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REGIONAL GDP GROWTH IN CZECH AND SLOVAK NUTS3 REGIONS: SPATIAL ANALYSIS*

Introduction

To analyse the regional GDP growth is nowadays a very attractive issue especially for governments in order to capture the regional disparities and thereafter to perform adequate steps to reduce or to remove them. Both the Czech Republic and the Slovak Republic have its own National Regional Development Strategies in order to promote the regional development at the national level. The concentration in national strategies is on individual regions at different NUTS (Nomenclature of Units for Territorial Statistics) levels, especially interesting are the tasks for regions at NUTS3 levels. One of the main tasks is to specify the potential of the region and its competitiveness not only inside the country but also in the broader context based on e.g. the global growth trends, analysis of components of GDP growth, assessment of impacts of main determinants of regional development and growth and creation of adequate development opportunities for all regions (see [18] and [21]).

The National Regional Development Strategy of the Slovak Republic [18] in context of regional growth analysis clearly stresses the spatial aspects. Since the traditional regional policy is mostly concentrated on the support of construction of technical infrastructure and formal education, it turns out that innovation and the other determinants of growth are closely related to a spatial dimension which points to growth in some regions based on these determinants of growth.

The treatment of space in the growth analysis can be considered based on the distinction between the absolute and relative location. As mentioned by Abreu, De Groot and Florax in [1], absolute location expresses the impact of being located at a particular point in space and relative location reflects the impact of being located closer or further away from another region, i.e. important is the position of a region relative to another region(s). In the further text of this paper the concentration will be on the relative location. In this context we can speak about spatial dependence which occurs when the growth rate at one region depends on the growth rates of other regions. There have been published many studies dealing with the growth analysis based on spatial dimension. The problem of possibly biased results and hence misleading conclusions with using of aspatial empirical analyses that have ignored the influence of spatial location on the process of growth is pointed out in the study of Fingleton and López-Bazo [6]. Furková [8] dealt with spatial

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models and spatial dimension in econometric modelling, Furková and Surmanová [9] provided the stochastic frontier analysis of regional competitiveness for NUTS2 regions of V4 countries. Lundberg [16] analysed regional growth pattern for Swedish regions, Curran [5] in his spatial analysis of British regional economic development and sectoral trends focuses on NUTS3 regions. Pede, Sparks and McKinley [20] did the spatial analysis of regional income inequality and economic growth for provinces in the Philippines. The main aim of this paper is to provide the spatial analysis of GDP growth rates in 22 NUTS3 Czech and Slovak regions in order to find out if the geographical neighbours tend to share similar GDP growth rate levels. The paper is organised as follows: section 1 introduces the descriptive spatial statistics to reveal whether the spatial autocorrelation in the data is present or not, section 2 deals with data and definition of neighbours, section 3 presents empirical results and finally the last section concludes.

1 SPATIAL AUTOCORRELATION – DEFINITION AND VARIOUS MEASURES

The concept of spatial autocorrelation has become very attractive in recent years. Spatial autocorrelation reflects a lack of independence between regions and it is therefore important to analyse if the spatial autocorrelation is present or not. In case that "yes", it is necessary to take this fact into account. There exist many definitions of spatial autocorrelation. Commonly known in this context is the Tobler's first law of geography: "Everything is related to everything else, but near things are more related than distant things" (see [23], p. 234). In the literature, also the terms like "spatial dependence", "spatial association", "spatial interaction", "spatial interdependence" had been used to describe the spatial autocorrelation (see e.g. [11]). The term "spatial autocorrelation" was first developed in a statistical framework by Cliff and Ord [4]. The spatial autocorrelation can be in general characterized as the correlation of a variable with itself through space, i.e. the data from one region may influence the data from some other region through spatial spillover effects.

There are several tests of spatial autocorrelation which can be differentiated by the scope of analysis into global and local categories. Global statistics provide us a measurement of the global spatial autocorrelation - a single value which applies to the entire data set, but they fail to capture the local spatial pattern. Local statistics usually assess the spatial autocorrelation for one particular spatial unit.

