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THE RELATIONSHIP BETWEEN GDP CREATION AND THE SELECTED VARIABLES OF BUSINESS ENVIRONMENT

The main aim of this paper is to study the relationship between GDP creation and selected variables of business ehvironment by using the multiple linear regression model which describes the statistical dependence between the researched parametres. We found that from the selected variables the small and medium-sized enterprises and the level of employment have the greatest effects on economic performance of the country.

Keywords: *business environment; small and medium-sized enterprises; employment rate; GDP creation.*

Peer-reviewed, approved and placed: *16.05.2016.*

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ВЗАЄМОЗВ'ЯЗОК МІЖ ФОРМУВАННЯМ ВВП ТА ОБРАНИМИ ЗМІННИМИ БІЗНЕС-СЕРЕДОВИЩА

У статті досліджено взаємозв'язок між формуванням ВВП та змінними бізнес-середовища за допомогою побудови моделі множинної лінійної регресії, що описує статистичну залежність між досліджуваними параметрами. Доведено, що найбільший вплив на економічні показники країни мають змінні «малий та середній бізнес» та «рівень зайнятості».

Ключові слова: *бізнес-середовище; малий та середній бізнес; рівень зайнятості; формування ВВП.*

Форм. 10. Табл. 4. Літ. 28.

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ВЗАИМОСВЯЗЬ МЕЖДУ ФОРМИРОВАНИЕМ ВВП И ВЫБРАННЫМИ ПЕРЕМЕННЫМИ БИЗНЕС-СРЕДЫ

В статье исследована взаимосвязь между формирование ВВП и переменными бизнес-среды при помощи построения модели множественной линейной регрессии, которая описывает статистическую зависимость между исследуемыми параметрами. Доказано, что наибольшее влияние на экономические показатели страны имеют переменные «малый и средний бизнес» и «уровень занятости».

Ключевые слова: *бизнес-среда; малый и средний бизнес; уровень занятости; формирование ВВП.*

Introduction. Economic performance at national and regional levels is in the center of economic debates in most countries. During the last decade attention of an increasing number of scholars and policy-makers is attracted to analysis of entrepreneurship and its impact on economic growth (at both regional and national levels) from various points of views. In the conditions of Slovak Republic there is a lack of studies linking the impact of business environment indicators on economic performance for the observation units: the country and regions. Just a few studies relate business environment indicators to economic performance of the related regions. It is sometimes argued that nations and regions differ in their underlying business environment. In recent years more researchers started being interested in the analysis of

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business environment, mainly in the context of national and regional competitiveness. There has been a problem with defining and measuring entrepreneurial factors and in identifying their exact contribution to economic growth. At the regional level of Slovakia the key problem is the lack of data using which we can determine the economic growth of regions. The fundamental macroeconomic variable, which is used to measure economic performance, is gross domestic product (GDP). We can use only the data on GDP per capita in PPS. Other serious problem is data delay in time. This study contributes to the ongoing debate on economic performance measured by GDP creation at both national and regional levels. The links between the selected variables of business environment and GDP creation in the conditions of Slovak Republic is examined. This paper is part of the project "The evaluation of clusters' impact measurement on regional development of the Slovak Republic" supported by Grant Agency VEGA (No 1/0953/16).

