Visegrad Four Countries – Case Study of Econometric Panel Data Model for Regional Competitiveness Evaluation

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Abstract

The aim of the paper is to create an econometric panel data model with techniques using dummy variables for simplification of regional competitiveness evaluation in the case of selected EU Visegrad Four (V4) countries. Theoretical background of the paper is based on the knowledge of theoretical concept and issues of regional competitiveness and productivity in the context of growth theories. The empirical part of the paper is focused on the application of linear panel data regression model for 35 regions at NUTS level 2 of selected V4 countries. The level of regional competitiveness is analysed by selected indicators evaluating the performance of the EU growth strategies objectives. Selection of explanatory variables in the panel data model appropriately reflects the level of competitive potential in NUTS 2 regions of the selected EU V4 countries in the reference period 2000 - 2008. The use of econometric panel data model seems to be appropriate, since it marks the better capture of the dynamics of changes and fixed or random effects that have occurred in the proposed explanatory variables. Based on the estimation of the panel data model, econometric and economic verification, the final part of the paper includes a comparison of results for all explanatory variables in NUTS 2 regions which are cross-sectional and time used to determine the order of influence of each NUTS 2 region of the selected V4 countries to the overall competitiveness of the European Union. The basic hypothesis assumes that the average value of EU 27 GDP per capita is considered as an ideal region, i.e., the most competitive region. In the paper, we have observed contributions of each statistically significant V4 NUTS 2 region to the average level of the whole EU 27 performance approximated by GDP per inhabitant in PPS. For the model purposes, the overall EU competitiveness is approximated with the average volume of GDP per capita in PPS for 271 NUTS 2 regions in the EU 27, according to the NUTS 2008 -2011 classification methodology.

Key words: competitiveness, Visegrad Four, NUTS 2 region, macro econometric modelling, panel data model

1. INTRODUCTION

Effectively analysed competitiveness means to be based on a defined concept of competitiveness. For evaluation of regional competitiveness, we face the problem of the basic concept and definition of competitiveness due to absence of a consistent approach of its definition. Competitiveness has become quite a common term used in many professional and non-specialized publications. Evaluation of the competitiveness issue is not less complicated. In the absence of mainstream views on the assessment of competitiveness, there is sample room for the presentation of individual approaches to its evaluation. In our paper we will examine the possibility of evaluation the competitiveness of the regions of selected Czech and Slovak regions at NUTS 2 level in terms of analytic hierarchy process. The level of NUTS 2 regions for evaluation of com-

petitiveness seems to be legitimate especially because of the fact that European Commission accents the level of regional units from aims of economic and social cohesion view and realization of structural aid in the EU member states. When making concept of suitable evaluation tools of national and regional competitiveness it is necessary to suggest not only difficult but also simple methods which enable quick evaluation of competitiveness by accessible tools. This paper examines the possibility of evaluation the competitiveness of the regions of selected V4 countries at NUTS 2 level in terms of macro econometric modelling methodology (see e.g. Garrat, Lee, Pesaran, Shin, 2006; Šmídková, 1995) which as one of the techniques offers panel data regression models (see e.g. Greene, 2007; Baltagi, 2008). Macro econometric modelling as a scientific discipline allowing the estimation of the regression model, which would have sufficient economic importance to the appropriate regional indicators, which would be based on economic theories and approaches directly, reflect developments in the regions and their competitive potential.

2. THEORETICAL BASIS OF COMPETITIVENESS IN REGIONAL CONTEXT

2.1 Definition of Competitiveness

The *definition of competitiveness* is a problematic issue because of the *lack of mainstream view* for understanding this term. Competitiveness remains a concept that is not well understood and that can be understood in different ways and levels despite widespread acceptance of its importance. Competitiveness is one of the fundamental criteria for evaluating economic performance, and also reflects the success in the broader comparison. The concept competitiveness is understood at different levels especially at the *microeconomic and* the *macroeconomic level*, among which is the difference. In original meaning the concept of competitiveness was applied only to companies and corporate strategies. Competitiveness of companies is usually understood as *the ability to provide products and services as well as or more effective than their main competitors* (Porter, 2003).

