REGIONAL DISPARITIES AND THE WAYS OF THEIR MEASUREMENT: THE CASE OF THE VISEGRAD FOUR COUNTRIES

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Abstract. Real convergence of countries within European Union is measured mostly at the national level by the indicator of gross domestic product (GDP) per capita. Generally, countries with relatively low GDP per capita should catch-up with richer ones and this has become the main objective of post-communist countries at the beginning of the transition process. However, when we look at the regional level and regional GDP per capita data in these countries one can assume that the intensity of real convergence strongly differs among regions and disparities between regions still prevail. The paper attempts to identify factors responsible for persistence of regional disparities in the Visegrad Four countries. In the paper, available Eurostat NUTS 3 statistical data were used for analysis of economic disparities development in the Czech Republic, Hungary, Poland and Slovakia. The paper has two main parts. In the first theoretical part approaches to regional disparities and their measurement on the basis of indexes are provided. The second, empirical, part contains description of the main trends in regional development of Visegrad Four countries. This is followed by comparison of these trends in the Visegrad Four regions. Calculations suggested conclusion that the regional disparities between regions are growing.

Keywords: regional disparities, Visegrad Four, statistical analysis, GDP.

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1. Introduction

The catching up the economic level of the original fifteen European Union countries (EU-15) by the post-communist countries of Central and Eastern Europe, which in 2004 became the EU member states, called as the process of real convergence has become a very debated

topic in the last years. Recently, the discussion about this phenomenon has taken on the intensity, particularly because of the prospective membership of some new countries in the euro area. The process of real convergence is mainly observed at the national level and the most frequently used indicator is the gross domestic product per capita, respectively its rate of growth. Generally, if the growth rate of GDP for countries with lower GDP per capita is higher than that in advanced economies, there exists a gradual convergence. Since the beginning of the transition process in the New Member States it was clear that the objective of post-communist countries will be to achieve the economic level of Western European economies within a certain timeframe. Looking at regional data, however, we find that the process of real convergence does not take place in all regions with the same intensity. For this purpose it is necessary to characterize what phenomena and processes exist in regions and which comparison has any rational sense. The aim of this paper is twofold. First, we try to provide a summary of current approaches to the extent and the impact of regional disparities in the Visegrad Four (V4) countries and the ways and methods of their measurement and evaluation. Second, we analyze the development of regional disparities of economic nature in the V4 countries. This analysis is based on specific methods and available statistical data. As the main indicator of regional imbalances we have chosen the GDP respectively GDP per capita. We used the data from Eurostat's Regional Database on selected indices. The paper is structured as follows. In the second section, based on review of literature, we discuss theoretical approaches to regional disparities. Next section deals with methodology of measurement and evaluation of regional disparities. In the fourth we describe the development of disparities in V4 countries, then we provide the estimation results and the last section concludes.

2. Approaches to measuring regional disparities

Regional disparities are understood as differences in the socio-economic development of regions that are the result of some inequalities (Matlovič *et al.* 2008). It can be said there is no consistent, principle and generally accepted terminological definition of regional disparities. Moreover, the concept of regional disparities is very often confused with the concept of regional differences. In our understanding and approach the regional disparities are a broader concept which accumulates in itself not only the existence of imbalances between the regions but also the convergence and polarization of regions. The fundamental issue in this problem is what causes the regional differences and disparities which, inter alia, generate a number of subsequent consequences not only economic in nature. The theory of regional economics uses in this context the term "cumulative causation". The disparities if they occur at the local level tend to persist and to interact which ultimately leads to the increase of differences between the territories. In other words, one socio-economic cause can initiate a number of consequences that may affect the further development of the region as a whole.

The identification and measurement of regional disparities is a fundamental aspect in the design of economic policy-making and space-based instruments that are to mitigate or eliminate these inequalities (Wishlade, Yuill 1997). Usually, the discussion on regional disparities focuses on the following issues: What types of disparity are taken into consideration? What indicators can be used to measure the disparities identified? What are the factors which determine these disparities?

In the European context it is often discussed whether the disparities have some broader context. Felsenstein and Portnov (2005) are of the opinion that even if individual studies dealing with regional disparities often use separate measurements of sub-indicators of descriptors such as evolution of the population, wages, wealth and productivity, an integral part should be the creation and the use of integrated indicators of regional disparities, especially if they are to be applied to inter-regional comparative analysis.

In the context of Czech, Slovak and Hungarian economies, which are characterized as a small open economies, it is necessary to mention another implication of these authors. They add, moreover, that the small economy may differ from the large one (in the group of V countries it is the case of Poland) in three fundamental features. First, the relatively lower number of territorial units; second, the territorial units may differ significantly in terms of population and finally, regions within the relatively small economies can faster change their position in the imaginary ranking, particularly through the development of income or number of population as in large economies the ranking is more consistent.

Following the above mentioned issues Wishlade and Yuill (1997) and many other authors distinguish between three types of disparities and they also compare the approach of individual EU countries how they select indicators for determining the value of these disparities:

- Physical disparities are associated with geographical or natural conditions and they are mostly permanent. They concern mostly climate, access or proximity to infrastructure. Indicators that authors use to express the physical nature of the disparities are primarily focused on their effects, especially on population density and aspects of migration.
- Economic disparities are related to differences in quantity or quality of regional output. To reflect the disparities in this area, the authors use a traditional indicator of gross domestic product, which is accompanied by tax revenues, industrial activity, demographic trends, economic outlook and transport facilities.
- Social disparities concern with the income and standard of living. For the majority of countries the greatest emphasis in this area is given to indicators of unemployment. Other possible indicators are unemployment structure, future employment trends, rate of economically active population, qualification structure of the population, income of population, poverty rates and housing standards.

