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MEASURING THE EFFECTS IN THE DEVELOPMENT OF THE REGIONS IN BULGARIA

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ABSTRACT
The aim of the study is to measure the effects in the economic development of the regions in Bulgaria. To achieve this aim, Eurostat data for the period 2014-2018 are used for the following indicators by NUTS 2 regions: Gross domestic product (GDP) at current market prices, Gross fixed capital formation, Compensation of employees, Inactive persons (%), Population and Households with access to the internet at home, Economical indicator for structural business statistics. The methodological framework of the study covers the use of the following statistical methods: stepwise regression, panel regression with fixed and random effect. The results of the study focus on the interpretation of the established cross-sectional and time-series effects.

Key words*:* GDP by region, economic indicators, panel regression, fixed effects model

INTRODUCTION

The aim of the study is to measure the effects in the economic development of the regions in Bulgaria. To achieve this aim, the following tasks are set: the first task - to consider the theoretical aspects describing regional development and consequently to substantiate the dependent and independent variables in the considered theoretical and empirical models and to identify the leading methods and models of research; the second task covers the selection of variables characterising the regions in Bulgaria for the period 2014-2018 and based on this, an analysis is performed, establishing the fixed effects by regions and by periods.

THEORETICAL ASPECTS OF REGIONAL DEVELOPMENT

The development of the regions can be considered at separate levels – units of several countries, a separate country, regions and districts. At different levels, different factors can be identified, considered by different authors as leading for the region. For instance, K. Josifidis, N. Supic and O. Glavaski examine the relationship between institutional change and income inequality in Central and Eastern European countries (1). Other authors emphasize the impact of certain leading sectors, influencing the level of development of the regions, thus solving problems with the unemployment rate and replacing economic activities that have lost their competitiveness (2). The idea of regional development corresponds to the ideas of economic growth, observing three options for economic growth (3): absolute convergence hypothesis; conditional β-convergence and concept of σ-convergence;

N. Islam focuses on the application of the panel data approach in the study of the growth and development of countries, as well as the level of convergence among them. The use of panel data in cross-country studies assists in the identification of unobserved individual effects for each country (4). Much of the research in the European Union (EU)

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focuses on the impact of the various EU funds on achieving cohesion at territorial, regional and national level (5). A distinction must be made between the terms "cohesion" and "convergence". Cohesion shows similarity of structures (economic, social, ethnic, etc.), convergence –similarity of processes (GDP development cycle, etc.) (6). According to some authors, there is empirical evidence of enhanced convergence between EU Member States compared to regions within the countries themselves. Furthermore, there is evidence to suggest that the economic effects of regional support are much stronger in more developed countries (8). A similar idea is expressed by C. Bähr (9), stated that the degree of decentralisation varies from one Member State to another and that this affects the degree of convergence between regions. The factors and the independent variable included in the empirical models of different researchers, as well as the methods used for processing and analysis of the results are listed in **Table 1.**

Table 1*. Independent variables, factors and methods used when assessing the development of the regions*

Authors	Independent variables	Factors (dependent variables)	Methods / Models
K. Josifidis, N. Supic, O.Glavaski	Gini index after taxes and social transfers	Lagged value Gini index Social security transfers as a % of GDP Transitional reforms Foreign direct investment as a % of GDP Annual growth rate of GDP Democracy (as measured by Freedom House)	Correlation, GMM regression OLS
E. Soukiazisq S. Proença	Growth in per-capita income	Initial level of per-capita income Accommodation capacity in the tourism sector	Fixed Effects Method, LSDV, Random Effects Method, GLS
N. Islam,	Output	Capital, Labour.	Cobb-Douglas production function LSDV, fixed effects
S. Dall'Erba, F. Fang,	Annual growth rate of per capita GDP in region	Initial per capita GDP Economic structure Employment or population Public investment or infrastructure stock Human capital or investment in education or research and development (R&D) Corruption/institutional quality	OLS, GLS, LSDV, GMM, 2SLS
A. Cappelen, F. Castellacci, J. Fagerberg, B.Verspagen,	Growth of GDP per capita	Initial GDP per capita Share of Agriculture Share of Manufacturing Infrastructure Unemployment Population density, R&D EU support	Correlation, OLS
M. Beugelsdijk, S. C.W. Eijffinger,	Growth of GDP per capita	Government consumption as part of GDP Government investment as part of GDP Inflation rate Private-sector investment as part of GDP Three-month interest rate Structural funds as part of GDP CorruptionIndex	GMM fixed effect
Bähr C.	Growth of per capita GDP	Per capita GDP (Lagged value) Domestic savings rate Rate of population growth Rate of human capital accumulation Exogenous rate of technological progress Rate of depreciation Degree of tax decentralization Structural Funds expenditure	Pooled cross-sectional regression