Nowadays, competitiveness is one of the most monitored characteristic of national economies and is increasingly appearing in the evaluation of their prosperity, welfare and living standards. The need for a theoretical definition of competitiveness at the macroeconomic level, emerged with the development of globalization process in world economy, so because of increased competition between countries. Despite of that, growth competitiveness of the territory belongs to the main priorities of the economic policies of the countries, there does not exist (compared with the competitiveness at the microeconomic level) a uniform definition and understanding of national competitiveness. The concept of national or regional competitiveness is an object of numerous discussions. One of the most common interpretations of this term understood *national competitiveness* as the ability to produce goods and services that are able to successfully face international competition, and people can enjoy growing and sustainable living standards (Klvačová, Malý, 2008). The Organization for Economic Cooperation and Development (OECD) defines the national competitiveness as *the degree or extent to which the country, in terms of open and fair trade, produce goods and services which meet the test of international markets while maintaining and increasing the real incomes of its citizens in the long run* (Garelli, 2002). Michael Porter suggests that the best way to understanding competitiveness is through the sources of a nation's prosperity. *"A nation's standard*

of living is determined by the productivity of its economy, which is measured by the value of its goods and services produced per unit of the nation's human, capital and natural resources. True competitiveness, then, is measured by productivity. Productivity allows a nation to support high wages, a strong currency and attractive returns to capital and with them a high standard of living" (Porter, 2003). The European Commission offers similar definition of this term in The Sixth Periodic Report on the Social and Economic Situation of Regions in the EU: *"...the ability to produce goods and services which meet the test of international markets, while at the same time maintaining high and sustainable levels of income or more generally, the ability of (regions) to generate, while being exposed to external competition, relatively high income and employment levels"* (European Commission, 1999). European Commission presented in the European Competitiveness Report that *the economy is competitive if its population enjoy a high and constantly rising living standards and permanently high employment.*

2.2 Concept of Regional Competitiveness

In last few years the topic about *regional competitiveness* stands in the front of economic interest. The concept of competitiveness has quickly spread into the regional level, but the notion of regional competitiveness is also contentious. Macroeconomic concept of national competitiveness cannot be fully applied at the regional level because the regional competitiveness is much worse and less clear defined; between these two concepts is a big difference (see e.g. Krugman, 1994). In the global economy regions are increasingly becoming the drivers of the economy and generally one of the most striking features of regional economies is the presence of clusters, or geographic concentrations of linked industries (Porter, 2003). Current economic fundamentals are threatened by the shifting of production activities to places with better conditions. The regional competitiveness is also affected by the regionalization of public policy because of the shifting of decision-making and coordination of activities at the regional level. Within governmental circles, interest has grown in the *regional foundations* of national competitiveness, and with developing new forms of regionally based policy interventions to help improve the competitiveness of every region and major city, and hence the national economy as a whole. Regions play an increasingly important role in the economic development of states. *Regional competitiveness can be understood as the result of joint efforts on the most productive use of internal resources development in the interaction with the use of external resources and development opportunities focused on sustainable increases in production potential* (Viturka, 2008).

The notion of regional competitiveness is also contentious. There are questions over how regions compete, and the extent to which regions are meaningful economic units to which the concept of competitiveness can be meaningfully applied. To talk of regional competitiveness would seem to imply that regional economies are like firms or nation-states, and are in competition with one another. However, *regions are neither like firms nor nations.* A region is not simply a scaled-up version of the individual micro firm, nor the simple aggregation of many such firms. Regions are not economic 'actors' in the sense that firms are. They have limited direct control of the activities that take place within them, and they have a lower level of organizational identity and, arguably, unity that firms and nation states. Rather, their economic prosperity can be significantly influenced by the macro level fiscal and monetary policies pursued by the nation-state.

The starting point for analyses and comparisons of regional competitiveness would thus seem to be examination of relative *regional aggregate productive performance* – output per head, output per

worker, and employment. The latter are what might be termed 'revealed' measures of overall regional competitiveness, themselves the outcome of complex underlying factors and processes. Trends in a region's aggregate performance, relative to trends in other regions, should reveal something about a region's dynamic competitive advantage (Martin, 2005).

