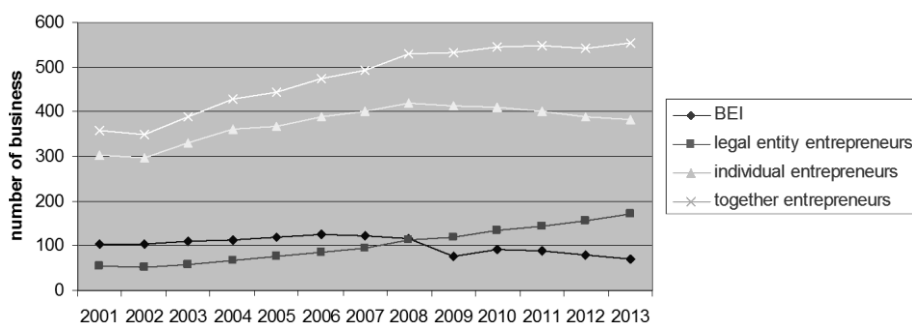
1. institutional area (poor law enforcement, high rates of clientelism, low independence of the judiciary, lack of transparency in the handling of public money, corruption, high government deficits, inefficient structure of public spending, low public confidence in politicians, high administrative burden on business),
2. investor protection (insufficient protection of property rights),
3. size of government interference (tax burden, inefficient government spending).

Deterioration of the quality of the business environment and competitiveness of Slovakia is due to persistent barriers (weaknesses) of business, which all governments, despite statements declared, fail in practice to remove. Necessary comprehensive reforms that would radically improve the business environment have not yet been put into practice nor have not even been processed.

### Regression and correlation analysis

Based on statistical analysis (regression analysis and correlation analysis – RACA) we want to determine *whether there is any dependency between quality of business environment index (cause) and the number of businesses (the result)*, and to quantify this relationship.

The statistical character (business) will be examined in the structure: individual entrepreneurs (FO=IE), trading companies (PO=TC), businesses IE and TC together. The preliminary tool for the examination of dependency is the graphical representation of the relationship between the statistical characteristics studied (fig. 4).

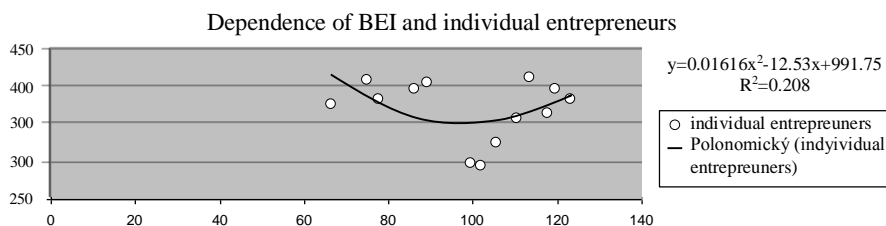


**Figure 4. Development of business environment index and the number of businesses in Slovakia 2001–2013**

Source: self-processed based on [www.PAS.org](http://www.PAS.org), [statistics.sk](http://statistics.sk).

The most appropriate mathematical model that describes the relationship between the dependent variable (number of enterprises) and changes in the independent variable (BEI) was found to be a polynomial function (fig. 5, 6, 7).

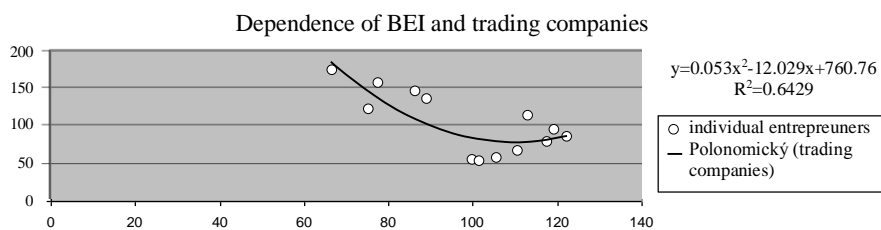
Table 6 quantifies the results of the Pearson correlation coefficient analysis (tightness/strength dependence) as well as the explanatory power of tested dependency expressed by a polynomial function (coefficient of determination  $R^2$ ).



