The importance of mining for socio-economic growth of the country

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Mining operations are spread all over the world. In Slovakia, it lasts many centuries, and it is still developing. The mining industry is in constant development on every continent. The reason is increasing demand for raw materials. The acquisition of mineral raw materials is the most important part of the mining industry, which produces raw materials worth hundreds of millions of euros per year in Slovakia alone. It, directly and indirectly, acts on many indicators of the states as well as the regions. It promotes employment, has an impact on wages and increases the value of the gross domestic product. Despite many positive aspects, there is widespread concern from the general public or parliamentarians about the negative effects of mining activities in

The contribution is oriented on the analysis of the influence of mining industry in Slovakia considering socio-economic indexes. The analysis shows a complex view about the development of mining in Slovakia, made by the correlation and regression analysis, which helped to find out dependence between regions in Slovakia. With the help of these analyses, we concluded the influence of mining operations in Slovakia and the regions.

The goal of the contribution is to evaluate the influence of mining activity on the development of socio-economic indexes of individual regions in Slovakia. Due to the comparing of the dependence of individual indexes at the level of Slovakia and the countries we will use correlation analysis. The results at the level of Slovakia will show us the highest dependence between GDP, average wage, employment and wages in mining. Results of the analysis could open new tasks and areas of searching.

Keywords: *Slovakia, social impact, economic impact, mining industry, macroeconomic indexes, economy, industry sectors, GDP, wage, education*

Introduction

The mining industry in Slovakia is wide-spread since 13th Century (Marsina, 1986). Mining activity is maintained until the present time. Nowadays, raw materials are mined almost in all Slovakian counties (Zámora et al., 2004). Majority of mined raw materials is consumed at the territory of Slovakia (Rybár et al., 2016). Some raw materials that are excessing in Slovakia are exported to surrounding countries and some materials, which are not occurring in Slovakia, are imported (Zámora et al., 2003).

According to data issued by the Bureau of Statistics of the Slovak Republic, there are 2.600 industrial enterprises with more than twenty employees in Slovakia (*http://www.statistics.sk/pls/elisw/metainfo.explorer*). Also, the dynamism of industrial growth in Slovakia did not stop – it can be seen from record increases of GDP (*http://www.finance.sk/hospodarstvo/hdp/bezne-a-stale-ceny*).

Total revenues are mostly represented by engineering (28 %), power engineering (18 %), chemical industry (13 %), and mining industry (9 %). They are followed by the food industry (9 %) and electrical engineering.

Material and methods

The highest representations in the Slovak industrial production sectors have the medium-high technology. In 2010, for instance, the proportion of these industries in the production and sales of the Slovak the industrial production of 42 % and corresponded with the values of this indicator in the most advanced countries of the European Union (Rybár et al., 2016). Dominant position on the creation of added value and thus the contribution to the GDP, industrial production in 2011, manufacture of motor vehicles, trailers and semi-trailers is maintained; all can be seen in Table 1. The second position is the production and processing of metals and the manufacture of computer, electronic and optical products in the third. The same order is of these sectors of employment in the industrial production. http://www.sario.sk/sk/trade/buyers/slovak-industry/industrial-sectors.

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Tab. 1. Slovak economy data, development through years 2012-2016.

Slovakia Economy Data	**2012**	**2013**	**2014**	**2015**	**2016**
Population [million]	5.4	5.4	5.4	5.4	5.4
GDP per capita [EUR]	13,454	13,707	14,023	14,515	14,92
GDP [EUR bn]	72.7	74.2	75.9	78.7	81.0
Economic Growth [GDP, annual variation in %]	1.7	1.5	2.6	3.8	3.3
Consumption [annual variation in %]	-0.4	-0.8	1.4	2.2	2.9
Investment [annual variation in %]	-9.0	-0.9	1.2	16.9	-9.3
Industrial Production [annual variation in %]	8.0	3.9	3.6	7.4	4.7
Retail Sales [annual variation in %]	-0.9	0.1	3.6	1.7	2.1
Unemployment Rate	14.0	14.2	13.2	11.5	9.7
Fiscal Balance [% of GDP]	-4.3	-2.7	-2.7	-2.7	-1.7
Public Debt [% of GDP]	52.2	54.7	53.6	52.5	51.9
Money [annual variation in %]	7.3	6.2	5.2	11.1	5.2
Inflation Rate [CPI, annual variation in %, eop]	3.2	0.4	-0.1	-0.5	0.2
Inflation Rate [HICP, annual variation in %]	3.8	1.5	-0.1	-0.3	-0.5
Inflation [PPI, annual variation in %]	3.9	-0.1	-3.5	-4.3	-0.2
Inflation Rate [HICP, annual variation in %]	3.8	1.5	-0.1	-0.3	-0.5
Inflation [PPI, annual variation in %]	3.9	-0.1	-3.5	-4.3	-0.2