2.3 Approaches to Competitiveness Evaluation

Evaluation of competitiveness is no less complex as the definition and understanding of the concept itself. Creation of competitiveness evaluation system in terms of the EU is greatly complicated by heterogeneity of countries and regions and also by own approach to the original concept of competitiveness. Evaluation of competitiveness in terms of differences between countries and regions should be measured through complex of economic (Enright et al, 1996), social and environmental criteria that can identify imbalance areas that cause main disparities. Currently not only quantitative but also qualitative development at the national level, and especially at the regional level, increase socio-economic attraction and create new opportunities that are fundamentals for subsequent overcoming disparities and increasing the competitiveness of the territory.

Competitiveness is most commonly evaluated by *decomposition of aggregate macroeconomic indicators* of international organizations. Competitiveness of countries is monitored in many institutions; however, two well-known international institutes publish most reputable competitiveness reports. To compare a level of competitiveness of countries we can use the databases performed by *Institute for Management Development* (IMD) and *World Economic Forum* (WEF). The World Economic Forum publishes the *Global Competitiveness Report* (GCR) that produces annual competitiveness indices that rank national economies. Global Competitiveness Reports use two main aggregate indexes for measuring the level of competitiveness – the *Global Competitiveness Index* (GCI) and the *Business Competitiveness Index* (BCI). The Institute for Management Development ranking on competitiveness is realized in the *World Competitiveness Yearbook* (WCY) which provides a comprehensive report on the competitiveness of countries assesses and analyses the national conditions for business competitiveness.

Regional competitiveness and its evaluation are issues constantly in the forefront of economic sciences, which lacks a mainstream method of regional competitiveness monitoring and evaluation. Decomposition of aggregate macroeconomic indicators is most common used approach at the regional level, as well as *comprehensive* (mostly descriptive) analysis aimed at identifying the key factors of regional development, productivity and economic growth (see e.g. Blažek, Viturka, 2008; Martin, 2003). Another approach is presented by EU *structural indicators evaluation*. These indicators are used for the assessment and the attainment of the objectives of the Lisbon Strategy. We can also find approach presented by application of analytic hierarchy process (Kiszová, Nevima, 2012).

Finally, we can provide an approach of *macro econometric modelling* and create econometric regression model (see e.g. Nevima, Melecký, 2012). *Evaluation of regional competitiveness* is determined by the chosen territorial region level, especially in terms of the European Union through the *Nomenclature of Units for Territorial Statistics* (NUTS). No less importance is the reference period, availability and periodicity of data, and selection of convenient specific factors. For evaluation of regional competitiveness is necessary to note that the data availability decreases in direct proportion to the lower territorial unit.

Comparing instruments for measuring and evaluation of competitiveness in terms of the EU is. There is linkages among instruments for measuring the EU competitiveness both national and regional level. There are different time period series at both levels, overlap of indicators of EU's Growth Strategies at national and regional level. Further there is continuity between approach of the WEF and approach of the EU to measuring and evaluation of EU competitiveness. Between EU Competitiveness and cohesion policy there is a link in terms of Reports on Economic and Social Cohesion – 4th and 5th reports (2007, 2010) articulated a special indices for measuring and evaluation of competitiveness of European regions. Indicators and indices cover a broad area of economic, social and environmental interests, but coverage and reference period decrease in direct proportion to the lower territorial unit. Because of these clear and close link among instruments (indicators and indices) for measuring of competitiveness is difficult to choose just the "best approach" to evaluation.

3. RESEARCH METHODS USED

3.1 Methodological Background of the Analysis

Regional panel data models, they form a link between micro and macro components and are constructed mostly ad hoc. The explanatory and interpretive ability is mainly dependent on the fulfilment of the appropriate model and especially the available data and specification of the applied model.

Before the *panel data model* will be defined, let us have the *benefits* of this model compared to conventional linear regression models. In the panel data model, we can concentrate more than a simple classical regression model. We are better able to affect the dynamics of change, to which the individual variables occurred. The main advantage is the detection of fixed, respectively random effects, which we were able to diagnose only cross-application data or time series. Another advantage is to design and test of complex models with an appropriate number of degrees of freedom. Further advantages and disadvantages of macro-econometric modelling states, for example Šmídková (1995). When using panel data model, there are also greatly eliminated variations caused by aggregation of data sets used. Panel model is used not only for a mezzo-business applications, but also in areas such as microeconomics and macroeconomics (Heij, Ch. et al, 2004), it is suitable for the analysis of competitiveness.