In this paper we consider only the economic disparities. One of the most important descriptors of regional economic differences is the performance of the region, which can be compared on the basis of several indicators. The most commonly used indicator is gross domestic product (GDP), which provides initial information about the regional performance however we can derive further secondary background information on the region. An alternative expression of regional performance can be a region's share of total national GDP, GDP by economic sectors or the rate of GDP growth.

GDP represents the value of goods and services produced in all sectors in a given territory and for a certain period (calendar quarter, year). This indicator is monitored not only at the national level but also at regional level. To capture the dynamics of the real economy in time and to eliminate the effects of changes in price level, GDP is calculated in constant prices and for interregional comparison we use GDP calculated per capita in the region (GDP per capita).

The calculation of GDP is linked with certain problems, mostly of methodological nature and its predicative ability or explanatory power is often overestimated and exaggerated. Ka-

houn (2007) illustrates this argument as follows: The regional GDP per capita is calculated dividing produced GDP in the region by population regardless the place of residence and including the commuting population from other regions. This ultimately leads to an overestimation of GDP per capita in regions with large urban centers. In the Czech Republic it is typical for the region of capital Prague. In regions with weaker urban centers it is the opposite phenomenon. This effect can be seen e.g. in case of Luxembourg, which has by Svennebye (2008) the large number of foreign workers in proportion to its resident population. Although this foreign workforce contributes significantly to GDP, they are not included in the total population, which is then used to calculate GDP per capita.

3. Methodology

For the calculation of regional disparities we can choose a dual approach (Shankar, Shan 2003): a) the static measurement of regional disparities and b) the dynamic concept of measurement the regional disparities, which is based on the Solow model of economic growth and which monitors the regional development in the long term.

The first approach can further be subdivided into (i) a single-criteria comparison of a chosen indicator (e.g. a comparison of the minimum and maximum values, the coefficient of variation, the Herfindahl and Gini index) or (ii) a multi-criteria comparison of a chosen indicator (e.g. the weighted coefficient of variation, the geographical concentration index or the Theil index). In this paper we focus on the static concept of measuring regional disparities. We calculated various indexes for time series years 2000–2006 and so we tried to eliminate possible distortions (see the empirical section of the paper).

The easiest way to evaluate the regional development in the country is simply to compare the values of selected indicators and their subsequent ranking from highest to lowest value or vice versa. Other related method similar to this approach involves comparison of the lowest and the highest value reached for selected indicators. If the share of these two values is close to 1, then e.g. the GDP per capita is similar in all regions and regional disparities are not significant. This method has its weaknesses, especially in the case of GDP, which tend to be several times higher in the capital regions of countries. For this reason, this approach is not appropriate to apply for the GDP per capita.

The first statistical method that is often used for the calculation of regional disparities is the coefficient of variation, which represents the ratio between the weighted standard deviation of regional GDP per capita and national GDP per capita. Since the coefficient of variation (CV) is not dependent on measured values of input parameters, it is therefore a more appropriate instrument for comparison than solely the standard deviation, with which we can meet in the studies on regional disparities (Matlovič *et al.* 2008). The standard deviation is a measure of variability, respectively variance of random variable values around the mean (here GDP per capita). Mathematical notation of the standard deviation is as follows:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{N}(y_i - y_n)^2}{N}}, \tag{1}$$

where y_i is regional GDP per capita of i-region, y_n is national mean of GDP per capita and N is the number of regions in the country.

Coefficient of variation (CV) is defined as the ratio of the standard deviation to the mean (national GDP per capita):

$$CV = \frac{\sigma}{y_n}. \tag{2}$$

For value in percentage we have to multiply this coefficient by 100. If the GDP per capita is the same in all regions, the variance is zero. Large differences in levels of GDP per capita between regions in the country represent a fairly wide dispersion of this parameter.

However calculation of regional disparities on the basis of the coefficient of variation is insufficient for detailed analysis. We cannot derive from it, what quantity of inputs (e.g. labor force) would be needed to produce it. The incorrect interpretation may be also due not to taking into account the territorial size of individual regions. To this end, we can modify the coefficient of variation into the so-called weighted coefficient of variation (CV_w), which represents the relative measurement of dispersion standardized by the mean value of variable. Deviations from this value are weighted by the proportion of population in the region to the country's total population. This factor is independent of variable size, and therefore it is usually used to measure imbalances over time. CV_w is defined as follows (e.g. OECD 2009a):

$$CV_w = \frac{1}{y_n} \left\{ \sum_{i=1}^{N} \left[\left(y_i - y_n \right)^2 \left(\frac{p_i}{P} \right) \right] \right\}^{\frac{1}{2}}, \tag{3}$$

where $y_{i,j}$ is the variable y in the region j of the country i; $\overline{y}_i$ is the average value of the variable in the country, and $p_{i,j}$ and p_i represent the population in the region j of the country i.

The Herfindahl index represents another approach by which we can determine the degree of concentration. Herfindahl index is defined as follows:

$$H = \sum_{i=1}^{N} y_i^2, \tag{4}$$

where y_i is the proportion of the region in the production of the total GDP in the country and N represents the number of regions in the country. The index value ranges between $1/N$, which would provide the same amount of GDP generated in all regions and therefore no geographical concentration, and 1, which would mean the total concentration of GDP generated in one region, i.e. the maximum concentration.

