Evolution of Regional Disparities in Spatial Dimension Urban versus Rural in V4 Countries

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Abstract

In the present era of globalization, economies of the individual regions are starting to play an increasingly important role, as the national economy of the entire country. Spatial development or conversely decline in regions might significantly influence the macroeconomic performance of the entire economy of the country. In regional structure of V4 countries, it does exist relatively extended differences among the urban and rural regions, what might also be conditioned by the spatial aspect of the territory. Spatial ties between the regions influence localization of production factors on its territory in the sense of their concentration in developed regions and deconcentration from stagnant regions, or their concentration only in some areas of stagnant regions. Urban and rural regions during its history of self -evolution, were still the object of self- struggling for production factors, offering yield, rent, interest, etc. conditioned by time shift, social trends and structural changes. The paper focuses on spatial aspects of the territory which maintains regional disparities in V4 countries and also measures the gauge of regional disparities between urban and rural regions using by structural indicators for the last decade of the 21th century.

Key words: Spatial development, region, spatial autocorrelation, regional policy

JEL Classification: R11

1 Introduction

The basic dimension of our existence is time and space. All activities that are the result of anthropogenic work of humans are being made in time and space. Evolution of human origin, accompanied by an advancement, knowledge and innovations is considered as a result of technological and social changes taking place in time. Already time was considered as factor of technological, intellectual and knowledge transformation of human society. Relevance of space did not adequately taking into account, it has been abstracted from its function of spatial dislocation and concentration of scarce resources, which were capable to initiate more broad economical and social development of the area, accompanied by technological advancement (Fáziková, 2005).

Currently, the space is the major element on field of regional planning policy in context of member states of EU countries. Spatial features of individual regions became the object of research for regional policy on supranational level for the purpose of providing development impulses to these regions. Within the area of EU countries, it is possible to bump on barriers of development due to imperfect mobility of production factors. Accumulation of these negative phenomena and its externalities cause the backwardness of these regions and tend to their mutual concentration, making it difficult to bringing adequate solutions to their future

development. On this basis, it may be considered that the regional imbalance, represented by differences in macroeconomic performance of individual regions is conditioned also spatially.

A primary object of paper is to point on the spatial conditionality of regional development and to identify the spatial imbalance in the context of regions of V4 countries. Secondary paper is focusing on measuring the gauge of regional disparities between urban and rural regions using by structural indicators.

2 Material and Methods

In our empirical research we relied on secondary data sourced collected in statistical databases from V4 countries (*www.statistics.sk, www.ksh.hu, www.stat.gov.pl, www.czso.cz)*. For analysis of spatial imbalance within the territory of V4 countries we have used state variable - regional GDP / capita.

In terms of examining causal relations of regional disparities in V4 countries is appropriate to rely on tools of spatial statistical analysis. From this point we will be concerned with measuring the spatial relations within the regional structure of V4 countries.

Our concern with the hypothesis according to which, the regional spatial differentiation within regions of V4 countries acquire more or less regular pattern. So, it proofs that regional imbalance is conditioned also spatially. By measuring we are coming out of the first law of geography, formulated by respected geographer and cartographer W. Tobler: ***everything is connected with all, but near things are related more than remote.*** (Stehlíková, 2002)
Based on gathered data we should formulate hypotheses:

H_0 = in base period within regions of V4 countries, there is no or only very low spatial autocorrelation between the examined regions
H_1= in base period within regions of V4 countries, there is mild or substantially significant spatial autocorrelation among the examined regions

As a basis for the measurement we took indicator of regional GDP / capita converted to dollars at PPP for the possibility of mutual comparison. Our sample in this case is identical to the basic sample which consists of individual regions within the V4 countries at NUTS II eventually at NUTS III level. The regions are divided into two groups in terms of regional GDP / capita on the basis of their national median regional GDP / capita.

As a key method of spatial statistical analysis we opt for the ***Moran coefficient*** for assessing the spatial autocorrelation rate. Coefficient take the values within the range of ***-1 to +1.*** Studied character (regional GDP/ capita) is dichotomous, i.e. it shall take two possible values. In our research, the first value within our sample is reg. GDP / capita in all V4 countries above the national median and the second value is reg. GDP / capita in all V4 countries below the national median. If a given character has a value which converges to +1, talking about the strong positive autocorrelation, if the value converges to -1, talking about negative autocorrelation. For values converging to 1/(n-1), studied phenomenon is randomly distributed in space (Stehlíková, 2002).