3.2 Sample of Regions and Data Base for Econometric Analysis

The utilization of panel data model for empirical analysis of regional competitiveness in EU V4 countries was motivated by previous research of the authors. The partial research was concentrated on application of panel data model in analysis and evaluation of competitiveness of 35 NUTS 2 Visegrad Four regions. For more detail of the results see Melecký, Nevima, (2011a, 2011b). The previous panel data model has been established on similar set of indicators and same reference period (2000-2008) in the frame of 35 NUTS 2 regions of Visegrad Countries. Paper wants to apply and test panel data model in different sample of observations presented by macroeconomic indicators of 35 selected NUTS 2 regions in V4 countries. The main *selection criterion* for V4 countries and their regions is presented by Gross Domestic Product in Purchasing Power Standard (PPS) per inhabitant in millions of the EU average (EU 27=100). This criterion we

found like a "mirror" of competitiveness performance in accordance with economic theory.

Data base econometric model for measuring regional competitiveness in 35 NUTS 2 regions of V4 countries is made up of regional data, which was taken from the database of the European Statistical Office - module Regional Statistics (Eurostat, 2011b) and from OECD *Regional Statistics* (OECD iLibrary, 2012). Under regional data has been used time series of four indicators expressed in all volumes per inhabitant. We use annual basis regional data sheets that include: Gross domestic product *(GDP)*, Gross fixed capital formation *(GFCF)*, Gross expenditure on research and development *(GERD)* and Net disposable income of households *(NDI)*. Comparability of data over time was ensured by using time series of the available indicators in PPS. Within each of selected indicators were always counted the average for the EU 27. The data analysis cover reference period 2000 - 2008.

3.3 The Specification of the Econometric Model of Panel Data for Selected V4 Regions

The estimate for each of the regions is the output of generally formulated model of the panel data. Due to it, we obtain the look at the level of competitiveness of each region. The access can be applied also on low number of observing in time, in our case for each NUTS 2 region during period 2000 – 2008 there were 9 observations. The negative of low number of observations in time is eliminated by using panel data and due to technique of *dummy variables* it is possible to observe regional disparities (fixed effects). The logging for the estimate of panel linear regression model with using of dummy variables for NUTS 2 regions of selected regions of Visegrad Four countries is with using above specified data base following (1):

$$GDP_{r,t} = \hat{\alpha} + \hat{\beta}_1 GFCF_{r,t} + \hat{\beta}_2 GERD_{r,t} + \hat{\beta}_3 NDI_{r,t} + \sum_{r=1}^{35} \hat{\gamma}_r D_{r,t} + \hat{\varepsilon}_{r,t} \quad (1)$$

Where:

$GDP_{r,t}$ Gross domestic product;

$GFCF_{r,t}$ Gross fixed capital formation;

$GERD_{r,t}$ Gross domestic expenditures on research and development;

$NDI_{r,t}$ Net disposable income;

α Constant;

$\beta_{1,\ldots,5}$ Slope parameter of regression model;

γ_r Differences parameter of fixed effects;

$\varepsilon_{r,t}$ Random error;

$D_{r,t}$ Binary variable for region specification;

$D_{r,t} = 1$(if it takes data of the region "r" in time "t"; $D_{r,t} = 0$ otherwise;

r Indexes sectional characteristics (in our case NUTS 2 regions of V4; *basic „region"* is average of EU 27 regions;

$r = 1, 2, \ldots, 35$ (in our case 35 selected regions of V4);

t Indexes time; $t = 2000, 2001, \ldots, 2008$.

Let's introduce single input variables, which are included in the model. GDP is in the position of explained variable. GDP was chosen as it is one of the most important macroeconomic aggregate which is simultaneously suitable basic for competitiveness assessment of the country, but also for the regional level, where also NUTS 2 regions belong.

Paper comes from the OECD competitiveness definition, according to which is competitiveness specified by *ability to produce products and services, which compete in the international competition test*. At the same time it is able to keep or increase real GDP. Simultaneously, by keeping assigned hypothesis, it is valid, that GDP is the *symptom of region competitiveness*, as regions with increasing GDP have ideal presumption for long-term increasing of their competitiveness or otherwise. It is obviously not always valid that with increasing level of GDP (i.e. increasing efficiency of regions) also the rate of obtained competitiveness or competitive advantage grows. However, this presumption is initial for lots of grow theories and theories of regional competitiveness (see e.g. Martin, 2003; Gardiner, Martin, Tyler, 2004; Hančlová et. al, 2010).