Source: own processing according to (http://www.focus-economics.com/countries/slovakia, 2017)

Considerate attention must be given mainly to the socio-economic indexes, among which belongs unemployment, GDP (Fig. 1), average monthly wage, migration etc. Such indexes help to characterise changes that connect with the living level of inhabitants in given country, as well as they contribute to the sustainable development of the whole economy (Divinský, 2016).

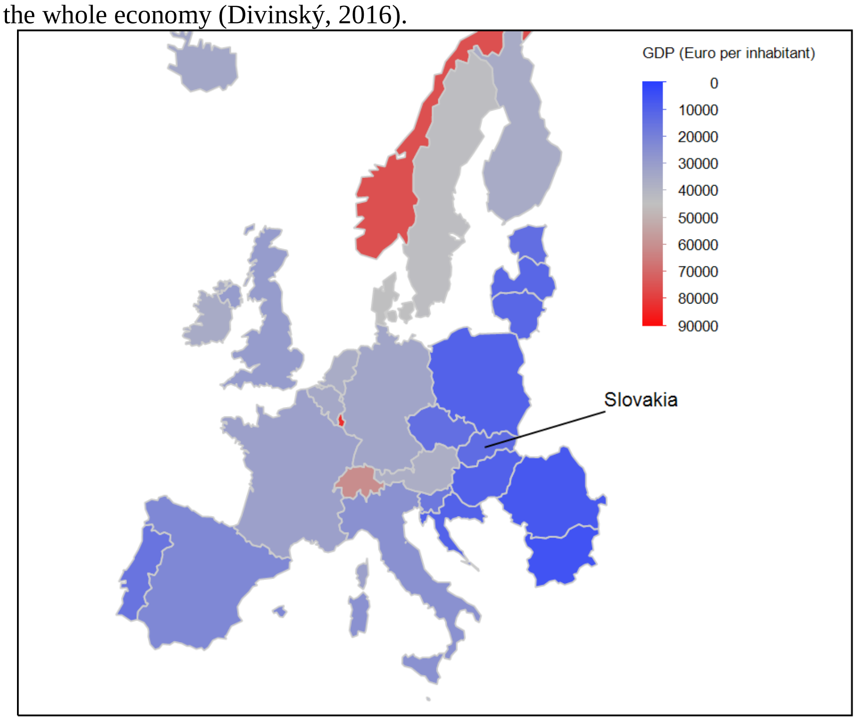

Fig. 1. Gross domestic product at market prices [Euro per inhabitant].

The natural resources of Slovakia are mainly brown coal and lignite with small quantities of iron ore, copper and manganese ore as well. In the year 2010, Slovakia imported 139,200 bbl/d of crude petroleum and 6.4 billion m^3 of natural gas (Baláž et al., 2013).

Fossil Fuels - the Ministry of Economy states that due to rigorous restructuring operations in the coal sector of Slovakia, production of coal is likely to be affected for the next 10 years. The Ministry predicted that in 2015, the production would be about 2 million Mt; in 2025 about 1.5 Mt; and in 2030 about 1 Mt. Hornonitrianske Banke Prievidza is Slovakia's top brown coal producer. The coal mine at Handlova is estimated to produce about

300,000 Mt/yr until 2020, following which it was scheduled to be closed. Similarly, the HBP Mine at Nováky is estimated to produce 1.2 Mt in 2015 and 2020, 1 Mt in 2025, and 0.5 Mt in 2030, following which it would be closed (*http://www.vlada.gov.sk/slovensko/)*.

Slovakia has wide potential for mining nonmetallic raw material. In Table 2, the position of Slovak Republic is in the frame of EU according to the volume of mining non-metallic raw material (*http://vitejtenazemi.cz/cenia/index.php?p=prirodni_nerostne_zdroju_ve_svete&site=puda.)*.