Moran coefficient can be formally specified as follows:

$$\boldsymbol{I = \frac{n}{2A}\ \frac{\sum_{i=1}^{n}\sum_{j=1;j\neq i}^{n}\delta_{ij}\,(x_i-\bar{x})(x_j-\bar{x})}{\sum_{i=1}^{n}(x_i-\bar{x})}} \qquad (1.1)$$

where
n – number of areas
A – number of borders
δ_{ij} - 1 if area *i* and *j* neighbours, δ_{ij} = 0 otherwise (i,j = 1,2, ...n)
x_i (i= 1,2...n) value of examined character *i*

In case of positive autocorrelation, regions with similar intrinsic value tend to be clustered next to each other, negative autocorrelation indicates their spatial distribution in a "checkerboard" shape and the last case (where values close to 0) tend to be randomly distributed.
Mentioned hypothesis we will statistically verify by means of two-sided test at significance level = 0.05 α significance of the spatial distribution of regional GDP / capita. The sample will be based on NUTS II level due to simplify the calculation. The basic procedure for the adoption or rejection of the null hypothesis and rejection, or adoption of an alternative hypothesis, according to Moran (1950), can be formally specified as follows:
The expected value of the Moran coefficient under the null hypothesis of no spatial autocorrelation is $\mathbf{E(I)= \frac{-1}{N-1}}$ **(**1.2)

Its variability equals to $\mathbf{Var\ (I)= \frac{N\,S_4 - S_3S_5}{(N-1)(N-2)(N-3)\left(\sum_i^n w_{ij}\right)^2}}$; where **(**1.3)

$$\boldsymbol{S_1 = \frac{1}{2}\sum_i\sum_j\left(w_{ij}+w_{ji}\right)^2} \qquad (1.4)$$

$$\boldsymbol{S_2 = \frac{\sum_i\left(\sum_j w_{ij}+\sum_j w_{ji}\right)^2}{1}} \qquad (1.5)$$

$$\boldsymbol{S_3 = \frac{N^{-1}\sum_i(x_i-\bar{x})^4}{\left(N^{-1}\sum_i(x_i-\bar{x})^2\right)^2}} \qquad (1.6)$$

$$\boldsymbol{S_4 = \frac{(N^2-3N+3)S_1 - NS_2+3\left(\sum_i\sum_j w_{ij}\right)^2}{1}} \qquad (1.7)$$

$$\boldsymbol{S_5 = S_1 - 2NS_1 + \frac{6\left(\sum_i\sum_j w_{ij}\right)^2}{1}} \qquad (1.8)$$

Resulting value of Moran coefficient we transform on statistics with normal distribution for testing the hypothesis of spatial autocorrelation at significance level α = 0.05 .

$$\mathbf{U = \frac{I-E(I)}{\sqrt{Var(I)}} \sim N\ (0,1)} \qquad (1.9)$$

Secondary, we will focus on measuring of regional disparities within the regional structure of V4 countries based on a selection from the set of panel data. For our analysis purposes we have chosen indicators which are describing the structural position of each region in the context of V4 countries:

- **Regional growth** - due to this indicator we are able to measure the pace of economic growth and convergence of region for a given reference period
- **Regional GDP/ capita –** indicator generally describing the living standard of citizens for for a given reference period

- **Average monthly gross nominal wage -** indicator generally describing the purchasing power of citizens
- **Unemployment rate -** indicator generally describing the structural position of region from the point of the labor market. The Average unemployment rate for a given reference period express the flexibility of the labor market and its resilience against the structural changes

These indicators have been chosen respectively for each region from V4 countries. In composing indicator we used all accessible data from national statistical databases in V4 countries, which were standardized on comparable level together (converted to us dollar). We have chosen selected panel data included time series of years 2001 – 20011 respectively.
Data for a given reference period were averaged by using a simple average of the relative numbers. In the case of regional growth, we used a simple geometric mean for calculating the average coefficient of economic growth in the region. Finally, we have data for all regions within individual indicators lined up from largest to smallest, and arranged the ***percentile rank[1]:***