Literature review. Entrepreneurship is a multifaceted phenomenon, being analyzed as a process, a resource or a state-of-being (Toma et al., 2014; Lemanska-Majdzik and Okreglicka, 2015). It has been considered as an important mechanism in achieving economic growth (Caree and Thurik, 2003; Acs et al., 2012; Naude, 2013; Galindo and Mendez, 2014; Audretsch et al., 2015). Consequences of entrepreneurship, in terms of economic performance, have generated extensive literature volumes that are generally restricted to two aspects of observations – that of the establishment or firm and that of a region (Carre and Thurik, 2003; Fiala and Hedija, 2015). Other points of views are the size of company (Thurik, 1996; Wiklund, 1998), start-ups, incubators (Audretsch and Fritsch, 2000; Audretsch et al., 2015), clusters and networks (Mura and Rozsa, 2013) and specific form of entrepreneurship (Grmanova and Jablonsky, 2009). The authors emphasize the importance mainly of small and medium-sized enterprises for regional and national economies and their performance (Thurik, 1996; Wiklund, 1998; Subertova, 2012; Buganova et al., 2014; Srovnalikova and Pekarskiene, 2015). Quality transport infrastructure (Masarova, 2009) and education institutions (Grencikova, 2010; Vila et al., 2015) also contribute to SMEs development. Except the stated factors of entrepreneurship that have impact on economic performance we can find other factors: social factors, capital concept, other latent factors, entrepreneurial activity, start-up activities, prevalence of nascent firms, new firms and many others, which are influenced by business environment. The fundamental prerequisite for successful development of all businesses is favorable business environment in which the state supports and protects economic competition, creates clear and stable rules, and ensures compliance by all market participants while minimizing administrative barriers towards entrepreneurs. This is confirmed by (Belas et al., 2014). Positive perception of business situation by the society might mean greater interest in starting a business, which can further lead to higher GDP and higher employment level (Belas et al., 2015).

Problem statement and research objective. Our study provides a brief reflection on some factors involved in the relationship between entrepreneurship in the frames of business environment and economic performance. The objective of this study is reached through solving the following several research tasks:

1. Identification of the variables suitable for model construction and verification. The dependent variable is presented by the level of GDP per capita in PPS.

GDP per capita is frequently used as the proxy measure for economic performance at both regional and country levels (Vojtovic and Krajnakova, 2013). Identification of explanatory (independent) variable is more difficult. It is based on the selection of appropriate indicators which have relationship with business environment and realization of correlation analysis. The selection of appropriate variables is based on the works of A.M. Grigore and I.M. Dragan (2015), M. Filko et al. (2010), E. Ivanova (2011), M. Kordos (2014), M. Kordos and R. Karbach (2014), M. Mynarzova and R. Kana (2014) and other researchers. By correlation analysis the independent variables suitable for model creation were detected.

2. Construction and verification of linear regression model and the results description. This step consists of regression analysis, variance analysis, model construction, test of model's parameters and construction of beta coefficients.

3. Applying the proposed model for 8 regions of Slovak Republic.

4. Conclusions and implications for future research.

Methodological framework and key results. The observed periods represented the interval of years 2001–2014 due to data availability in the regional databases of the Statistical office of Slovak Republic (SOSR). Primarily, the ***identification of variables (step 1)*** is based on decompositions of GDP. A.M. Grigore and I.M. Dragan (2015) emphasize that there is a clear, dialectical relationship between a country's entrepreneurial quality and density and the level of its economic development and growth. According to them, several variables of business environment should be considered significant and they have been grouped in two autonomous blocks: entrepreneurial "demography" block (the variables of education, tradition, motivation, skill, infrastructure, markets, entrepreneurial potential) and the business environment block (economic context – major shift from managerial economy to entrepreneurial economy, political mandate to promote new economic reality, policies, institutions, financing mechanism, market mechanism). M. Filko et al. (2010) decomposed GDP into 3 individual sections: labor productivity, labor market and demography. We decided to decompose GDP into 3 blocks that are represented by the indicators, are available at regional level in the SOSR databases and which have connections with business environment: 1) labor productivity; 2) labor market; 3) innovation (Table 1). The data for the observed periods on national and regional levels were available for: x_1 – average registered number of employees; x_2 – SMEs per 1000 economically active population; x_3 – density of road network; x_4 – average gross nominal monthly wage; x_5 – secondary vocational schools. These indicators are considered as explanatory variables for linear model construction.