**Figure 5. Dependence of BEI and individual business in thousands**

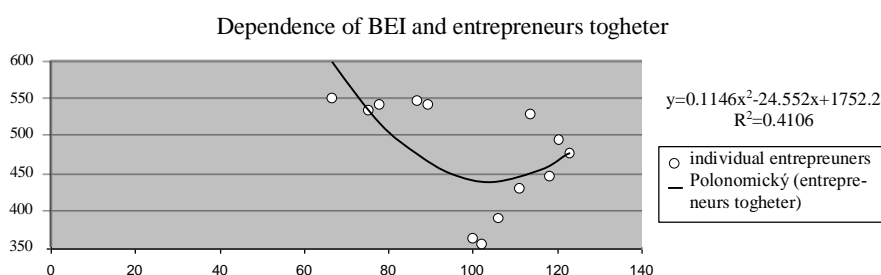
Source: self-processed based on [www.PAS.org](http://www.PAS.org), [statistics.sk](http://statistics.sk).





**Figure 6. Dependence of business environment index and trading companies**

Source: self-processed based on [www.PAS.org](http://www.PAS.org), [statistics.sk](http://statistics.sk).



**Figure 7. Dependence of business environment index and entrepreneurs together in thousands in the Slovak Republic in 2001–2013**

Source: self-processed based on [www.PAS.org](http://www.PAS.org), [statistics.sk](http://statistics.sk).

**Table 6. Results of correlation analysis dependency of business environment index and number of business subjects**

	Individual (businesses) entrepreneurs	Trading companies	Individual and Trading companies together
Pears. coefficient	-0,17402	-0,71512	-0,48085
R <sup>2</sup>	0,208 (20,8 %)	0,6429 (64,29 %)	0,4106 (41,06 %)

Source: self-processed based on [www.PAS.org](http://www.PAS.org), [statistics.sk](http://statistics.sk).

No statistical dependence was detected between the number of individual entrepreneurs and the business environment index. Between the number of trading companies and business environment index it is moderately tight and between the total number of businesses and business environment index there is moderate tight power dependence. Ironic is finding that the decline in quality of business environment (worsening business conditions) increases the number of business subjects in Slovakia (see fig. 4).

### Cluster analysis

One of the conclusions of Porter [2000, p. 15–34] is that clusters have the potential to affect competition in three ways: a) increasing the productivity of firms within the cluster; b) innovation support and c) attracting of new companies.

The underlying source of the business environment's quality analysis as a base of clustering are the results of the project *Competitive regions 21*, which was done by Enterprise Agency of Slovakia (PAS) in 2011. The business environment quality of Slovak's 79 NUTS IV regions was assessed through 106 indicators of the business environment, which are used by renowned international institutions to assess the competitiveness of countries on a scale of 1 to 6. This was used for stratification (division) of the 79 districts into a certain number of clusters (groups) in 4 sub-indexes with weights:

- sub index I: *economic activity* (31%),
- sub index II: *public administration and legislation* (15%),
- sub index III: *technology and infrastructure* (23%),
- sub index IV: *education and human resources* (31%).

The main method for the evaluation of the competitiveness of the business environment of 79 Slovak NUTS IV regions is *cluster analysis*. The resulting values of sub indices are standardized before processing so that the average value of the individual sub-indices are equal to 0 and standard deviation is equal to 1. The mathematical formulation of cluster analysis as a grouping of objects is [Stankovičová, Vojtková, 2007]:

$$X_i \text{ (} i = 1, 2, \dots, n \text{) into clusters } C_1, C_2, \dots, C_q \text{ (} 2 < q < n \text{) (1)}$$

K-means method [Hartigan, Wong, 1979, p. 100–108] divided 79 Slovak districts into 5 clusters based on the analysed sub-indices of business environment's quality, their average values and standard deviations are reported in table 7, where the generated clusters are also ranked and the number of Slovakian districts within each cluster enumerated.