$$\boldsymbol{p = \frac{c_l + 0{,}5 \cdot f_i}{N} \times 100\%} \qquad (2.0)$$

where

c_l – number of units smaller than currently observed unit

f_i – frequency of the reference unit

N – frequency of sample

Each region has reached a certain level of percentile for each observed indicator. Finally, the resulting percentile levels of each region were averaged to give the final percentile for all four indicators.
Finally, we formally test the hypothesis of equality of mean values resulting from the determined average percentile V4 regions according to their various stages of urbanization Considering if the aggregate macroeconomic performance of regions at NUTS III level of V4 countries is affected by the degree of urbanization. V4 regions were divided according to the degree of urbanization into three categories***: 1 Predominantly urban, 2.Temporary rural, 3.Predominantly rural*** and effects of urbanization denote by $a_i, i = 1,2,3$.Aggregate macroeconomic performance of the region (y) is given by $\boldsymbol{y_{ij} = M_y + a_i + e_{ij}}$ where $\boldsymbol{j}$ represents the region.
For the variance of macroeconomic performance of region measured by percentile applies:

$$\boldsymbol{\delta_y^2 = \delta_a^2 + \delta_e^2} \qquad (2.1)$$

Where $\boldsymbol{\delta_a^2}$ is a component of the region's macroeconomic performance variability due to varying degrees of urbanization region.

$\boldsymbol{\delta_e^2}$ - component of the region's macroeconomic performance variability due to other influences, including random effects.
In the analysis of variance further assume that the variables applies (Bakytová et al., 1979):

- variables $\boldsymbol{a_i}$ are independent, they share a common mean and variance $\boldsymbol{\delta_a^2}$[2]

[1] Note: By using indicator of unemployment rate we have used inverted percentile scale

[2] Note: Commnon assumption about the variance of variables a_i for each group we verify by setting confidence interval for the proportion of variances $\frac{\sigma_1^2}{\sigma_2^2}$ (F statistics): $(d,h) = \left(\frac{\frac{s_1^2}{s_2^2}}{F_{1-\frac{\alpha}{2}}(n_1-1,n_2-1)}, \frac{\frac{s_1^2}{s_2^2}}{F_{\frac{\alpha}{2}}(n_1-1,n_2-1)} \right)$

- variables $\boldsymbol{e_{ij}}$ are independent of each other and have a common variance $\boldsymbol{\delta_e^2}$
- variable $\boldsymbol{y}$ has a normal distribution with mean $\boldsymbol{M_y}$ and variance $\boldsymbol{\delta_y^2}$[3]

Given that the analysis of variance we consider only the single-factor, we separate the sample into our $\boldsymbol{m}$ groups, with $n_i(i = 1,2, \dots m)$ is the frequency of the i-th group. In each group, we find a group average, which is an estimate of the group mean value M_{yi}in sample

$$\boldsymbol{\overline{y_\iota} = \frac{1}{n}\sum_{j=1}^{n_i} y_{ij}} \tag{2.2}$$

and group sample variance, which is an estimate of the variance $\boldsymbol{\sigma_i^2}$ in the sample

$$\boldsymbol{S_{1i}^2 = \frac{1}{n_i - 1}\sum_{j=1}^{n_i}\left(y_{ij} - \overline{y_\iota}\right)^2} \tag{2.3}$$

To estimate the mean $\boldsymbol{M_y}$ use the total sample average

$$\boldsymbol{\overline{y} = \frac{1}{n}\sum_{i=1}^{m}\sum_{j=1}^{n_i} y_{ij}} \tag{2.4}$$

As the numbers of groups $(\boldsymbol{n_i})$ are not the same, i.e. $n_1 \neq n_2 \neq \cdots \neq n_m \; a \; \sum_{i=1}^{m} n_i = n$, account the different weight groups in the calculation of sample characteristics. Simple weighted average of the group means.

$$\boldsymbol{\overline{y} = \frac{1}{n}\sum_{i=1}^{m}\overline{y_\iota}\, n_i} \tag{2.5}$$

Variance estimates are selective characteristics

$$\boldsymbol{est\sigma_y^2 = \frac{1}{m-1}\sum_{i=1}^{m}(\overline{y_\iota} - \overline{y})^2 n_i} \tag{2.6}$$

$$\boldsymbol{F = \frac{\frac{1}{m-1}\sum_{i=1}^{m}(\overline{y_\iota} - \overline{y})^2 n_i}{\frac{1}{n-m}\sum_{i=1}^{m}\sum_{j=1}^{n_i}(y_{ij} - \overline{y})^2}} \tag{2.7}$$

In hypothesis we consider if the aggregate measured macroeconomic performance of regions, via the percentile is affected by the level of urbanization by region. A hypothesis can be formulated as follows:

H_0= within the regional structure of the V4 countries do not exist or exist only very low statistically demonstrable differences in macro-economic performance of regions depending on the degree of urbanization.