For evaluation of the selected variables the *correlation analysis* was used. The relationship between the indicators was assessed by means of Pearson correlation coefficient. For the significant correlation between the explanatory variables we considered the correlation coefficient $|r| > 0.8$ – high degree of dependence. Due to multicollinearity between the explanatory variables, variables x_3, x_4, x_5 were excluded from the model.

Construction and verification of linear regression model and the results description (step 2). First, the regression analysis was carries out. R^2 was calculated which refers to the power of tightness dependence between variable y and the variables explaininf

it. Multiple R takes the value of <0,1>. Its higher value refers to higher dependency between variable y and the variables that explain it (x_i). As we can see from the results of R^2 (0.99), between the dependent and the independent variables these is strong intensity of dependence. We can declare that between GDP and its explanatory variables (x_1, x_2) that were used in this model there is a significant dependence.

Table 1. **Decomposition of GDP,** *authors'*

GDP		
1) Labor productivity	**2) Labor market**	**3) Innovation**
SMEs, Secondary vocational schools, Universities, Gross value added, Gross fixed capital formation, Foreign direct investment	*Employed, Economically active population, Unemployment rate, Average registered number of employees, Average gross nominal monthly wage of employee, Total labor costs per employee, Disposable job applicants, Average number of job vacancies by economic activities*	*Expenditures on research and development, R&D Employees, Road, Infrastructure*

Table 2. **Correlation analysis,** *authors'*

	y	x_1	x_2	x_3	x_4	x_5
y	1.000					
x_1	0.896	1.000				
x_2	0.970	0.784	1.000			
x_3	0.889	0.718	0.892	1.000		
x_4	0.990	0.858	**0.977**	**0.903**	1.000	
x_5	**0.690**	0.589	0.736	0.778	0.693	1.000

Part of regression analysis is realization of the following tests:

a) Test for autocorrelation using Durbin-Watson statistics. It is a test for detection of autocorrelation presence in residuals (prediction errors) from a statistical regression analysis. The stated hypotheses are H_0: $\rho = 0$ (no first order autocorrelation) vs. H_1: $\rho \neq 0$. Autocorrelation between residuals is a negative phenomenon. The Durbin-Watson statistics is always between 0 and 4. The value of 2 means there is no autocorrelation in the sample. The Durbin-Watson statistics in our model is 1.85, and this means there is no autocorrelation between the residuals.

b) Test for heteroscedasticity with the Goldfeld-Quandt test. Tested was: H0: homoscedasticity vs. H_1: heteroscedasticity. Sample observations are divided into two groups, and evidence for heteroscedasticity is based on the comparison of the residual sum of squares using F-statistics. The results of GQ test confirms H_0. The level of the calculated value $F_{statx_1} = 1.8408$ and $F_{statx_2} = 3.7108$. $F_{0.05(3.3)} = 9.277$. Both results are lower than $F_{0.05(3.3)}$, and this means H0 about homoscedasticity is accepted.

c) Normality test was used to determine if a data set is well-modeled by a normal distribution. The Shapiro-Wilk normality test was used. H_0: the samples came from a normal distribution. $Wx_1 = 0.9567$; $Wx_2 = 0.943$; Thresholds: (p = 0.01) = 0.8249, (p = 0.05) = 0.8740 which implies that H_0 is accepted.

The multidimensional linear model is explained by the following formula:

$$y_i = \beta_0 + \beta_1 x_{1i} + \ldots + \beta_k x_{ki} + u_i, \quad (1)$$

where $i = 1, \ldots, n$ (observation unit is country or region); y_i indicates GDP of level i at time t; β_0 is the intercept (unknown parameter); β_k – regression coefficient (unknown parameter) for $j = 1, 2, \ldots, k$; u_i – error term. β_k indicates the endogenous variable change by the change of exogenous variable x_{ki} of one unit and by unchanged values of other exogenous variables (assumption of ceteris paribus). Alternatively, the formula for econometric model is

$$y_i = \beta_0 + \sum_{j=1}^{k} \beta_j X_{ij} + u_i \quad i = 1, 2, \ldots, n. \quad (2)$$