In order to create a standardized interpretation the so-called normalized Herfindahl index was introduced and which is defined as:

$$H^\star = \frac{(H - 1/N)}{1 - 1/N}, \tag{5}$$

where N is the number of regions in the country and the value of H is the Herfindahl index. The value of the normalized version of the Herfindahl index ranges from 0 (no concentration of the GDP) to 1 (maximum concentration).

The disadvantage of this index, but also other indices defined above is that its calculation does not take into account different spatial size of individual regions, which can then

more or less distort the conclusions derived from the value of this index. From this reason frequently used are so-called concentration indexes, which are based on the ratio between the economic position (e.g. GDP) in the region within the country and the weight of the region in the country's total area. Ellison and Glaeser (1997) in their paper grasped the problem and modified the traditional Herfindahl index as follows:

$$EG = \sum_{i=1}^{N}(y_i - a_i), \tag{6}$$

where a_i represents the proportion of the region i on the country's land area and y_i region's share in the total GDP generated in the country. Then, if the proportion of total GDP of any country´s region equals to its proportion of the territorial area of the country, then the concentration index is equal to zero. On the contrary, the higher is the value of this index, the greater is the geographic concentration of GDP produced in the country. The main disadvantage of EG can be seen in its limited applicability in international comparisons, which is due to the fact that it is very sensitive to the level of regional aggregation of data as a result squaring differences between the proportion in production and in territorial size. This deficiency can be avoided by removing the squaring differences and by introducing absolute values, as it was suggested by Spiezia (2002):

$$GC = \sum_{i=1}^{N}|y_i - a_i|. \tag{7}$$

Gini index as another possible calculation provides relatively accurate picture of regional disparities. Its advantage is that it looks at regional differences not only on the highest and lowest rates of achieved GDP, but also takes into account differences among all regions in the country. The index value ranges between 0 and 1, while the higher is the index value, the greater are regional disparities in the country. However, if the size of regions is large, there is a tendency to underestimate regional disparities (OECD 2009a). In general, the Gini index is known as the area between the Lorenz curve of the concentration for given distribution and the hypothetical curve of uniform distribution of observation factor. It represents a measurement of relative concentration with the assumption of zero value for the uniform distribution. In this respect, the Gini coefficient is more sensitive than, for example Theil index (see below), since the Gini coefficient is unlike the Theil's index, derived from the average:

$$\text{Gini} = \frac{2}{N-1}\sum_{i=1}^{N-1}|F_i - Q_i|, \tag{8}$$

$$F_i = \frac{i}{N}, \tag{9}$$

$$Q_i = \frac{\sum_{j=1}^{i} y_i}{\sum_{j=1}^{N} y_i}, \tag{10}$$

where N is the number of regions, and y_j is GDP per capita in the region j and these are sorted by the value of GDP per capita (from lowest to highest).

According to OECD study (2003) the application of Gini coefficient as an indicator of regional disparities is linked with several problems: (i) the Gini coefficient is constructed for the analysis of income inequality between individuals, while we focus on the inequalities between regions. Most studies circumvent this problem by measuring the regional disparities in GDP per capita that is as income inequality between groups of individuals living in different regions. Its explanatory power is limited as it does not capture the spatial distribution of population; (ii) the Gini coefficient is also sensitive to the level of spatial aggregation. Grouped data systematically underestimate the level of regional disparities, and when the aggregations of regional data are significantly different, this index is not suitable for international comparison.

Another possible way to measure regional disparities which we used is the Theil index of non-compliance by which it is possible to assess the level of GDP disparities between regions. Mathematically, the index can be written as follows (Fujita, Hu 2001):

$$T = \sum_{r=1}^{N} \left(y_r \cdot \log \frac{y_r}{x_r} \right), \tag{11}$$

where y_r is the GDP of the *r-th* region, x_r is the region's share of the total population in the country and N represents the number of regions.

According to Villaverde and Maza (2009) the Theil index is an indicator of inequality, which is based on the concept of entropy and thus deals with deviations from perfect equality. Unlike the Gini index Theil index has consistently given the range of values. It takes values from 0 to log N, whichever is the higher value being achieved, the more there is uneven distribution of the variables. This index is used as a tool for analyzing the spatial distribution and the reason for its frequent use is the weighting system and its decomposition. These features are particularly useful for the analysis of regional imbalances in heterogeneous regional arrangements, such as is the system NUTS of regional classification used by Eurostat.

4. Development of regional disparities in the V4 countries

On the one hand, after 1989 new democratically elected governments in V4 countries had to cope with inefficient economies that were characterized by a disproportionate proportion of heavy industries, obsolete production capacities and undersized service sector, and on the other hand the inter-regional disparities were relatively insignificant in comparison with other European countries. This was mainly due to the previous communistic governments' pressure to remove inter-regional inequalities. According to Blažek (2000) this policy was quite effective but also very inefficient and it led to lag behind the West European countries in the socio-economic context. Hapiot and Slim (2004) add that the establishment of industrial centers was planned to facilitate regional development which was entirely dependent on central planning due to the lack of market mechanism. In this context, the location of industries was more dependent on political objectives and military strategies than on economic calculation based on the optimal solution. This was also the reason why e.g. transport was not supported to prevent discrimination of remote regions but to ensure "fair" development of all regions. The end of the centrally planned economy caused suspension of such aid and it caused growth of transport costs which represented a relatively strong shock for some regions during the transformation process.