H_1 = within the regional structure of the V4 countries, there is statistically demonstrable differences in macro-economic performance of regions depending on the degree of urbanization.

Different results of calculatig test characteristics may indicate a divergence in regional development.

[3] Pozn.: This assumption has been verified in all regions of the sample by degree of urbanization rate through a test of skewness and kurtosis rate

3 Results and Discussion

3.1 Spatial imbalance in regional structure of V4 countries

Spatial imbalance for the purpose of empirical research is a relatively vague concept. Nevertheless, in general it can be characterize it as an uneven deployment of resources and services in its quality and quantity dependence of the area. Spatial imbalance is caused for numerous reasons, like religion, culture or race. Spatial imbalance is perceived as differences in wealth inequality on grounds of social and economic factors throughout the latitude and longitude (Kanbur, Venables ; 2005). In the territory, spatial imbalance may exist at various spatial levels; between states, regions and districts, between rural and urban and also between urban neighborhoods (Lall, Chakravorty ; 2005).

Most often to analyzing spatial imbalances bind indicators such as income inequality, measured as the ratio of regional GDP / inhabitant in PPS. For the analysis of income differentiation in the early period of economic transformation of V4 countries, it can be assumed from foreign studies. Based on these analyzes, we can come to the same conclusion for all V4 countries, that it can be stated, that in the late 80s and early 90s, there was quite a very moderate income polarization. Income polarization measured by the Gini coefficient according the methodology of OECD, in the case of all V4 countries ranged from 0.08 to 0.15 points (OECD, 2011). Among the most important factors affecting income inequality in the country is its degree of involvement in international trade, differences in earnings due to differences in education of the workforce, the impact of technological advances and changes in labor market policies (OECD, 2011).

These factors as determinants of income inequality and the consequent polarization of wealth in the society were created by anthropogenic human activities. In addition, we must take into account the basic factors of human development, which are raw materials, energy resources and energy systems (Volner, 2012). Income inequality, as such, to some extent, may not be harmful. Some income inequality within society stimulates the flow of investment based on labor-intensive industries, but too high income inequality acts destructive (IMF, 2012).
In the case of doing research for the aspects of spatial imbalances V4, we have created the matrices of neighborhood area, which includes all of the V4 regions at NUTS II level. In our case, we consider a symmetric matrix:

$$[35 * 35]$$

Median regional GDP / capita. in 2011 for V4 countries was set at 18 384 dollars. The final calculation we proceeded as follows:

$$I = \frac{35}{156} * \frac{10{,}08}{8{,}76} = 0{,}25793$$

In regions ofV4 countries we can speak about positive autocorrelation. Moran coefficient reached 0.25793, which indicates a moderate degree of positive spatial autocorrelation.
On significance level $\boldsymbol{\alpha = 0.05}$, we tested the hypothesis of spatial autocorrelation based on the level of regional GDP / capita in the regional structure of the V4 countries at NUTS II level. In the calculations we proceed as follows:

$$\boldsymbol{S_1 = \frac{1}{2}\sum_i \sum_j \left(w_{ij} + w_{ji}\right)^2 = 318}$$

$$\boldsymbol{S_2 = \frac{\sum_i \left(\sum_j w_{ij} + \sum_j w_{ji}\right)^2}{1} = 3072}$$

$$S_3 = \frac{N^{-1}\sum_i (x_i - \bar{x})^4}{\left(N^{-1}\sum_i (x_i - \bar{x})^2\right)^2} = 1{,}000641$$

$$S_4 = \frac{(N^2 - 3N + 3)S_1 - NS_2 + 3\left(\sum_i \sum_j w_{ij}\right)^2}{1} = 324486$$

$$S_5 = S_1 - 2NS_1 + \frac{6\left(\sum_i \sum_j w_{ij}\right)^2}{1} = 127842$$

$$\text{Var (I)} = \frac{N S_4 - S_3 S_5}{(N-1)(N-2)(N-3)\left(\sum_i^n w_{ij}\right)^2} = 0{,}012528$$

Moran index for regions of V4 countries transform on the normal distribution statistics for testing the hypothesis of spatial autocorrelation at significance level α= 0.05.

$$U = \frac{I - E(I)}{\sqrt{Var(I)}} \sim N(0,1)$$

$$u = \frac{0{,}257938 - (-0{,}02941)}{\sqrt{0{,}012528}} = 2{,}567258$$

To determine the confidence interval on significance level α= 0.05 we find in tables of normal distribution quantile $u_{0,975}$ = 1,96.The confidence interval for the alternative hypothesis is $(-\infty; -1{,}96\rangle \cup \langle 1{,}96; \infty)$. Our calculated value is realized in the given interval, and therefore we should accept the alternative hypothesis about the significance of spatial autocorrelation of regions of V4 countries at NUTS II with at least a 95% probability.