It can be summarised that in a large part of the research, the production and growth of GDP per capita is a dependent variable. The authors also use relatively identical variables, regardless of the level – country or region. The methods and models that are strongly represented in this type of research are based on correlation analysis and various methods for processing regression equations such as OLS, GLS, LSDV, GMM and others.

METHODOLOGICAL FRAMEWORK OF THE RESEARCH

In the general case, the combination of time series and spatial data can be illustrated by the following functional forms (10):

$$y_t = a + \sum_{w=1}^{k} b_w X_{wt} + e_t, \quad t = 1, 2, 3, \ldots\ldots, T$$

$$y_i = a + \sum_{w=1}^{k} b_w X_{wi} + e_i, \quad i = 1, 2, 3, \ldots\ldots, N$$

$$y_{it} = a + \sum_{w=1}^{k} b_{wt} X_{wit} + e_{it}, \quad i = 1, 2, 3, \ldots\ldots, N, \quad t = 1,2,3, \ldots\ldots, T,$$

where: y is the dependent variable; X – independent variables (explanatory variables); t – reflects the time range, in this case from 1 to 5, where T = 5; i – reflects the spatial range, in this case from 1 to 6, where N=6; k – reflects the number of explanatory variables; a – free member of the model; b – unknown parameter to be calculated and reflecting the degree of change of the dependent quantity due to the change by one at the independent quantity; e – model error. To calculate the fixed effects, the above equation is transformed as follows:

$$y_{it} = a + \sum_{w=1}^{k} b_w X_{wit} + \mu_i + \gamma_t + v_{it}.$$

In the fixed effects model, the constant in the model is specific to each group (section), but does not change over time. In the case of a fixed effects model, each economic unit is considered to be "unique" and cannot be considered as the result of a random selection of a particular combination. This approach is used in the analysis of countries, regions, industries or large enterprises (10).

The present study covers the planning regions in Bulgaria, and the time horizon is 5 years from 2014 to 2018. The data on the variables included in the model are derived from Eurostat and cover:

- Economical indicator for structural business statistics (SB STATISTICS);
- Households with access to the internet at home (Percentage of households) (ACCESS TO INTERNET);
- Inactive persons (%) (INACTIVE PERSONS);
- Compensation of employees by NUTS 2 regions (COMPEMPL);
- Gross domestic product (GDP) at current market prices by NUTS 2 regions;
- Gross fixed capital formation by NUTS 2 regions (GFC).

RESULTS

The results of the study were obtained through the use of statistical software and in particular - the software products Excel and EViews 6. When testing model 1, all variables were included, and the dependent variable was GDP **(Table 2**). As it can be seen from **Table 2**, there are variables that are not significant. They were excluded when testing the second model **(Table 3)** by performing stepwise regression. R-squared is very high, close to 1 in both models **(Table 2 and Table 3).** The F-criterion is also significant in both models **(Table 2 and Table 3)**.

Table 2. *Test results of Model 1*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GFC	-0,352390	0,201632	-1,747685	**0,0933**
SB STATISTICS	0,037571	0,005650	6,649552	**0,0000**
COMPEMPL	1,817872	0,063213	28,75810	**0,0000**
INACTIVE PERSONS	18,35946	23,89481	0,768345	0,4498
ACCESS TO INTERNET	-5,203164	7,087621	-0,734120	0,4700
C	-288,7547	1147,162	-0,251712	0,8034
R-squared	**0,999330**	Mean dependent var.		8188,743
Adjusted R-squared	**0,999190**	S. D. dependent var.		7204,644
S.E. of regression	205,0467	Akaike info criterion		**13,66121**
Sum squared resid.	1009059,	Schwarz criterion		**13,94145**
F-statistic	7155,769	Hannan-Quinn criter.		**13,75086**
Prob. (F-statistic)	**0,000000**	Durbin-Watson stat.		**0,687340**