The Czech Republic can be an example that these relatively small inter-regional dispari-
ties at the beginning of the transformation process led to the promotion of the neo-liberal
economic policy which rejected state interventionism. This was also the main reason why
regional policy was on the edge of government interests (Blažek 2000). However, soon after
the start of economic transition regional disparities began to appear and grew over time on
the basis of other related factors such as new economic structure, industrial and entrepre-
neurial traditions, geographic location, educational structure, development of infrastructure
and last but not least, the state of the environment. Blažek (2000) further argues that the
Czech government, despite the gradual accumulation of regional disparities, did not pay
sufficient attention and therefore did not design and implement relevant regional policy in
this period. Illner (2001) confirms this statement and argues that growth of regional dispari-
ties has been underestimated. In particular, insufficient importance was given to imbalances
between urban and rural areas in the case of their possible development or existing different
standards of living. Moreover, some regions were heavily dependent on traditional manufac-
turing industries which had limited technological potential and it was strongly sensitive to
the decreasing cost competitiveness (Kahoun 2007). Above mentioned regional differences
brought significant imbalances during the transition period that have persisted up to the
present day. As a result of the severe economic transformation, economic development from
a regional perspective showed different dynamics. Problems arose in those regions, where a
higher rate of uncompetitive and inefficient production existed. These sectors were affected
by the decline in demand or by the loss of traditional markets, which had an impact on the
loss of economic dynamics, living standards and employment. The typical examples of this
phenomenon are two traditional industrial regions (Moravskoslezsko, Severozápad) in the
Czech Republic (Martinčík 2008).

On contrary, the service sector, which is spatially concentrated in larger cities or areas
attractive for development of tourism, experienced significant growth of its share in total
employment and GDP. As a result, the widening of regional disparities has occurred and
Stryjakiewicz (2009) divides regional disparities into (i) disparities arising between east-
ern and western regions; and (ii) disparities between metropolitan and rural regions that
are significantly reflected, particularly in relationship between regions of capital cities and
regions of the rest of the country. An OECD study (2008) covers among these two types of
disparities also the so-called intra-regional disparities within individual regions, as in the
case of Poland, due to growing disparities between urban and rural areas. Petrakos (2001)
believes that a significant aspect of the transition period was a collapse of the Council for
Mutual Economic Assistance (CMEA), which had serious regional implications. Reduction
or elimination of the existing trade barriers with western countries increased imports and
exposed previously protected domestic production to international competition. As a result,
regions that were dependent on armament industry contracts within the CMEA, the regions
with prevailing mono-industries and regions with low-integrated production structures were
more sensitive and directly affected by the more open economy (Urbančíková, Burger 2010).

Concept of geographic location of a region as the cause of regional disparities is based on
its distance from the more developed regions in EU-15. Possibility of cooperation between
regions on the western borders, especially on the borders with Germany and Austria might

create competitive advantage for these regions in comparison with regions in the east. Attractiveness of the western border regions arises from the low distance from the developed regions and partly from the fact that reflects close cultural and economic relationships in these areas. However, this aspect is rather typical for the Slovak economy where we can find out strong dichotomy of economic levels between East and West (see Abraham and Vošta 2006; Uramova, Kožiak 2008) or for the Polish economy (Blažek 2000).

In this respect, Illner (2001) argues that the importance of east-west axis was overestimated in the case of the Czech Republic. It became apparent that growth of production and geographical advantages has to be supported by other aspects, such as high-quality human capital, the existence of cultural values and housing availability (Sunega *et al.* 2009). Therefore, many regions that are located on the borders with Germany and Austria are still seen as "troubled" regions, although they have obviously competitive advantage over other regions in the east. Many of eastern regions were often able to overcome their relative disadvantage resulting from remote geographic location by the mobilization of internal resources and its own activities.

Integration of New Member States in the European Union, which are without exception despite years of economic growth below the average of the original EU Member States (EU-15) – measured by GDP per capita in PPS – has stimulated a debate about a timeframe in which they will eliminate or reduce this difference. Moreover, we must take into account that the catching-up process was not conducted with the same intensity in V4 countries and it was even suspended for a time in some countries. The Czech economy is considered a representative example where the catching up process was affected by the economic crisis in last years of the 90s (1997 and 1998). Moreover, a pace of the convergence process was relatively slow during this period. Since 2000, when the economies of EU-15 Member States slowed down quite significantly, we can observe the acceleration of catching up process. Landesmann and Römisch (2007) mention that average annual growth of GDP per capita in the New Member States exceeded by nearly four percentage point growth of the EU-15 Member States in the period 2000 to 2005. This trend was particularly evident in the case of the Slovakia. On the contrary, Hungary got into serious macroeconomic problems mainly of fiscal nature in this period, which had significant influence on the catching up process. According to the report of the European Commission (2004) catching up process was rapidly accompanied by increasing regional imbalances. In this context, there is a certain parallel with Portugal and Spain, which underwent similar experience in the 80s and 90s (Barrios, Strobl 2009). This phenomenon was due to dynamic growth of rich metropolitan regions, whose economic growth remarkably affects the catching-up process of the whole country (Paas, Schlitte 2006). On the other hand, it is necessary not to confuse convergence at the national level with regional convergence (e.g. regional disparities among Czech regions). Dunford (1993) concludes that regional disparities tend to increase during periods of economic recession and decrease during periods of economic growth, suggesting their cyclical nature.

The process of convergence at the national level is monitored both in nominal and real level. To meet the conditions for entry into the euro area it is the most important nominal convergence, i.e. meeting the Maastricht convergence criteria. In addition, real convergence is especially important to maximize advantage of a single currency, i.e. the gradual elimination of the differences in the levels of the main macroeconomic indicators. While nominal

convergence is monitored at the national level, real convergence is observed at both levels, i.e. national and regional level. When looking at real convergence of V4 countries, a few questions arise (Hapiot, Slim 2004): (i) whether convergence at the national level automatically includes convergence at regional level, or (ii) whether regional convergence is a spontaneous process. It also is important to find the factors and sources which can obstruct real convergence.