The extraction of selected non-metallic raw materials is of economic importance not only within the Slovak Republic but also within the EU as to the individual positions of Slovakia based on the amount of extracted mineral raw material (Zeleňáková et al., 2017). It is clear from data that Slovakia has the most significant position in magnesite mining compared to other EU countries and kaolin is the least exported raw material, which is affected by the quality of deposits located in our territory. In Table 2, the meaning of mining nonmetallic mineral raw materials in Slovakia can be seen.

Tab. 2. Position of Slovak Republic in the frame of EU according to amounts of mined nonmetallic raw materials.

Non-metallic raw material	**Position of placement**	**Mined amount** [metric t]
Bentonite	5.	158 400
Kaolin	12.	46 000
Magnesite	1.	1 196 600
Talk	7.	7 000
Pearlite	3.	23 000
Gypsum and Anhydride	10.	143 000

Source: own processing

The mining industry has a major impact on society - from an economic, environmental and social perspective and due to a vast number of criteria. Which criteria should be given priority depends on where the mining operations take place. In this sense, Ranängen and Lindman (2017) suggested the following as sustainability criteria: corporate governance, fair operating practices, economic aspects, human rights, labour practices, society and the environment. For more than a century, the mining sector has played a crucial role in the economic development in many countries. However, it also causes immense harm to the country’s people and environment. (Naidoo, 2015).

Problems related to the mining influence the sustainable development. In this sense, it is extremely important to encourage cooperation among the mining sectors, the society, and state and municipal governments in the process to consolidate advantages and opportunities for this industry (Macedo et al., 2017). Also, Amezaga et al. (2011) review how mining practices have evolved to consider sustainability over the last few decades and remark on what challenges still need to be overcome.

A sustained and sustainable mine development requires the collaboration with the host communities concerned, which means that it has to be developed in a process commonly termed social licensing. However, a ‘social license’ will not be granted once and forever, but in fact is an evolving process, as the communities and their needs evolve. (Falck, 2016)

Owen and Kemp (2013) discussed and debated over how best to frame the industry's social and environmental obligations and how these obligations can be met by the mining sector. Where a social license has contributed to raising the profile of social issues within a predominantly industrial discourse, a primary failure is its inability to articulate a collaborative developmental agenda for the mining sector or a pathway forward in restoring the lost confidence of impacted communities, stakeholders, and pressure groups.

Bridge (2004) stated four distinct approaches to sustainability in the mining sector: (a) technology and management-centered accounts, defining the issue in terms of environmental performance; (b) public policy studies on the design of effective institutions for capturing benefits and allocating costs of resource development; (c) structural political economy, highlighting themes of external control, resource rights, and environmental justice; and (d) cultural studies, which illustrate how mining exemplifies many of society's anxieties about the social and environmental effects of industrialization and globalization.

In the mining sector, local communities have emerged as particularly important governance actors. These have been spurred by the growth of the sustainable development paradigm and governance shifts that have increasingly transferred governing authority towards non-state actors (Prno et al., 2012). Agrawal and Gibson (1999) reconsidered the role of community in resource use and conservation, exploring the conceptual origins of the community, then analysed aspects of the community most important to advocates for community's role in resource management.

Bebbington et al. (2008) described different types of resistance and social mobilisation that have greeted mineral expansion at a range of geographical scales, and consider how far these protests have changed the relationships between mining and political economic change.

There are interactions of the role players in the coal mining industry commencing with the government regulations, supply chain members, employees and the society who are the beneficiaries of the process underpins the socio-economic attributes of the industry. (Mathu et al., 2013).

Social issues are critical to the mining industry. The study of Michell and McManus (2013) highlights that local communities can be empowered through development, that benefits can extend to both the community and the business and that the ongoing management of social issues will increasingly be critical to the success of the mining industry.

Methodology

Theoretical Background

While monitoring socioeconomic phenomena, we often see whether a change of one or more variables affects another variable and if, then how. Define relation between two or more variables allows regression and correlation analysis. The aim of regression analysis is to explain the biggest part variability of a primary variable through its relationship with others variables. Correlation analysis through statistical methods and approaches valuates intensity of statistical dependence between quantity variables. The existence of a linear relationship between two variables is classified due to covariance *cov xy*.

$$\boldsymbol{cov\ xy} = \frac{1}{n}\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y}). \quad (1)$$

or

$$\widetilde{cov}\ xy = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y}) = \frac{n}{n-1}(\overline{xy} - \bar{x}.\bar{y}) \quad (2)$$

Covariance acquire values from the interval $<-\infty ; +\infty>$.