1.1 Global statistics

From the global statistics e.g. Moran's I, Geary's C, and the Getis-Ord G statistic can be mentioned. The most well known is the Moran's I statistic [17] which is structured as the Pearson product moment correlation coefficient. The substantial difference is that space is included as a spatial weight matrix $\mathbf{W}$ and instead of finding the correlation between two variables, the goal is to find the correlation of one variable with itself through a matrix $\mathbf{W}$ (see e.g. [11]). This statistic is given by [11], [24]:

$$I = \frac{N}{\sum_{i=1}^{N}\sum_{j=1}^{N} w_{ij}} \frac{\sum_{i=1}^{N}\sum_{j=1}^{N} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{N}(x_i - \bar{x})^2} \quad i \neq j \tag{1}$$

where x_i represents the underlying variable for region *i*, $\bar{x}$ denotes the sample mean, *N* is the number of regions in the data set and w_{ij} are the elements of spatial weight matrix **W** of dimension $N \times N$ corresponding to the observation pair *i*, *j*. The theoretical mean of the Moran's *I* is $-1/(N-1)$, which approaches to zero when *N* increases and indicates a random pattern. In case that $I > -1/(N-1)$, this indicates a positive spatial autocorrelation, i.e. regions with similar values of observed variable tend to cluster in space (high-high, low-low). On the other hand, if $I < -1/(N-1)$, there is a negative autocorrelation, which implies that regions with high and low values are mixed together (high-low, low-high). The values of Moran's *I* (similar as in case of correlation coefficient) range from -1 (strong negative spatial autocorrelation) to 1 (strong positive spatial autocorrelation).

Geary‘s *c* statistic [10] is similar to Moran‘s *I*. The difference between these two statistics is that in case of Geary‘s *c* statistic the interaction is not the cross-product of the deviations from the mean, but the deviations in intensities of each observation location with one another (see e.g. [15]). The null hypothesis is that there is no difference between related spatial units. The theoretical value of Geary‘s *c* is 1. Values less than 1 indicate positive spatial autocorrelation and values greater than 1 imply negative spatial autocorrelation. It is therefore clear, that Geary‘s *c* is inversely related to Moran's *I* [11], [15].

Geary‘s *c* statistic can be calculated as follows (all the symbols have already been defined above):

$$c = \frac{(N-1)\sum_{i=1}^{N}\sum_{j=1}^{N} w_{ij}(x_i - x_j)^2}{2\sum_{i=1}^{N}\sum_{j=1}^{N} w_{ij}\sum_{i=1}^{N}(x_i - \bar{x})^2} \quad i \neq j \tag{2}$$

Getis-Ord *G* statistic [12], [19] also measures the global spatial autocorrelation in order to identify a set of neighbours for each region, i.e. regions that fall within a specified distance, *d*, from the region we are interested in. In comparison to Moran's *I* and Geary's *c* it is able to identify only positive spatial autocorrelation, but it can distinguish between positive spatial autocorrelation of type high-high (regions with high values are near to other regions with high values as well) and positive spatial autocorrelation of type low-low (regions with low values are near to other regions with also low values). Mathematically it can be formulated as follows [12]:

$$G(d)=\frac{\sum_{i=1}^{N}\sum_{j=1}^{N}w_{ij}(d)x_i x_j}{\sum_{i=1}^{N}\sum_{j=1}^{N}x_i x_j} \quad i \neq j \tag{3}$$

where $w_{ij}(d)$ is a distance weight by which the cross-product of the analysed value at region i and at another region j are weighted and all the other variables were defined above. In context with Getis-Ord G statistic it can be pointed out that there are in fact two G statistics. As mentioned by Levine [15], the first one, G^*, includes the interaction of a region with itself, i.e. region i and region j can be the same region. The second one, G, does not include interaction of a region with itself.

In calculation of all the above mentioned spatial statistics plays the specification of the spatial weight matrix **W** a crucial role. The simplest and most commonly used is the contiguity matrix **W**. Besides this specification we can meet with the distance-based weights, combination of contiguity and distance, ranked distances, *n* nearest neighbours, etc. (for some other schemes see e.g. [11]). The contiguity matrix **W** is usually a binary one made up of ones for contiguous neighbours and zero for all others. Very often are the contiguous neighbours defined analogously as in the game of chess – e.g. the rook's case (regions share edges), the bishop's case (regions share corners) and the queen's case (regions share edges or corners) – see Fig. 1.