Concerning the theoretical background, there are two main approaches in this area – (i) the standard neoclassical framework that advocates for spontaneous convergence; (ii) and an approach that infirms this assumption, seeking the causes of differences and seeking government engagement such as regional policy. In our case it would be setting up the criteria of suggestibility, i.e. whether the state is able to use relevant instruments to reduce or even to eliminate any disparities. Cuadrado-Roura (2001) highlights the need to keep in mind two factors. First it is an obvious influence of a national economy on the development results that reach regions in the European context. The other circumstance which is not visible in the analysis at the aggregate level is that in the case convergence is not evident; the regions can behave in a very different way.

5. Data and results

In this paper, we used data from Eurostat Regional Accounts database. Regions are divided, based on the Eurostat's methodology NUTS, into three territorial levels: (i) NUTS 1 territorial unit as major regional countries; (ii) NUTS 2 territorial unit which usually corresponds to the level of lower level of the administrative division and (iii) NUTS 3 territorial unit which generally corresponds to the lowest administrative level (see Table 1). We used data at the lowest regional level (NUTS 3) for calculations formulas which are mentioned in the previous chapter. The reason is the NUTS 3 territorial level corresponds in three out of four cases (Poland is exception) to natural administrative units in V4 countries with their own regional government. While in Hungary, the Czech Republic and Slovakia the NUTS 3 regions are essential administrative regional units (counties or regions) in case of Poland they are called sub-regions, which are artificially created regions resulting from the merger of several districts. Concerning the level of NUTS 2 regions which are important for allocation of EU Structural Funds the situation is reversed. While in Poland they are the basic regional administrative units (provinces) with their own government for the rest of V4 countries NUTS 2 level or so called cohesion regions are only a purposeful combination of 1 to 3 administrative NUTS 3 regions due to the allocation of EU Structural Funds.

As stated above, we have chosen for the calculation of individual indices of regional disparities the data at the NUTS 3 level. Moreover, these data offer among others higher variability. A certain disadvantage compared to higher level regions is the fact that the time series for individual indicators are shorter (2006 was the last available year) and often incomplete. The major complication was incomplete time series for some Polish regions which were available only since 2004. For Polish NUTS 3 regions we therefore had to use data obtained from the Polish Statistical Office. However, even here the time series were shorter and began only in 2000 which is the key condition for shortening the time series of the originally planned period 1995–2006 to shorter period 2000–2006.

Table 1. NUTS 2 and NUTS 3 level regions in V4 countries

Country	NUTS 2 regions	NUTS 3 regions
Czech Republic	8 cohesion regions	14 regions
Hungary	7 cohesion regions	20 regions
Poland	16 provinces	66 subregions
Slovakia	4 cohesion regions	8 regions

Source: Eurostat, own processing

As mentioned above, regions in V4 countries were polarized into those that managed to gradually converge to the average value of the EU-27 significantly or slightly (see Fig. 1). Significantly converging regions are mostly metropolitan regions and the gap between them and the remaining regions in the country is even expanding. Slightly converging regions belong to the rest of the country. Fig. 1 also shows the basic trends of regional development in the V4 countries at the level of NUTS 2 regions. The data at this level are compared with NUTS 3 level available in a longer time series and are suitable for determining the basic trends of regional development. The observed data show that while most of the NUTS 2 regions in the V4 converge to the average value of the EU-27 in the Czech Republic and Hungary we find regions that are stagnating or even diverging (e.g. the Northwest and Northeast region in the Czech Republic or the Hungarian regions Southern Transdanubia and Southern Great Plain). The strengthening positions of capital cities were affected mainly by the growing concentration of management functions, i.e. the headquarters of national and multinational
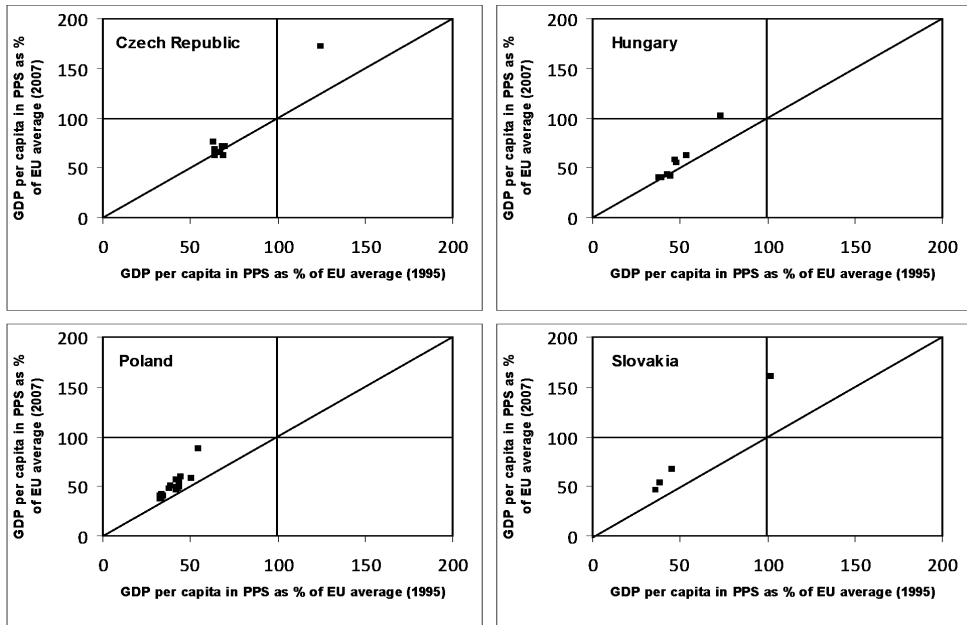