The calculated values indicate the direction of linear dependence between the two variables.

- $cov(X,Y) > 0$, between X and Y exists positive linear dependence.
- $cov(X,Y) < 0$ between X and Y exists negative linear dependence,
- $cov(X,Y) = 0$ between X and Y no existing of linear dependence

By studying the strength of linear relationship between two variables, we use the coefficient of correlation r. The correlation coefficient is defined by the equation:

$$r_{xy} = \frac{cov\ xy}{S_x.S_y} = \frac{\widetilde{cov}\ xy}{\tilde{S}_x.\tilde{S}_y} \quad (3)$$

S_x, S_y measures the spread of distribution around the mean. It is often denoted as s, and it is the square root of the sample variance, denoted s^2.

$$Sx = \sqrt[2]{S_x^2} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(X_i - \bar{X})^2} \quad \textit{and} \quad Sy = \sqrt[2]{S_y^2} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(Y_i - \bar{Y})^2} \quad (4)$$

$$r = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2}\sqrt{\sum_{i=1}^{n}(Y_i - \bar{Y})^2}} \quad (5)$$

where:

X_i – variable X observed in time i
$\bar{X}$ – arithmetic mean of variables X in time series
Yi – variable Y observed in time i
$\bar{Y}$ – arithmetic mean of variables Y in time series
n – scope of time series examined

Coefficient of correlation measure two-sided linear dependence and gains value form the interval $<-1,1>$, while the closer is the value to $|1|$, the stronger is the dependence. In the case of coefficient $r = 1$, there is positive linear dependence between variables. In the case $r = -1$, it means a negative dependence. If correlation coefficient equals 0, there is no dependence between variables X and Y. Correlation coefficient can have also other values, which can be classified as follows:

$0 < \|r\| < 0,3$	low level of dependence between variables
$0,3 \leq \|r\| < 0,5$	moderate level of dependence between variables
$0,5 \leq \|r\| < 0,7$	medium level of dependence between variables
$0,7 \leq \|r\| < 1$	strong level of dependence between variables

Clustering clumps together points that are close to each other (points that have similar values). In Ward's minimum variance method, the distance between two clusters is the ANOVA sum of squares between the two clusters added up over all the variables (Stehlíková et al., 2016). At each generation, the within-cluster sum of squares is minimised over all partitions obtainable by merging two clusters from the previous generation.

Ward's method joins clusters to maximise the likelihood at each level of the hierarchy under the assumptions of multivariate normal mixtures, spherical covariance matrices, and equal sampling probabilities (Meloun et al., 2005).

Ward's method tends to join clusters with a small number of observations and is strongly biased toward producing clusters with roughly the same number of observations.

The clusters are formed in such a way that the increase in the variability of the intragranulary component W is small, and the increase of the inter-noise variability B is large (Hebák et al., 2007).

$$\boldsymbol{W} = \sum_{j=1}^{k} \boldsymbol{W_j} = \sum_{s=1}^{m} \sum_{i=1}^{k} (\boldsymbol{x_{si}} - \boldsymbol{\bar{x}_s})^2 \quad (6)$$

$$\boldsymbol{B} = \sum_{s=1}^{m} \sum_{j=1}^{k} \boldsymbol{k}\left(\boldsymbol{\bar{x}_{sj}} - \boldsymbol{\bar{x}_s}\right)^2 \quad (7)$$

Where $\bar{x}_s$ – total diameter of the *s*-th cluster
x_{si} – The value of the *s*-th cluster for the *i*-th variable

Evaluation of mining impacts to the individual regions of Slovakia had been verified by correlation analysis of key indexes in mining and basic macroeconomic indexes, resulting from publicly available sources, published by statistic Office, mining annuals, etc., (Ballek, 2016; Kladivík, 2013) while analysing data between 1970-2016.

The process of analysis was as follows:

1. Determination of key indexes in analysed mining sector
2. Determination of key indexes from macro environment
3. Realization of correlation analysis at the level of whole Slovakia
4. Realization of correlation analysis at the level of individual counties
5. Determination of dependences and independence of variables.