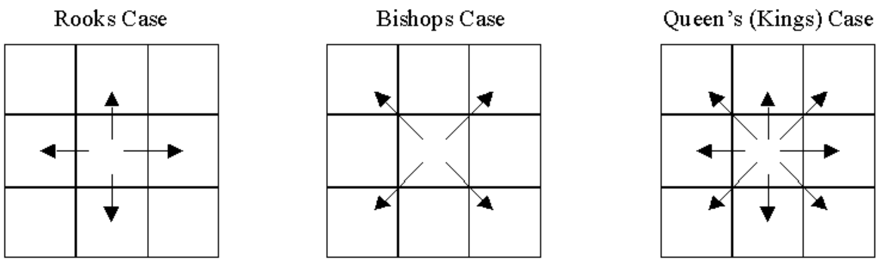


Fig. 1: Different definitions of contiguity
Source: [25]

Since in case of Moran's I and Geary's C statistics the spatial weight matrix can be specified as contiguity matrix, the Getis-Ord G statistic usually uses a distance-based weights which are defined by a one in case that two regions are closer than or equal to a threshold distance d, or zero otherwise. However concerning Ord and Getis (see [19], p. 288) distance can be interpreted "as travel time, conceptual distance, or any other measure that enables the n points to be located in a space of one or more dimensions".

1.2 Local statistics

To assess the spatial autocorrelation for individual spatial units (regions), local versions of Moran's *I*, Geary's *C* and the Getis-Ord *G* statistic can be used. The LISA (Local Indicators of Spatial Association) were published by Anselin [3] and are especially useful for identifying of spatial clusters. For more information on local measures of spatial autocorrelation and spatial clustering see e.g. [7]. In further text we will characterize local Moran's *I* and local Getis-Ord *G* statistics which will be used in the analysis.

The local Moran's *I* statistic for individual regions can be calculated as follows [3]:

$$I_i = \frac{(x_i - \bar{x})\sum_{j=1}^{N} w_{ij}(x_j - \bar{x})}{\frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})^2} \qquad i \neq j \tag{4}$$

where I_i denotes a decomposition of the global Moran's *I* and all other variables are defined in the same way as mentioned above. The Moran's scatterplot which contains the value of the variable (x_i) on the horizontal axis and the spatially lagged values for the same variable on the vertical axis ($lag\ x_i$) gives an insight into the extent to which an individual region influences the value of the global Moran's *I* statistics. The global Moran's *I* statistics is given by the slope of the straight line of regression of $lag\ x_i$ on x_i. The spatially lagged values of x_i can be calculated as follows [2]:

$$lag\ x_i = \frac{\sum_{j=1}^{N} w_{ij} x_j}{\sum_{j=1}^{N} w_{ij}} \tag{5}$$

Moran's scatterplot can be divided into four quadrants which correspond to four possible spatial associations: high-high (HH), low-high (LH), low-low (LL) and high-low (HL). The associations HH and LL indicate the positive spatial autocorrelation, while the associations LH and HL the negative autocorrelation.

The local Getis-Ord G_i statistics is constructed for each region *i* as follows [12]:

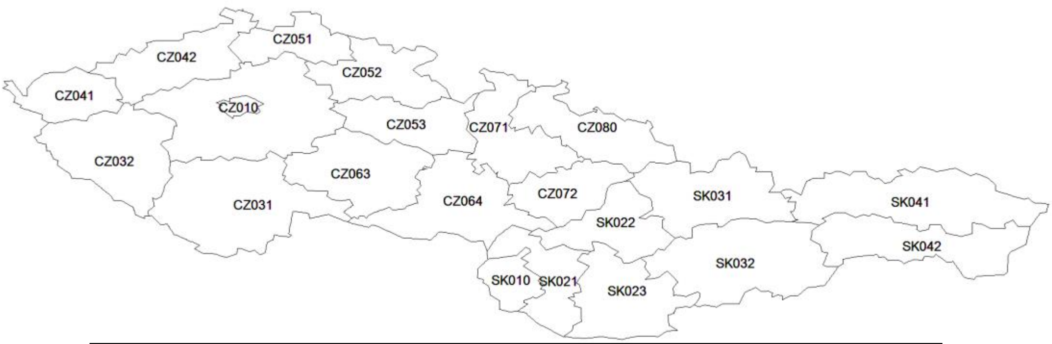
$$G_i(d) = \frac{\sum_{j=1}^{N} w_{ij}(d) x_j}{\sum_{j=1}^{N} x_j} \qquad i \neq j \tag{6}$$

where all the symbols have already been defined above.