Fig. 1. Regional performance over time (NUTS 2 regions, GDP per capita. In PPS (EU27 = 100)
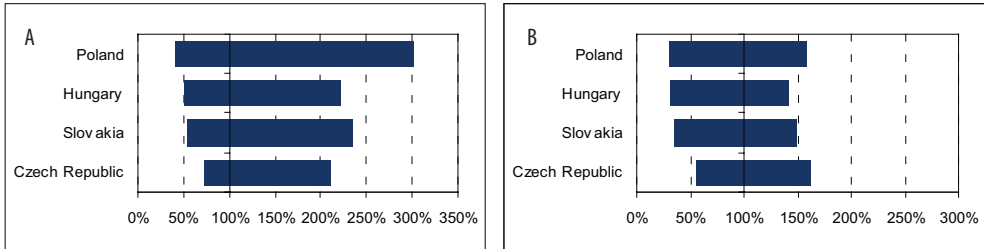
Fig. 2. The minimum and maximum range of regional GDP (NUTS 3): A) against national average,
B) to the EU-27 average (GDP per capita in purchasing power parity 2006)

companies, banks, etc. This phenomenon is also the result of the growing importance of cities in the global economy (see Pokorny *et al.* 2008).

Fig. 2 presents the basic characteristics of regional disparities (at NUTS 3 level) in V4 countries. The graph consists of two panels. In Panel A, we tried to capture the minimum and maximum value of GDP per capita against the national average in each V4 country.

As it is seen from the figure, there are significant differences in all the analyzed countries. Significantly the biggest differences were achieved in Poland, where the difference between the lowest and highest value was 235%, while for example in the Czech Republic this difference was only 139%. These data may at first sight suggests an idea that in the case of Poland there are significant regional differences in GDP per capita, which was also confirmed by the OECD study (2008) which states that Poland was among those OECD countries that exhibited the biggest regional disparities at NUTS 3 level (in the case of the OECD methodology so called TL3 regions). As it was mentioned earlier, the distinguishing phenomenon is the dominance of a capital region for all V4 countries, in which all countries reached the maximum value against the average. Panel B shows the position of regions in the V4 countries to the regional average of the EU-27. Due to the relatively higher level of mean GDP per capita in EU-27 compared to the national average variance of the minimum and maximum values is not so high and every country does not deviate significantly (range of minimum and maximum value is 107% in the Czech Republic and 128% in Poland). According to an OECD study (2009b) metropolitan regions are the most dynamically growing and a result of this development may be the fact that regional disparities tend to increase and diverge in these countries while in the original EU-15 countries the levels of regional GDP tend to converge.

Another option to measure regional disparities is the calculation of the coefficient of variation and the so-called weighted coefficient of variation. Both coefficients are calculated for the period from 2000 to 2006 (see Fig. 3). The graph shows that except for Slovakia the weighted coefficient of variation reached higher values. It could lead to the conclusion that the role of the population or its geographic distribution across NUTS 3 regions is underestimated in calculation of the simple coefficient of variation. As shown in the OECD study (2009a), V4 countries belong to those OECD countries which are characterized by the smallest values of the index of geographic concentration of population, which reflects the more even distribution among the regions (compared for example with Canada or Australia were the contrast is remarkable). The two coefficients were relatively stable in all analyzed countries
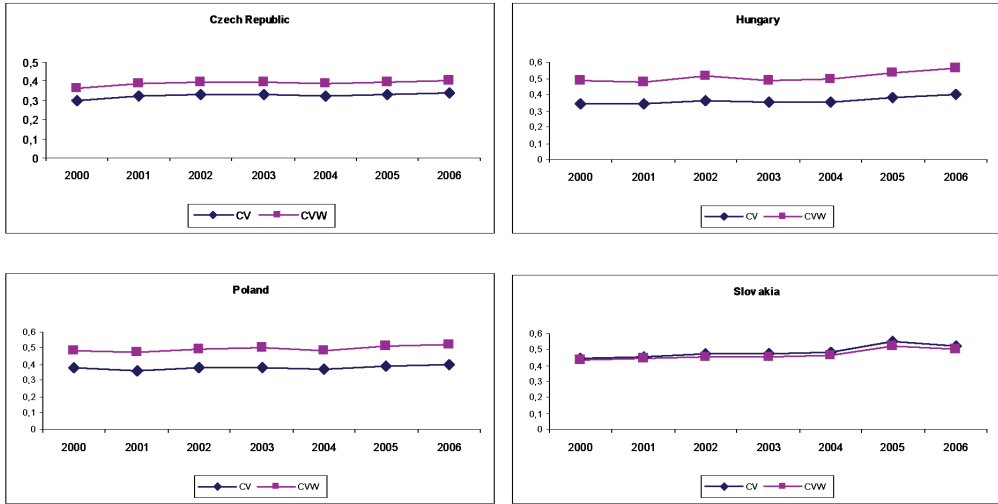
Fig. 3. The coefficient of variation and the weighted coefficient of variation
(NUTS 3 regions, 2000–2006)

in the monitored period. There was only a slight deepen of regional disparities during the monitored period. Moreover, according to an OECD study (2005) the differences in the levels of GDP per capita are more at national level which proves inter alia that the coefficient of variation of GDP per capita at the level of national economies has relatively higher stability.