Resulting from the limitation of information sources, the mining industry had been defined by indexes:

- Volume of mining in mil. ton,
- Raw material sales in mil. €,
- Volume of average monthly wage in mining in €,
- A number of employed persons in mining in persons.

Socio-economic development of individual counties in Slovakia was defined by indexes:

- Total employment in Slovakia and individual counties,
- GDP and regional GDP,
- Average monthly wage in Slovakia and individual counties,
- Education
- Number of migration

Case study

The correlation analysis verified the dependence between indexes of the mining industry and macroeconomic indexes at the state level in Slovakia. Results of the analysis are given in the correlation map (Fig. 2) that divides indexes into two sectors – blue and red.

- Blue sector – indexes with considerable mutual dependence,
- Red sector – indexes with a low level of dependence.
- It is necessary to orientate to the index of employment in the mining sector that reports considerable negative dependence in relation to the majority of analysed indexes.

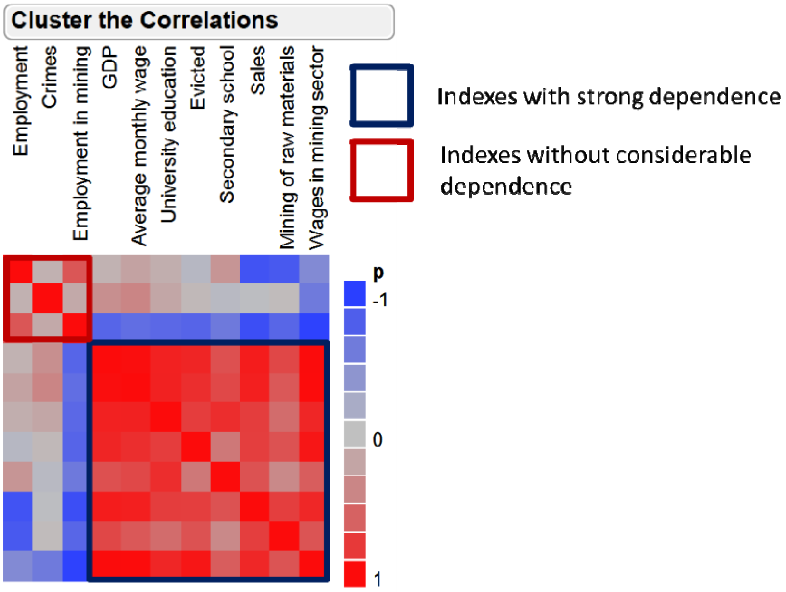

Fig. 2. Correlation map – segmentation of indexes (result from JMP software)
Source: own processing.

In this case, there is necessary to see the relationship between mining and not mining indexes, which is presented in Table 3. According to the analysis, we can state that values of correlation indexes proved a very considerable dependence of mining companies sales and wages in mining in relation to GDP, average monthly wage, a number of evicted and number of university education (graduates with values <0,78 ; 1>). On the other hand, it proved a negative dependence on employment in the state at level <-0,49 ; -0,88>.

Tab. 3. Correlation matrix of chosen mining and not mining indexes during the period (1960-2016).

	Employment	**GDP**	**Average monthly wage**	**Evicted**	**Crimes**	**University education**	**Secondary school**	**Sales**	**Mining of raw materials**	**Employment in mining**	**Wages in mining**
Employment	1,00	0,11	0,22	-0,09	0,12	0,14	0,31	-0,88	-0,84	0,66	-0,49
GDP	0,11	1,00	0,99	0,89	0,34	0,91	0,69	0,93	0,73	-0,76	1,00
Average monthly wage	0,22	0,99	1,00	0,85	0,40	0,91	0,73	0,92	0,65	-0,69	1,00
Evicted	-0,09	0,89	0,85	1,00	0,06	0,78	0,48	0,78	0,68	-0,76	0,95
Crimes	0,12	0,34	0,40	0,06	1,00	0,19	-0,08	-0,03	0,04	0,17	-0,61
University education	0,14	0,91	0,91	0,78	0,19	1,00	0,85	0,78	0,54	-0,73	0,89
Secondary school	0,31	0,69	0,73	0,48	-0,08	0,85	1,00	0,68	0,38	-0,61	0,63
Sales	-0,88	0,93	0,92	0,78	-0,03	0,78	0,68	1,00	0,78	-0,90	0,88
Mining of raw materials	-0,84	0,73	0,65	0,68	0,04	0,54	0,38	0,78	1,00	-0,75	0,67
Employment in mining	0,66	-0,76	-0,69	-0,76	0,17	-0,73	-0,61	-0,90	-0,75	1,00	-0,98
Wages in mining	-0,49	1,00	1,00	0,95	-0,61	0,89	0,63	0,88	0,67	-0,98	1,00