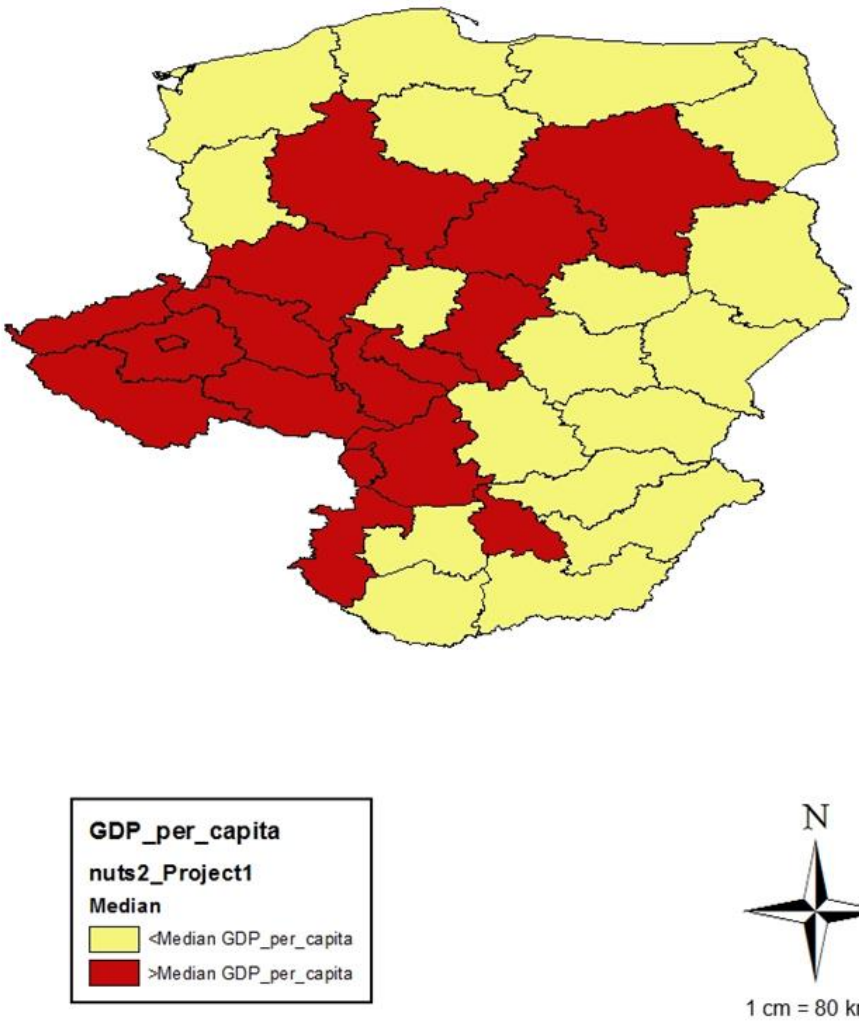

Fig. 1 Regional classification of V4 countries on base of median of regional GDP per capita
Source: own elaboration, , www.statistics.sk, www.ksh.hu, www.stat.gov.pl, www.czso.cz

From the results of our research it shows us, that may be accepted statistically significant degree of spatial autocorrelation in the regional context of V4 countries. Figure one shown us the opportunity to observe the concentration of developed and underdeveloped regions in terms of sorting character in certain tighter clusters, indicating a spatial conditionality of regional development.

The production factors of the regions come into mutual interactions, resulting in a conditional relationship in terms of economic growth and development. It may also be considered about the presence of core regions, which are characterized by higher levels of economic development. These regions are able to attract mobile factors of production and concentrate them in their catchment area. The result is economically developed core surrounded by a ring of small contingent economic centers. Such economically emerging structure is a vital element of the region and due provision of correct development impulses can grow beyond the region borders and create and link further economic chains.

The results of the research also pointed to quite clearly emerging economic gap between the western part on the one side, and the central and eastern parts of the V4 countries on the other side. Maybe consider further about factors that cause increasing backwardness of regions in CEE Europe.