Another alternative measurement of regional inequalities is to use concentration indexes, especially Normalized Herfindahl Index (NHI, values on left axis), Ellison-Glaesner index (EG, values on left axis), and Spiezia index (GC index, values on right axis). Looking at the Fig. 4, some conclusions can be drawn: (i) values of all indexes increased, (ii) the largest
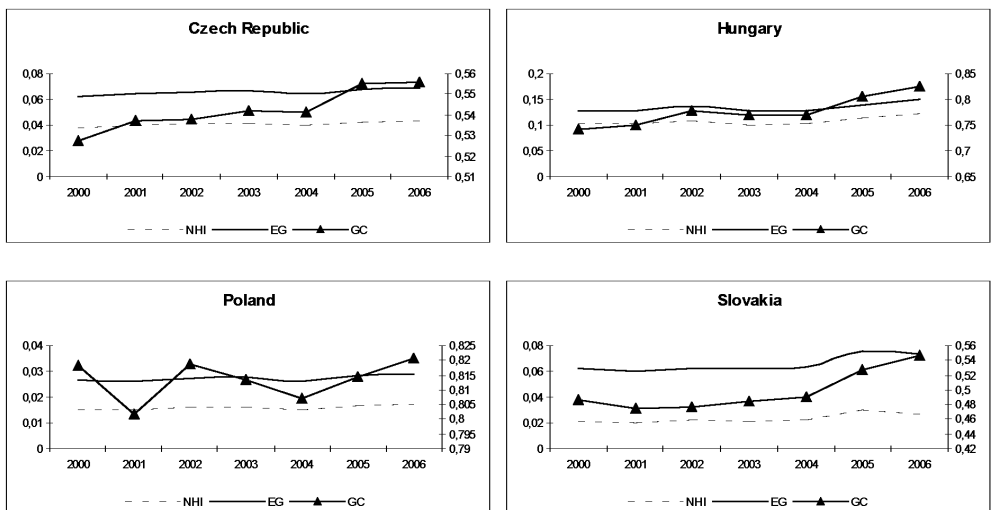

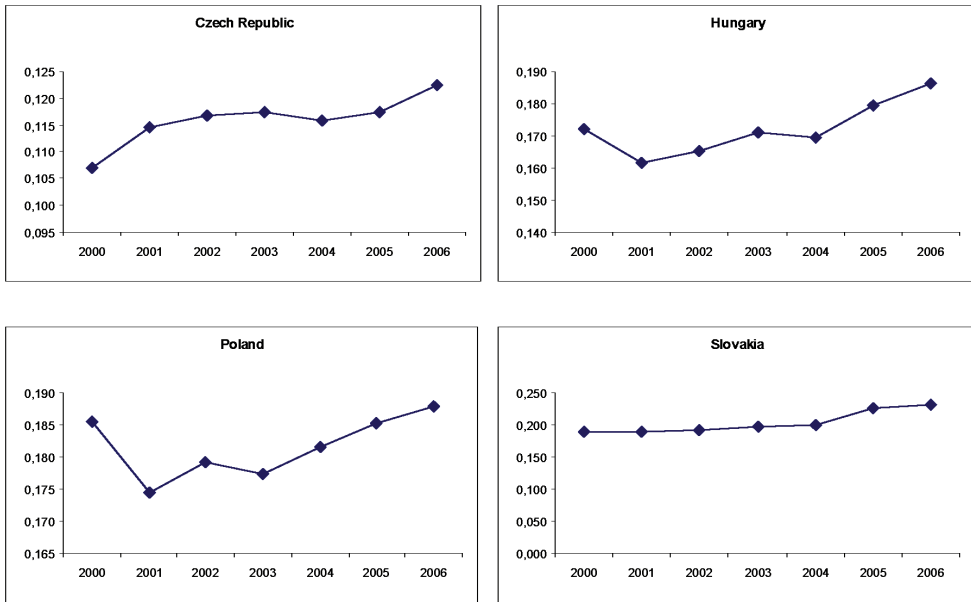**Fig. 4.** Indices of regional disparities on the NUTS 3 regions, 2000–2006

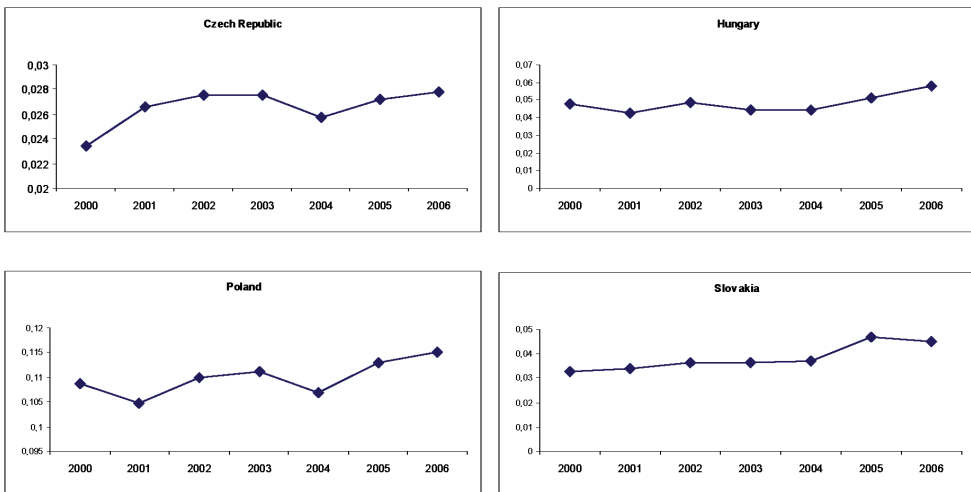**Fig. 5.** Gini index, NUTS 3, 2000–2006

Fig. 6. Theil index, NUTS 3 regions, 2000–2006

increase was recorded in the case of the GC index and significant growth was particularly seen in the last three years of the period which was accompanied by massive GDP growth in all V4 countries; this confirms the hypothesis about increasing regional disparities during the rapid catch-up process, (iii) Hungary reached the highest values of all indexes, with the exception of the GC index.