Concerning the advantages and limitations of above mentioned local statistics, it can be concluded that while the local Getis-Ord G_i statistic is very good at identifying of HH and LL type of association, local Moran's *I* statistic can only identify the type of spatial autocorrelation as positive or negative, i.e. whether the regions are similar or dissimilar. On the other hand, the biggest limitation of the local Getis-Ord G_i statistic is that it cannot detect the negative spatial autocorrelation. As mentioned by Levine [15], both local Moran's *I* statistic and local Getis-Ord G_i statistic should be used to provide a full interpretation of the results. Furthermore he also recommends to be careful in interpreting results for regions with significant above mentioned local statistics and to concentrate only on regions with the highest or the lowest values of corresponding local statistic.

2 DATA AND DEFINITION OF NEIGHBOURS

The main aim of this paper is to perform the spatial analysis of regional GDP growth in 22 NUTS3 Czech and Slovak regions and to find out if location affects the above mentioned growth levels, i.e. if the neighbouring regions have a tendency to share similar GDP growth rate levels. The NUTS3 regions together with their codes are graphically depicted on Fig. 2.



CZ010 - Hlavní mesto Praha	CZ071 - Olomoucký kraj
CZ020 - Stredoceský kraj	CZ072 - Zlínský kraj
CZ031 - Jihoceský kraj	CZ080 - Moravskoslezský kraj
CZ032 - Plzenský kraj	SK010 - Bratislavský kraj
CZ041 - Karlovarský kraj	SK021 - Trnavský kraj
CZ042 - Ústecký kraj	SK022 - Trenciansky kraj
CZ051 - Liberecký kraj	SK023 - Nitriansky kraj
CZ052 - Královéhradecký kraj	SK031 - Zilinský kraj
CZ053 - Pardubický kraj	SK032 - Banskobystrický kraj
CZ063 - Kraj Vysocina	SK041 - Presovský kraj
CZ064 - Jihomoravský kraj	SK042 - Kosický kraj

Fig. 2: Czech and Slovak NUTS3 Regions
Source: own figure

The data of regional GDP defined at current market prices in mil. Euro were retrieved from the web page of Eurostat [26]. Thereafter the corresponding growth rates in %, i.e. *gGDP*, were calculated using the following formula:

$$gGDP_t = \left[\left(GDP_t / GDP_{t-1}\right) - 1\right].100\,\% \qquad (7)$$

We analysed growth rates for the pre-crisis, crisis and post-crisis period, i.e. for the following periods: 2007/2006, 2008/2007, 2009/2008 and 2010/2009. The GDP growth rates for these periods were for analysed individual NUTS3 regions as depicted on Fig. 3. It is obvious that the GDP growth rates (7) were during analysed pre-crisis periods (2007/2006, 2008/2007) high, there was a negative GDP growth during the crisis period (2009/2008) in almost all analysed regions (the only exception was SK010 - Bratislavský kraj) followed by moderate GDP growth in post-crisis period (2010/2009). Since it is impossible just from the values depicted on Fig. 3 to say whether the similar GDP growth rates of individual regions are more clustered than could be expected from pure chance, we did the spatial analysis which enables us also to find out how strong is the spatial association between neighbouring regions. The whole analysis was carried out in the software GeoDa (Geographic Data Analysis) which can be downloaded for free from the web page [27]. The corresponding shapefile (.shp) for Europe was downloaded from the web page of Eurostat [28], thereafter only the Czech and Slovak NUTS3 regions were selected in GeoDa and a new shapefile was created.