3.2 Analysis of structural indicators within the regional structure of V4 countries

We are verifying the relevance of the impact of urbanization rate on macroeconomic performance of region on NUTS III level basis, by hypothesis testing for period 2001 – 2011.

$$\boldsymbol{H_0}: \boldsymbol{M_{y1} = M_{y2} = M_{y3} = M_{y4}}$$

The number of regions n = 108, $n_{i1} = 20$, $n_{i2} = 37, n_{i3} = 51$ and $m = 3$.
First, calculate totals in groups:

$$\boldsymbol{\sum_{j=1}^{17} y_{ij} = 1479,6 \; ; \sum_{j=1}^{37} y_{2j} = 1755,7 \; ; \sum_{j=1}^{51} y_{3J} = 2044,2}$$

calculate the group means:

$$\boldsymbol{\overline{y_1} = 70,4 \; ; \overline{y_2} = 51,6 \; ; \; \overline{y_3} = 78,4}$$

and squares group means:

$$\boldsymbol{\overline{y_1^2} = 4964,4 \; ; \; \overline{y_2^2} = 2666,7 \; ; \; \overline{y_3^2} = 6157,8}$$

overall average $\boldsymbol{\overline{y} = 67,7}$ and its square $\boldsymbol{\overline{y^2} = 4596{,}2}$
Next, we compute an estimate of the variance of group averages

$$\boldsymbol{est\ \sigma_y^2 \frac{1}{3-1} 15611,51 = 7805,75}$$

and finally calculate test characteristics

$$\boldsymbol{F = \frac{\frac{1}{3-1} 15611,51}{\frac{1}{108-3}\ 102842} = 7,96}$$

In table of F distribution we find the critical value F_α for $k_1 = 2$ a $k_2 = 105$ degrees of freedom. At significance level $\alpha = 0{,}05$ is $F_{0,05} = 3{,}09$ nad $\alpha = 0{,}01$ is $F_{0,01} = 4{,}82$. Calculated test characteristics are higher than both critical values and therefore we reject the null hypothesis test of equality of mean values of aggregate macro-economic performance of regions at different rates of rurality (urbanization) of the region, and thus the rate of urbanization in the region contributes significantly to the differences in the economic performance of regions.

4 Conclusions

Within the empirical examination, we analyzed the spatial imbalance in the context of the V4 region, via using the instruments of spatial statistics. The results of our research revealed relatively strong spatial conditionality of regional development. As epicenters of regional development can be considered the core region of the V4 countries, which are in all cases the capital regions and regions with cities on a supra-regional level. From national comparisons we can see that the Czech Republic has maintained a leading position in terms of regional development, as indicated by the indicator of GDP per capita. Regional development effects extend beyond the national borders of the Czech Republic and interfere to other border regions of V4 countries. Gradually the intensity of development effects towards the center and east of the V4 region weakens and that regions can be viewed as lagging.

In the second part we submitted regions of V4 countries to structural analysis by using indicators based on GDP growth, GDP/ capita, unemployment rate and wage levels. These indicators serve as components for assessing the overall level of macroeconomic performance according the degree of urbanization. The empirical findings showed us relatively spread macroeconomic gap among the regions based on various degrees of urbanization. General, the gap between predominantly urban regions on one side and between intermediate and predominantly rural regions are large, however if we take it partly, the gap among the predominantly urban regions and predominantly rural regions is only slightly in a number of cases, so it indicates that also predominantly rural regions are able to maintain economic resilience and keep their economic potential in place. However it is needed for doing further research, in more details and based on large scale of social-economic indicators for taking the point.

In conclusion we can state, that in general the regional policy realized by each state of V4 group fails to bring social-economic balance on its territory. Regional disparities are most significant within the society and their living standard in terms of opportunities on labor market and wage levels. However, it is naturally that somewhat disparities will be ever present on the territory, but if economic conditions in lagging regions worsen further it will lead to further drain of production factors from these regions and brings even greater costs to the government.

On future from a macroeconomic point of view, policy makers should focus on long – term growth rather than driving the economic cycle. Removing further trade barriers between the EU countries and the rest of the world should also help to form and strengthen economic ties and contribute to more jobs and growth of particular regions. From a microeconomic point of view, government should focus on incentives which could bring to the regions the prospect of long-term growth. Tangible and intangible investments to education, research and development based on productive resources and localization factors of the regions could bring from long-term prospect more job places and accelerate the regional growth. Fostering the knowledge economy is best provision for enhancing the competitiveness and future growth.

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