The multiple linear regression model for Slovak Republic is:

$$y_{SR} = -20751{,}3 + 596{,}9x_1 + 0{,}2x_2.$$

This step also consists of specifying the coefficients b_i ($i = 0, \ldots, 2$) and verification of their significance. The coefficients of parameter we estimated using the least squares method.

$$\sum_{i=1}^{n} e_i^2 = \vec{e}^T \vec{e} = \left(\vec{y} - X\vec{b}\right)^T \left(\vec{y} - X\vec{b}\right) = \vec{y}^T \vec{y} - \vec{y}^T X\vec{b} - \vec{b}^T X^T \vec{y} + \vec{b}^T X^T X\vec{b} \longrightarrow \min. \quad (3)$$

By solving the (3) formula, we achieved

$$\vec{b} = \left(X^T X\right)^{-1} X^T \vec{y}. \quad (4)$$

We found a solution by solving the system of equations ($k + 1$)

$$\begin{gathered}
b_0 n + b_1 \sum_{i=1}^{n} X_{i1} + b_2 \sum_{i=1}^{n} X_{i2} + \ldots + b_k \sum_{i=1}^{n} X_{ik} = \sum_{i=1}^{n} Y_i; \\
b_0 \sum_{i=1}^{n} X_{i1} + b_1 \sum_{i=1}^{n} X_{i1}^2 + b_2 \sum_{i=1}^{n} X_{i1} X_{i2} .. + b_k \sum_{i=1}^{n} X_{i1} X_{ik} = \sum_{i=1}^{n} X_{i1} Y_i; \\
b_0 \sum_{i=1}^{n} X_{i2} + b_1 \sum_{i=1}^{n} X_{i2} X_{i1} + b_2 \sum_{i=1}^{n} X_{i2}^2 + \ldots + b_k \sum_{i=1}^{n} X_{i2} X_{ik} = \sum_{i=1}^{n} X_{i2} Y_i; \\
\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\
b_0 \sum_{i=1}^{n} X_{ik} + b_1 \sum_{i=1}^{n} X_{ik} X_{i1} + b_2 \sum_{i=1}^{n} X_{ik} X_{i2} + \ldots + b_k \sum_{i=1}^{n} X_{ik}^2 = \sum_{i=1}^{n} X_{ik} Y_i.
\end{gathered} \quad (5)$$

Next, ANOVA was calculated. This analysis was used for testing the whole model's significance and individual parameters of model significance. The tested statistics is F which has Fischer distribution with k and $(n - k - 1)$ degree of freedom. For testing the whole model the following hypotheses were tested:

H_0: the multidimensional linear model is not statistically significant (all regression coefficients are zero-one).

$$H_0 : \beta_1 = \beta_2 = \ldots = \beta_k. \quad (6)$$

Against:

H_1: the multidimensional linear model is statistically significant (at least one regression coefficients is not zero-one)

$$H_1 : \exists \beta_j \neq 0 \quad j = 1, 2, \ldots, k. \tag{7}$$

For explanation of the test the Significance F was used: If $SF < 0.05$, the econometric model as an entity is considered to be statistically significant (+), similarly the coefficient of determination and the coefficient of correlation. If $SF < 0.01$, the econometric model as an entity is considered to be statistically highly significant (++). If $SF > 0.05$, the econometric model is considered as non-significant (-), similarly also the coefficient of determination and correlation coefficient. If the calculated value of statistics is higher than the critical value, H_0 is rejected. The results show that the model achieved the value of Significance F lower than 0.05 and lower than 0.01 (0.000). We can consider the whole model as being statistically highly significant. H_{0i} was rejected and alternative H_{1i} was accepted.