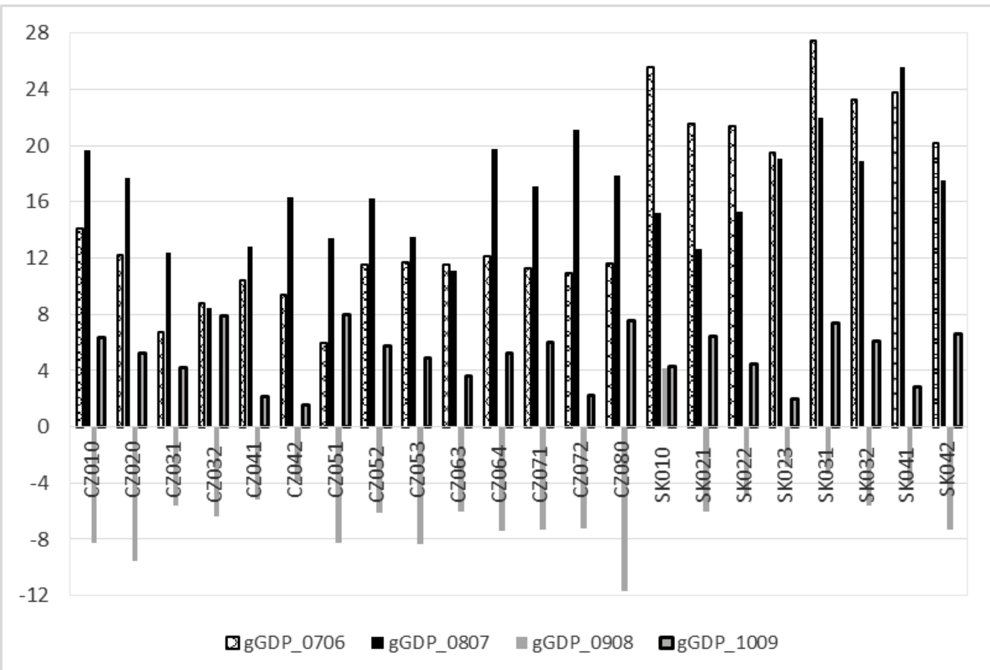


Fig. 3: GDP growth rates (in %) for Czech and Slovak NUTS3 regions
Source: own figure based on Eurostat data [26]