Explanatory variables of estimated model fulfil the role of the source base for following growth of GDP. Gross fixed capital formation (GFCF) due to international accounting is a basic part of gross capital (capital investments), in which is also the change of inventories and net acquisition of valuables included. According to ESA 95 (European System of Accounts) methodology GFCF consists of the net assets acquisition minus decrease of fixed assets at residential producers during the time period plus certain increasing towards the value of non-produced assets originated as a consequence of production activity of producers or institutional units. Net fixed capital formation is the difference between gross fixed capital formation and fixed capital consumption. It is estimated in purchase price including costs connected with instalment and other costs on transfer of the ownership. Fixed assets are tangible or intangible/invisible assets produced as the output from production process and are used in production process repeatedly or continuously during the one-year period. However, GFCF sense is much broader. It is an index of *innovating competitiveness* which enables to increase production on modern technical base. Gross domestic expenditures on research and development (GERD) are sources for further economic growth increasing as stimulation of basic and applied research creates big multiplication effects with long-term efficiency and presumptions for long-term economic growth in economics. R&D is defined as creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society and the use of this stock of knowledge to devise new applications. Net disposable income of households (NDI) is the result of current receipts and expenditures, primary and secondary disposal of incomes. It explicitly excludes capital transfers, real profits and loss from possession and consequences of the events as disasters. In contrast to gross disposable income it does not cover fixed capital consumption. Disposable income (gross or net) is the source of expenditures on final consumption cover and savings in the sectors: governmental institutions, households and non-profit institutions for households. In sectors of non-financial enterprises and financial institutions is disposable income equal to savings.

From the explanation of regression linear model of panel data theorem is clear that it is necessary to assign dummy variable $D_{r,t}$ for each selected NUTS 2 region of V4 before estimate of the model is provided. Overall, the model will content 35 of the dummy variables, which assigning is obvious from the following table 1.

Tab. 1 – Assigning of the dummy variables for selected NUTS 2 Visegrad Four regions.
Source: Eurostat, 2012, own elaboration

Dummy variable	Code	Name of the region	Dummy variable	Code	Name of the region
D_{1t}	CZ01	Praha	D_{19t}	PL22	Slaskie
D_{2t}	CZ02	Střední Čechy	D_{20t}	PL31	Lubelskie
D_{3t}	CZ03	Jihozápad	D_{21t}	PL32	Podkarpackie
D_{4t}	CZ04	Severozápad	D_{22t}	PL33	Swietokrzyskie
D_{5t}	CZ05	Severovýchod	D_{23t}	PL34	Podlaskie
D_{6t}	CZ06	Jihovýchod	D_{24t}	PL41	Wielkopolskie
D_{7t}	CZ07	Střední Morava	D_{25t}	PL42	Zachodniopomorskie
D_{8t}	CZ08	Moravskoslezsko	D_{26t}	PL43	Lubuskie
D_{9t}	HU10	Közép-Magyarország	D_{27t}	PL51	Dolnoslaskie
D_{10t}	HU21	Közép-Dunántúl	D_{28t}	PL52	Opolskie
D_{11t}	HU22	Nyugat-Dunántúl	D_{29t}	PL61	Kujawsko-Pomorskie
D_{12t}	HU23	Dél-Dunántúl	D_{30t}	PL62	Warminsko-Mazurskie
D_{13t}	HU31	Észak-Magyarország	D_{31t}	PL63	Pomorskie
D_{14t}	HU32	Észak-Alföld	D_{32t}	SK01	Bratislavský kraj
D_{15t}	HU33	Dél-Alföld	D_{33t}	SK02	Západní Slovensko
D_{16t}	PL11	Lódzkie	D_{34t}	SK03	Střední Slovensko
D_{17t}	PL12	Mazowieckie	D_{35t}	SK04	Východní Slovensko
D_{18t}	PL21	Malopolskie			

The model conception unambiguously determines which regions contribute to total average output of EU 27 by its economic level, which is approximated in endogenous variable by *GDP per capita*. According to the *hypothesis*, that average of EU 27 stands for *ideal region* – the most competitive region, it will be valid: the higher value of γ_r, the higher contribution of each NUTS 2 region to average level of economic output of whole EU 27. The regions with the highest contribution will be currently considered as the most competitive. This aspect is crucial for the model. The value of γ_r sets "distance" of V4 regions from level constant so called ideal region. Based on that contribution of regions towards total competitiveness is set. The process presents own access of the authors to the solved problems.