The most outstanding difference has been found out in the case of the normalized Herfindahl index. Even though the achieved value of this index in Hungary is in comparison with other V4 countries visually high, its total value reflects relatively low regional concentration of GDP production in the country. As it was already mentioned in the theoretical part, this index does not take into account spatial size of each region. Low values of this index for each country are driven mainly by the fact that we have mentioned above – most of the regions in the V4 countries oscillate around the national average, which is usually significantly beyond the capital region's level. Taking into account the geographical size of each region and comparing their proportion in the total GDP with their proportion in the total area of the country, we get the so-called indices of geographic concentration of GDP. Even in this case Hungary reached the highest values (except the GC index which reached the highest values for the Poland's economy).

We also used the Gini coefficient for calculation of regional disparities based on GDP per capita (period 2000–2006). Also in this case as Fig. 5 shows there is a gradual increase for all V4 countries. Like in the GC index the most dynamic growth in its value was recorded in the past three years of the period.

If we look at its values and compare them among V4 countries we find out that the absolutely highest values reached Slovakia followed by Poland and Hungary. In 2005, according to calculations of the OECD (2009a) Slovakia together with Mexico and Turkey were among the countries in the OECD which had the highest value of this index. The Czech Republic reached significantly lower values.

Values of the Theil index ranged relatively low in all V4 countries (see Fig. 6). From the development of values we can conclude that regional disparities increased during the monitored period, especially between 2004 and 2006.

If we concentrate on the absolute values of the Theil index, then the highest level of regional disparities was reached in Poland, the lowest one in the Czech Republic. If we look at the overall trend of values in the monitored period it is not as static as e.g. the normalized Herfindahl index or the coefficient of variation and its development can be compared with the development of the Gini index.

6. Conclusions

In this paper we monitored the development of regional disparities in V4 countries. A key indicator was GDP, respectively GDP per capita. At the same time we were also looking for links between national and regional levels in V4 countries. Generally we argue that after the accession of new members to the EU the existing regional disparities enlarged. Our analysis shows that in V4 countries there are wide regional disparities in GDP per capita which reflects uneven pace of economic development. Assessment of long-term trends in regional development in V4 countries is still difficult and the main reason is the lack of longer time series for each indicator. Problematic country for evaluation became Poland, where the data at the NUTS 3 level regions were available only since 2000 and only in the database of the National Statistical Office. Already the view at GDP per capita in different regions of the V4 countries shows a noticeable increase in regional disparities mainly between metropolitan

areas and the rest of regions in the countries. The partial calculations have confirmed the link between fast catching up the level of advanced economies and the increase of regional disparities, which were recorded e.g. in Spain and Portugal. A similar trend was recorded in the last three years of the monitored period for the majority of indices which values significantly increased. But we must add simultaneously that some regional disparities are inevitable and they even can be described as natural.

In other words, the differences in the achieved GDP, respectively GDP per capita cannot be in principle in all cases denoted as the source of the problem, which is meant in particular in relation to the level of GDP per capita in capital city regions and the rest of the country. Moreover this phenomenon is evident in all EU Member States, not only in V4 countries. More serious problem are the regional disparities among other regions of the country, which are caused mainly by structural changes. As one of the key factors that could positively affect the production of GDP in less developed regions for a short-term we consider the effective utilization of financial resources of the European Union. In this context, we consider beneficial for local governments in poorer areas to be successful in obtaining such funds under the conditions this will become economically rational investment of resources with a prolonged effect.

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REGIONINIAI SKIRTUMAI IR JŲ MATAVIMO BŪDAI: KETURIŲ VYŠEGRADO ŠALIŲ ATVEJIS

M. Tvrdoň, K. Skokan

Santrauka. Tikroji Europos Sąjungos šalių konvergencija nacionaliniu lygiu dažniausiai matuojama bendruoju vidaus produktu (BVP), tenkančiu vienam gyventojui. Apskritai pagrindinis pokomunistinių šalių tikslas pereinamojo proceso pradžioje – pasivyti turtingesnes šalis pagal BVP vienam gyventojui. Tačiau pažvelgus į duomenis, matyti, kad regioninių skirtumų vis dar yra. Straipsnyje siekiama nustatyti veiksnius, nuo kurių priklauso keturių Vyšegrado šalių regioniniai skirtumai. Šiame straipsnyje, naudojant „Eurostat" NUTS statistinius duomenis, buvo analizuojami Čekijos, Vengrijos, Lenkijos ir Slovakijos ekonominio vystymosi skirtumai. Straipsnis padalytas į dvi pagrindines dalis: pirmojoje dalyje išdėstyti regioninių skirtumų matavimo pagrindai, antrojoje, empirinėje, dalyje aprašomos pagrindinės keturių Vyšegrado šalių regioninės plėtros tendencijos. Šios tendencijos palygintos. Skaičiavimai atskleidė, kad regioniniai skirtumai didėja.

Reikšminiai žodžiai: regioniniai skirtumai, Vyšegrado ketvertukas, statistinė analizė, BVP.

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