For the significance verification of parameters bi the P-value was used. If P-value < 0.05, the parameter b_i is statistically significant (+) and variable (by which the parameter is standing) is included into the model. If P-value < 0.01, bi is statistically highly significant (++) and variable (by which the parameter is standing) is included to the model. If P-value > 0.05, b_i and also the variable are not statistically significant and it is necessary to exclude the parameter or it is possible to use other indicator for this variable. The results of P-value are presented in Table 3.

Table 3. **Statistical significance of parameter** b_j**,** *authors'*

	Coefficient b_i	P-value	Statistical significance of parameter b_i
Intercept	-27194.7	0.000	++
Variable x_1	596.9613	0.000	++
Variable x_2	0.210631	0.000	++

The model construction also contains the testing of parameters' significance by using t-Stat. For multidimensional linear model's parameters the following hypothesis were formulated:

H_0: The economy's performance in *i* (observation unit: national and regional level) is not statistically dependent on the development of the selected indicators.

$$H_0 : \beta_j = 0. \tag{8}$$

Against:

H_1: The economy's performance in level *i* is statistically dependent on the development of the selected indicators.

$$H_1 : \beta_j \neq 0. \tag{9}$$

To test the parameters we used t-Test. Random variable *t* has Student's distribution with $(n - k - 1)$ degrees of freedom. Student's t-distribution quantile for α (0.05) = 1.796 and for α (0.01) = 2.718. Table 4 presents the results of t-Stat. We conclude that H_0 is rejected, $H1$ is accepted and the coefficients of regression function are statistically significant.

Finally, calculation of β_j was realized. These coefficients indicate how individual explanatory variables contribute to the explanation of the endogenous variable *y*. For their calculation formula (10) was used:

$$\beta_j = \frac{|b_j| \frac{s_{xj}}{s_y}}{\sum_{j=1}^{n} |b_j| \frac{s_{xj}}{s_y}}, \quad (10)$$

where $|b_j|$ means the coefficients $i = 1, ..., j$; s_{xj} – the standard deviation of variable x_i; s_y – the standard deviation of variable y.

Table 4. **Statistical significance of parameter** b_j, *authors'*

	t-Stat	Significance of coefficients of regression function
Intercept	-4.22054	++
Variable x_1	5.136135	++
Variable x_2	13.40634	++

As results show, SMEs contribute to the explanation of the endogenous variable y (GDP) by 72.3% and the level of employment – by 27.7%.

Using the proposed model for the regions of Slovak Republic (step 3). The constructed model was used for all observation units in Slovak Republic – self-governments regions. There are 8 regions in Slovak Republic: Bratislava, Trnava, Trencin, Nitra, Zilina, Banska Bystrica, Presov and Kosice. The proposed model was verified for each of this region. As follows from the realized correlation analysis, it is suitable for Trnava and Nitra regions. In the step of regression analysis we found that due to negative results of autocorrelation, the model is not suitable for Nitra Region. The linear regression function for Trnava region is:

$$y_{TN} = -320395{,}5 + 757{,}6x_1 + 0{,}299x_2.$$

Conclusions and directions for further investigation. This study contributes to the literature on the relation between GDP creation and business environment. Continuing the works of Z.J. Acs et al. (2012), D.B. Audretsch et al. (2015) and L.E. Vila et al. (2015) we proposed a multiple linear regression model which can be used in Slovak conditions. A direct measurement is provided for 3 main areas which mostly influence economic performance, at both national and regional levels. Data used in calculations are limited by the availability on the regional level, which had finally negative impact on some results. As shown by simple statistics, SMEs play the most important role in Slovak economy. Our results should lead to further deeper exploration of other indicators at national and regional levels and the proposed model could be the basis for the improvement of this study. Our results confirm that in Slovak Republic it is important to validate these results with the help of a more recent period and a larger sample. These conclusions lead to recommendations for economic practice that other aspects e.g., road infrastructure and R&D are important parameters of national and regional economy and it is necessary to support these areas. Another recommendation leads towards the improvement of statistical data evidence.

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