4. APPLICATION OF ECONOMETRIC PANEL DATA MODEL

4.1 The Estimate of Econometric Panel Data Model

The panel linear regression model will be estimated on method of least squares (OLS). The statistical verification will be evaluated on 5 % level of statistic significance. For calculation SPSS software for Windows (15.0 version) has been used.

Economic verification deals with the explanation of the meaning and formulating of the conclusions on economic behaviour. The formula (2) is the result of (the first) estimate of panel linear model by dummy variables technique included all regions:

$$\hat{GDP}_{r,t} = 0.86GFCF_{r,t} + 9.48GERD_{r,t} + 1.83NDI_{r,t} + \\ + 112156D_{1,t} + ... + 5307.6D_{35,t} \quad (2)$$

When we look at the formula, it is evident that all 3 explanatory variables have a *different partial influence* on the development of average GDP per capita for EU 27. It is valid, at the same time, that relations in formula (2) are inter-dependent, i.e. their significance, respectively their economic influence can mutually overlap. Indicator of gross domestic expenditures on research and development (GERD) has the highest partial influence. The second partial influence on economic growth has increasing of net disposable income (NDI). The lowest impact has parameter of gross fixed capital formation (GFCF).

After providing brief economic verification, *statistic* and *econometric verification* follows. The *F–test* for evaluation of model significance as whole was used. At testing of model significance the model is statistically significant (level of significance 5 %). *T-test* for testing of partial regression coefficients was used. All of regression coefficients (parameters) are statistically significant (lower than 5 % level of significance).

After statistical verification view phase of *econometric verification* follows. Econometric verification consists of testing of presence/absence of autocorrelation, heteroscedasticity and multicolinearity in the model. The *autocorrelation* was tested mathematically by Durbin – Watson (D–W) test and graphically by using autocorrelation (ACF) and partial autocorrelation (PACF) function. The value at D–W test at estimated model is 1.562. The value acts for evaluation of autocorrelation presence (serial dependency of residual components connected with sectional and time influences of panel model). According to critical values of D-W test, *the presence of autocorrelation was proved*. It was acknowledged by orientation graphical test which verifies D-W test validity (D-W test identifies autocorrelation of residues of the first order). The test identified presence of autocorrelation, especially of the first order and confirmed also autocorrelation of higher orders. However, this is not systematic. The fact led us to removing of autocorrelation of residues or to reduction of their influence.

In the view of this fact (presence of autocorrelation in model) we provide corrections of econometric model.

The correct estimate of the model was realised by Cochrane-Orcutt (C-O) method. C-O method is de facto algorithm for estimation of regression model by GLS method in case of autocorrelation of first order residues. It subsists in transformation of the original model when using Rho parameter and its estimation by OLS method. In fact, correct estimation negated all above presented results of verifications. However, by C-O method application we removed autocorrelation of first and higher orders from the model. *The formula (3) shows the final form of corrected estimation:*

$$\hat{GDP}_{r,t} = 0.706GFCF_{r,t} + 10.412GERD_{r,t} + 1.898NDI_{r,t} + \\ + 11278024D_{1,t} + ... + 5593.126D_{35,t} \quad (3)$$

The estimate of formula signalizes that change of statistical significance of the model has not occurred as whole and simultaneously all parameters of the corrected model are statistically significant. Then we can continue in economic verification tests. Autocorrelation in corrected

model was not proved. The value of D-W test is 1.949. It means that also according to critical values of D-W statistics as well as according to orientation graphical test autocorrelation of first order was removed.

The next part of econometric verification covers testing on heteroscedasticity and multicolinearity presence. The final corrected model can be considered as homoscedastic on selected level of significance, which was verified by graphical test. The graph could be constructed which could evaluate development in each region. However, for purpose of the paper, the graph which evaluates development of standardised value of residua of corrected model against predicted value (GDP for all regions) was constructed. By evaluating the presence of multicolinearity in the model we have to consider eventuality of inner-cohesion of explanatory variables. For the purpose of the work multicolinearity was orientation tested only by pair correlation coefficient. The reasons of multicolinearity we can see mainly in economic view. There is a narrow structural interconnection which is economic logical and justifiable. Another factor is a small number of observations for each region. However, the value of pair correlation does not lower relevance of presented results. Moreover, due to methodical recommendation, multicolinearity is diagnosed when it is statistically significant and the value of a pair correlation coefficient is about 0.9. In our case it is not so, as both conditions are not fulfilled simultaneously.