**Table 7. Basic statistical characteristics of the 4 sub-indices of business environment quality for k=5 clusters**

Economic activity	Average			Rank of clusters	Descr. of cluster and number of districts	Standard deviation			
	Government and legislative	Technologies and infrastructure	Education and human resource			Economic activity	Government and legislative	Technologies and infrastructure	Education and human resources
3,5633	3,3211	3,2511	3,5889	III.	Cluster 1 (18)	0,2073	0,1310	0,2861	0,2022
3,1824	3,4595	2,9281	3,2319	IV.	Cluster 2 (21)	0,1396	0,1400	0,1846	0,1387
4,5167	3,0983	4,3367	4,3767	I.	Cluster 3 (3)	0,3832	0,0898	0,2247	0,1684
2,7259	3,5647	2,5547	2,8224	V.	Cluster 4 (17)	0,2149	0,2156	0,0,1871	0,1598
3,7776	3,1047	3,7846	3,7641	II.	Cluster 5 (17)	0,1356	0,1432	0,2220	0,2097

Source: self-processed based on: alianciapas.sk.

First place was awarded to *cluster 3*, which achieved the highest values in three business environment sub-indices (4.33 to 4.51). The regions/districts belonging to cluster 3 are among the most developed regions in Slovakia (5 districts

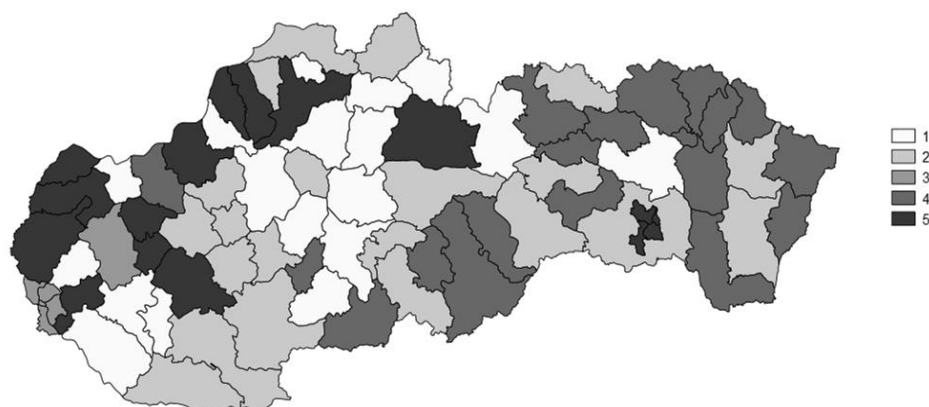
of Bratislava and Trnava Region). Next is *cluster 5* (17 regions) with values of 3 business environment sub-indices around 3.7. These includes counties in western Slovakia, near Žilina, along the northern highway D1 and 4 districts of the city of Košice.

Third place in the maturity of the business environment is *cluster 1* (18 regions) around cities: Bratislava, Žilina, Banská Bystrica, Zvolen, Poprad and Liptovský Mikuláš, whose values of 3 sub-indices range from 3.25 to 3.58. In the fourth place was *cluster 2*, with values of business environment sub-indices ranging from 2.92 to 3.23. This was the most numerous with 21 regions distributed across the whole country. The 17 least developed regions are in *cluster 4*, comprising the districts/regions in the south and east of Slovakia with their business environment sub-indices values in the range of 2.55 to 2.82. The above demonstrates significant regional disparities in quality of business environment between 5 created clusters.

It can be stated that the clusters ranked the highest (*cluster 3 and cluster 5*) are formed by the regions/districts in Slovakia, having developed economic activities. Home of companies such as Volkswagen, PSA Peugeot – Citroen, Kia, U.S. Steel and others, as well as infrastructure (motorway D1) and thus employment. Regions using more local natural resources, whose economic activity is in this type of industry, are listed in clusters rather in the middle and lower levels (*cluster 1, 2, 4*).

Public administration affects the evaluation of the business environment especially via employment created, which is concentrated in the centres of political self-governing regions and districts.

Figure 8 shows 5 created clusters set up of the 79 Slovak regions based on the statistical characteristics of the business environment quality sub-indices.



**Figure 8. Geographical location of Slovak regions belonging to k – 5 clusters**

Source: self-processed.

## CONCLUSIONS AND RECOMMENDATIONS

Based on the index analysis and time series analysis (2.1) it can be said that business conditions measured via IPP were improving from 2001 to 2006 only. From 2008 the conditions for doing business in Slovakia have been worse than they had been in 2001. The level of IPP over the 13 years dropped to 55% of the 2001 baseline. The average annual absolute decline of the business environment was -0.76 points/year within the studied period.