Table 3. *Test results of Model 2*

Variable	Coefficient	Std, Error	t-Statistic	Prob,
COMPEMPL	1,454282	0,148747	9,776892	**0,0000**
GFC	-0,356616	0,139603	-2,554511	**0,0205**
SB STATISTICS	0,078573	0,033323	2,357916	**0,0306**
C	-1553,411	1770,847	-0,877214	0,3926
R-squared	**0,999846**	Mean dependent var.		8188,743
Adjusted R-squared	**0,999738**	S. D. dependent var.		7204,644
S. E. of regression	116,6380	Akaike info criterion		**12,65471**
Sum squared resid.	231275,3	Schwarz criterion		**13,26190**
F-statistic	9219,233	Hannan-Quinn criter.		**12,84895**
Prob. (F-statistic)	**0,000000**	Durbin-Watson stat.		**2,096681**

The Durbin-Watson criterion, in model 1, is very low and shows the presence of autocorrelation, as well as the possibility of the presence of "false" regression **(Table 2)**. In model 2, the values of this criterion are close to 2 which indicates a lack of autocorrelation in the residues, or the established regression between the variables can be perceived as existing **(Table 3)**. The low values of the Akaike info criterion show that the constructed models well describe the change in the studied variables. When comparing the values of the criterion for the individual models, it can be seen that the difference is very small **(Table 2 and Table 3)**. The main weakness of both models is that the constant is not significant.

The analysis of **Table 4** shows that the fixed individual effect by regions reveals the presence of very large differences among the studied six regions for the covered period of five years. In this case, Nenova (11) proposes the formation of groups. In the present study, based on the obtained values, three groups can be distinguished: the first group, regions with a high positive fixed effect (over 500); the second group, regions with a lower positive fixed effect (0 to 499); and the third group, regions with a negative fixed effect. The first group includes the Severozapaden and Severen tsentralen region, the second group includes the Severoiztochen and Yugoiztochen region, and the third group includes the Yugozapaden and Yuzhen tsentralen region.

It can be assumed that in the regions with high positive effect (Severozapaden and Severen tsentralen region) there is a greater influence of endogenous quantities on the dependent variable, at the expense of those not included in the model and vice versa - for close to 0 and negative values. In addition, consequently, it can be pointed out that in the presence of a large positive effect, the

influence of the variables covered in the model on the dependent quantity is stronger, and vice versa - in the presence of a negative effect, their influence weakens.

Table 4. *Results describing the effects of Model 2*

	REGION	Cross-sectional Effect	Years	Time Effect
1	Severozapaden	1019,051	2014	-107,9049
2	Severen tsentralen	553,0834	2015	-5,956254
3	Severoiztochen	107,5299	2016	-42,05420
4	Yugoiztochen	286,3663	2017	71,07794
5	Yugozapaden	-1421,845	2018	84,83739
6	Yuzhen tsentralen	-544,1856		

CONCLUSION

It can be summarised that the presence of positive individual spatial effects shows that in these regions (Severozapaden, Severen tsentralen, Severoiztochen, Yugoiztochen) there are unused opportunities for GDP growth. This may mean that it is necessary to increase investments which in the model have a negative sign due to the fact that their size for the period decreases and the level of GDP increases at a slow pace. The change in the economic indicator for structural business statistics shows the presence of opportunities generated by a change in the structure of business units in these regions and the transition to higher value-added industries. At the same time, compensation of employees for the studied period increases, which can be interpreted as an increase in labour productivity as a result of the acquisition of specific knowledge and skills by staff, i.e. increase in human capital (12), not investing physical capital in technological innovation. The calculated fixed effect by years (model 2) divides the study period into two sub-periods. The first sub-period (2014 - 2016) is characterised by negative individual effects, and the second sub-period (2017 - 2018) - with positive ones. This shows that initially GDP grows more slowly than the variables included in the model and in 2017 – this trend is reversed.

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