4.2 Results Interpretation

After brief econometric verification we can verify the model from *economic point of view*. When interpreting corrected estimate we have to emphasize that all 3 explanatory variables *have different partial influence* on development of average GDP per capita of EU 27. Simultaneously it is valid that relations in the formula (3) are inter-dependent, i.e. their significance, respectively economic influence can overlap and depends on explanatory variables selection. GERD has higher partial influence, which was proved again (when increasing GERD by 1 million €, ceteris paribus condition, the change of average level of expected GDP EU 27 can be increased about 10.412 millions €). NDI has the second higher partial influence on next economic growth, here by increasing by 1 million € the change of average level of expected GDP of EU 27 can be expected at approximately 1.898 million €, ceteris paribus. It was found out, that increasing of GFCF by 1 million can generate in average level of expected GDP of EU27 of 0.706 million € ceteris paribus, so GFCF has the lowest partial influence.

It is necessary to emphasize that above interpreted results depend on partial contribution of 35 NUTS 2 regions of EU to overall EU 27 output in reference period 2000 – 2008. The dummy variables in the panel model show, which regions *have the highest contribution to GDP formation* of EU 27 in time and section of each NUTS 2 region. The complex results of econometric model estimation in software SPSS 15.0 are introduced in appendix 1. The final order of NUTS 2 regions from their contribution view, respectively their influence on EU 27 global competitiveness measured by average level of GDP per capita is also given in appendix 1.

Among regions, which have the highest *positive impacts* on GDP per capita formation belong regions: *Bratislavský kraj* (SK01) and *Praha* (CZ01). On the other hand, the *negative impacts* on GDP formation have following regions - *Lódzkie* (PL11) and *Střední Čechy* (CZ02). As from region category with the lowest impact we will only mention CZ02 region. Here it is necessary to accent that the population of the region is mostly employed in Prague or in other words, commute to

Prague. It means that created production by population is counted in Prague. In case of region PL121 we can identify problems with decreasing number of residents and leaving to work abroad because of local textile industry decline. We should remind that the above presented model does not present economic growth, but regional competitiveness. A model of economic growth on contrary with a model of competitiveness has clearly defined form of input variables. Meanwhile in this case we more or less search for suitable factors which contribute to growth of competitiveness due to GDP production. It is logical that by a choice of other explanatory variables we can expect different competitiveness order. As factors which determine its result level would change. To say it simply, meanwhile aggregate demand comes out of System of National Account by its four-sectors´ model; in case of competitiveness we have not had the "support" in the System of National Account yet.

5. CONCLUSIONS

Presented linear regression model of panel data by using technique of dummy variables was based on original concept of econometric model specification. Average value of GDP per capita for EU 27 in period 2000 – 2008 is dependent variable at considering 3 independent variables *(GFCF, GERD, NDI)* which were chosen arbitrary and also computed per capita. The basic hypothesis assumes that average value of EU 27 GDP per capita is considered as an *ideal region*, it means the most competitive region. In the paper we have observed contributions of each statistically significant V4 NUTS 2 regions to the average level of whole EU 27 performance approximated by GDP per inhabitant in PPS. The regions with higher score of parameter γ_r have a positive impact to overall competitiveness of EU 27 because they contribute to average value of EU 27 GDP per inhabitant. The higher positive score of parameter γ_r, the higher positive impacts of NUTS 2 region on the overall competitiveness of EU 27. On the other hand, the regions with lower score of parameter γ_r have negative impacts to overall competitiveness of EU 27 because they reduce the average value of EU 27 GDP per inhabitant.

The paper outlined and verified possible way for competitiveness analysis at regional level but let's simultaneously remind that above mentioned model is not model of economic growth, but by contrast to model of competitiveness, it has explicitly defined form of input variables. Meanwhile, in this case we partially look for suitable factors which contribute to competitiveness growth by means of GDP formation.

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