source: own processing

Placement of mining activity in Slovakia was and still is uneven, which is also reflecting on achieved results of followed mining indexes at the level of individual countries. Through cartograms (Fig. 3) that expresses the volume of mining in tones and the number of employed persons in mining, we chosen a country with most considerable mining activity, presented with highest values of such indexes (red space of cartogram) – Trenčiansky region; and country with lowest level of mining activity (blue space in cartogram) – Nitriansky region.

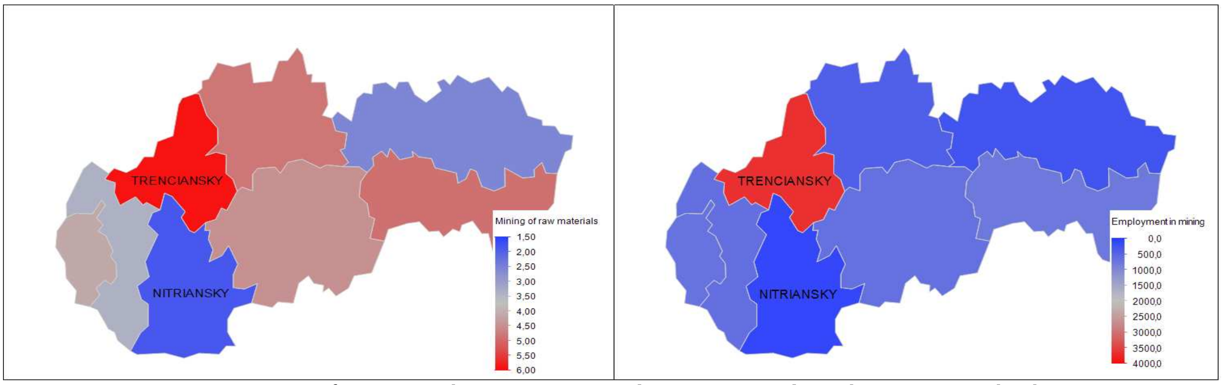

Fig. 3. Cartogram of average employment in mining and average mining during last 10 years in Slovakia source: own processing according to results from JMP software.

We verified expectations through comparing of this different region from the view of the sector through correlation analysis, (Fig. 4). While there is very strong dependence in Trenčiansky region, presented by correlation coefficient in interval <0,73;0,9>, index „employment in the country“ and all mining indexes (mining, employment in mining, wage in mining) and in Nitriansky region there was not proven statistically significant dependence of followed indexes with correlation coefficient to |0,5|.