The ranking of Slovakia in world institutions rankings measured by the International Index (GCI, DBI, EFI) decreased, which means that the quality and competitiveness of Slovak's business environment (2.2) deteriorated (table 4). The *weakest areas* of Slovak's business environment based on international evaluation are: 1. Institutional Area (poor law enforcement, high degree of clientelism, low independence of the judiciary, the lack of transparency in the handling of public money, corruption, high government deficits, inefficient structure of public spending, low public confidence to politicians, high administrative burden on business), 2. investor protection (insufficient protection of property rights), 3. the size of government interference (e.g. tax burden, inefficient government spending). A negative fact is that the identified barriers (weaknesses) of business environment are long-term. Despite declarations they failed in practice to be eliminated by any government.

Ironic is discovery, using regression and correlation analysis (2.3), that despite the decline in the quality of the business environment (worsening of conditions for business), the number of businesses in Slovakia is growing (but we understand the impact of other variables that have not been studied).

By identifying growth cluster potential (2.4) of five clusters (from 79) Slovak regions based on business environment quality it can be stated that the clusters located highest (*cluster 3 and cluster 5*): are formed by the regions/districts in Slovakia, which have developed a production culture (the focus on economic activities). They are home to companies such as Volkswagen, PSA Peugeot – Citroen, Kia, U.S. Steel and others. Another growth factor is the infrastructure (motorway D1) and human resources/employment. Overall, the cluster potential of 5 clusters decreases from west to east Slovakia.

A negative conclusion is that the conditions for doing business in Slovakia since 2008 (the outbreak of the global crisis) have deteriorated. A positive finding is that the deterioration of BE has had no significant effect on the motivation of domestic and foreign investors to do business. It was confirmed that it is necessary to maintain and further qualitatively develop the potential of doing business in Slovakia, especially in the area of manufacturing and services, infrastructure and human resource development and employment. The role of the leaders continues to be to improve framework conditions for business. Performance of this task was proven by evaluations of Slovakia during 2014, when "Slovakia ranked 75th place

in the competitiveness of WEF in 2014<sup>7</sup>. Compared to 2013, this ranking increased by 3 positions. This turnaround in the evaluation of Slovakia is mainly due to an increase in macroeconomic stability, decrease of the deficit and the government intensified fighting of tax evasion. [*Výsledky správy o globálnej...*].

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[www.HeritageFoundation.org](http://www.HeritageFoundation.org).

### *Summary*

The paper presents some possibilities for the utilization of basic statistical methods in the evaluation of the business environment in Slovakia: i.e. index analysis to identify strengths and weaknesses of the business environment (BE), time series analysis for the knowledge of state and development of BE, cluster analysis to classify the level of BE quality and growth potential of Slovak regions, regression and correlation analysis to determine dependencies between business conditions and the state of the business sector. A database for statistical processing is created from numerical values of business environment index, respectively from index of regional business environment published by Business Alliance of Slovakia (PAS) and numerical evaluation of the business environment in Slovakia by international indices: Global competitiveness index (GCI), Doing Business index (DBI), Economic Freedom index (EFI). Quantified outputs about the state and development of BE provide the architects of national and regional policies, with documents for the formation of basic priorities, strategies and programs to improve regulation of BE and thus streamlining business practices in Slovakia.

*Keywords:* business environment, statistical methods, analysis, strategy, Slovakia

## **Wykorzystanie metod statystycznych do oceny środowiska biznesowego Słowacji**

### *Streszczenie*

W pracy przedstawiono możliwości wykorzystania podstawowych metod statystycznych w ocenie środowiska biznesowego na Słowacji, w tym: analizy wskaźnikowej, w celu identyfikacji mocnych i słabych stron otoczenia biznesowego (BE), analizy szeregów czasowych, w celu pozyskania wiedzy nt. stanu i rozwoju BE. Ponadto wykorzystano analizę skupień w celu sklasyfikowania jakości BE oraz potencjału wzrostu słowackich regionów. Przeprowadzone analiza korelacji oraz regresji posłużyły do określenia zależności między warunkami biznesowymi a stanem sektora biznesowego.

*Słowa kluczowe:* środowisko biznesowe, metody statystyczne, analiza statystyczna, strategia, Słowacja

JEL: O18; C15, M19