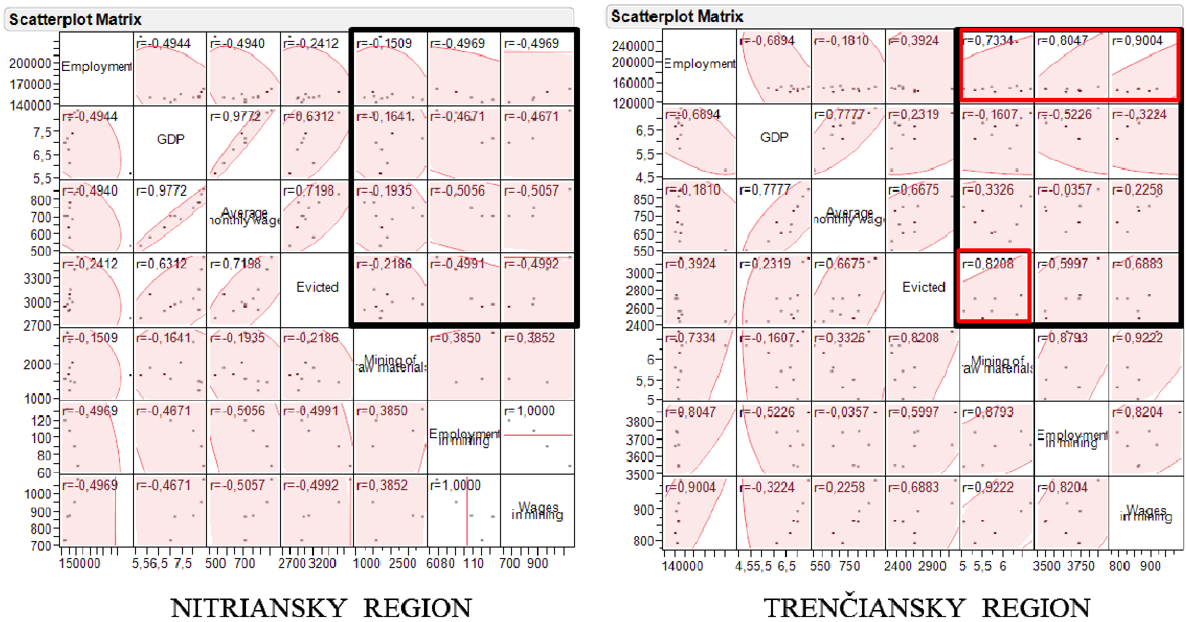

Fig. 4. Correlation matrix at the level of countries - Trenčiansky, Nitriansky source: own processing according to results from JMP software.

The high correlation of indexes in Trenčiansky region documents only the dependence of the region on the mining since one from the biggest mining companies in Slovakia from the view of mining volume, and the view of a number of employees, is acting there – Hornonitrianske bane Prievidza, Joint Stock Company. The company employs approximately 4000 employees and other 6000 employees are directly and indirectly connected with the company. In the case that the company would finish its operation suddenly, also values of socio-economic indexes would change markedly. A number of registered applicants of employment would change from original value 6 315 to approximately 15 000, and a measure of unemployment will increase from 8,13 % to 21,74 %, which could mean third highest measure of unemployment in Slovakia. Also, there will be a change in indexes of average wages. Due to the mentioned mining activity has considerable impact to the Trenčiansky region, especially in Prievidza region.

Results and discussion

Regional correlation analysis at the level of individual countries divides countries to significantly “mining” with considerable influence of mining activity to results of indexes and “not mining”, in which there was any statistically important dependence. First of all Trenčiansky region, then Košický, Banskobystrický and Žilinský region are among regions where the influence of mining activity is the highest and Nitriansky and Prešovský region belong to regions that are typically "not mining".

Based on these arguments, we can claim that mining does have a major impact on the socio-economic indicators to the Prievidza district, where Hornonitrianske bane Prievidza, a.s. is located. It is the largest employer in the region. It employs around 4,000 employees, and another 6,000 employees are directly and indirectly connected to this company. If the company suddenly ceased to operate, the values of the socio-economic indicators would also change markedly. The number of registered jobseekers would change from an initial value of 6,315 to about 15,000, and the unemployment rate would increase from 8.13 % to 21.74 %, which would represent the third highest unemployment rate in Slovakia. There would also be a change in average wage indicators. For this reason, mining activity has a significant impact on the entire Prievidza district.

Results of the analysis opened new tasks and areas of searching. Also, other factors, except mining activity, influence indexes as wages in the industry, a measure of unemployment, registered applicants for employment. In Slovakia, it presents for example influence of other sectors, as automotive industry (Bratislava, Žilina, Trnava) or metallurgical industry (Košice, Podbrezová, Žiar nad Hronom) than it is linking of industries to the raw material chain, connected with mining sector in Slovakia (Lacko et al., 2017). The subject of further searching should be therefore evaluation of other sectors influence to the regions, in which chosen sectors have a dominant position and yet according to such comparing it would be possible to evaluate expressiveness of mining sector impact to the individual regions of Slovakia objectively.

Conclusion

In last period questions of society about mining activity and its influence to the inhabitants are rising, as well as questions of the economic situation of the mining and its surrounding (Dvořáček, J. et al., 2013). The goal of the contribution was to evaluate the influence of mining activity on the development of socio-economic indexes of individual regions in Slovakia. Due to the comparing of the dependence of individual indexes at the level of Slovakia and the countries we used correlation analysis. Its results at the level of Slovakia show the highest dependence between GDP, average wage, employment and wages in mining.

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