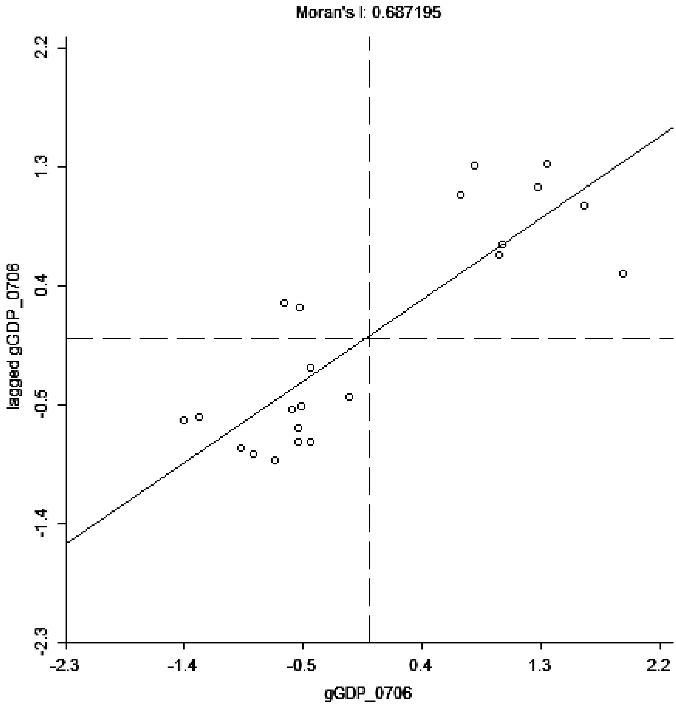
3 EMPIRICAL RESULTS

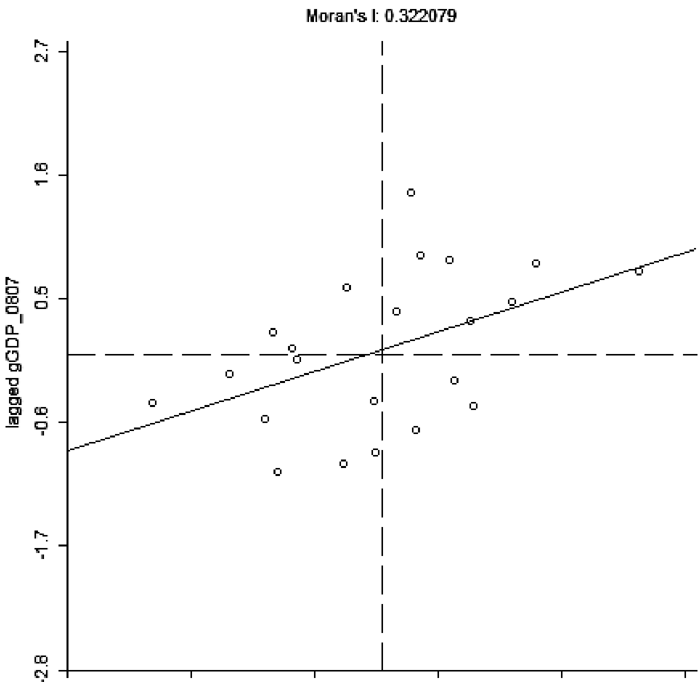
In order to test for spatial autocorrelation based on the above mentioned measures, it is necessary to define spatial neighbourhoods and spatial weights. As a spatial weight matrix **W** the queen first order contiguity matrix was used (see e.g. [13]). No region is isolated, two regions (CZ010 - Hlavní mesto Praha and SK010 - Bratislavský kraj) have only 1 neighbour, majority of regions has 3 to 5 neighbours.

In the second step it follows the global spatial autocorrelation analysis based on global Moran's *I* statistic (1) which enables to find out how strong the spatial association is between neighbouring places, since it is not always clear whether a GDP growth level variable is unevenly distributed over space just by looking at a map [22]. The third step is the local spatial autocorrelation analysis in order to test for the presence of differences across regions. The local Moran's *I* statistic (4) and local Getis-Ord *G* statistic (6) were used for analysis. The global statistic as well as both local statistics were calculated based on the queen first order contiguity matrix. The calculated global Moran's *I* statistics for individual periods together with Moran's scatterplots are depicted on Fig. 4. The theoretical mean of the Moran's *I* is $-1/(N-1) = -1/(22-1) = -0.0476$. The calculated values of global Moran's *I* statistics for the pre-crisis periods 0.6872 and 0.3221, respectively indicate the positive spatial autocorrelation, in the crisis period its value is still positive, but very low, i.e. 0.0896. In the last analysed period (post-crisis period) there was based on global Moran's *I* statistic -0.2580 a negative spatial autocorrelation.

In order to visualise the spatial clustering, LISA cluster maps based on significant local Moran's *I* statistics for *p* values up to 0.05 significance level are graphically depicted in the left part of the Fig. 5 a) – d). The local spatial analysis was also done based on local Getis-Ord G_i statistics – corresponding cluster maps also for *p* values up to 0.05 significance level are graphically depicted in the right part of the Fig. 5 a) – d).

In the first analysed period 2007/2006 two types of relationships were identified to be significant based on local Moran's *I*: HH (7 out of 8 Slovak regions, the only exception was SK010 - Bratislavský kraj) and LL (4 Czech regions - CZ020 - Stredoceský kraj, CZ032 - Plzenský kraj, CZ041 - Karlovarský kraj and CZ042 - Ústecký kraj). Taking into account the local Getis-Ord G_i statistics we received similar results: positive spatial autocorrelation of type HH was confirmed for 4 Slovak regions (SK031 - Zilinský kraj, SK032 - Banskobystrický kraj, SK041 - Presovský kraj and SK042 - Kosický kraj) and positive autocorrelation of type LL for 3 Czech regions (CZ020 - Stredoceský kraj, CZ041 - Karlovarský kraj and CZ042 - Ústecký kraj).


Moran's I: 0.687195
lagged gGDP_0706
2.2
1.3
0.4
-0.5
-1.4
-2.3
-2.3
-1.4
-0.5
0.4
1.3
2.2
gGDP_0706


Moran's I: 0.322079
lagged gGDP_0807
2.7
1.6
0.5
-0.6
-1.7
-2.8
-2.8
-1.7
-0.6
0.5
1.6
2.7
gGDP_0807

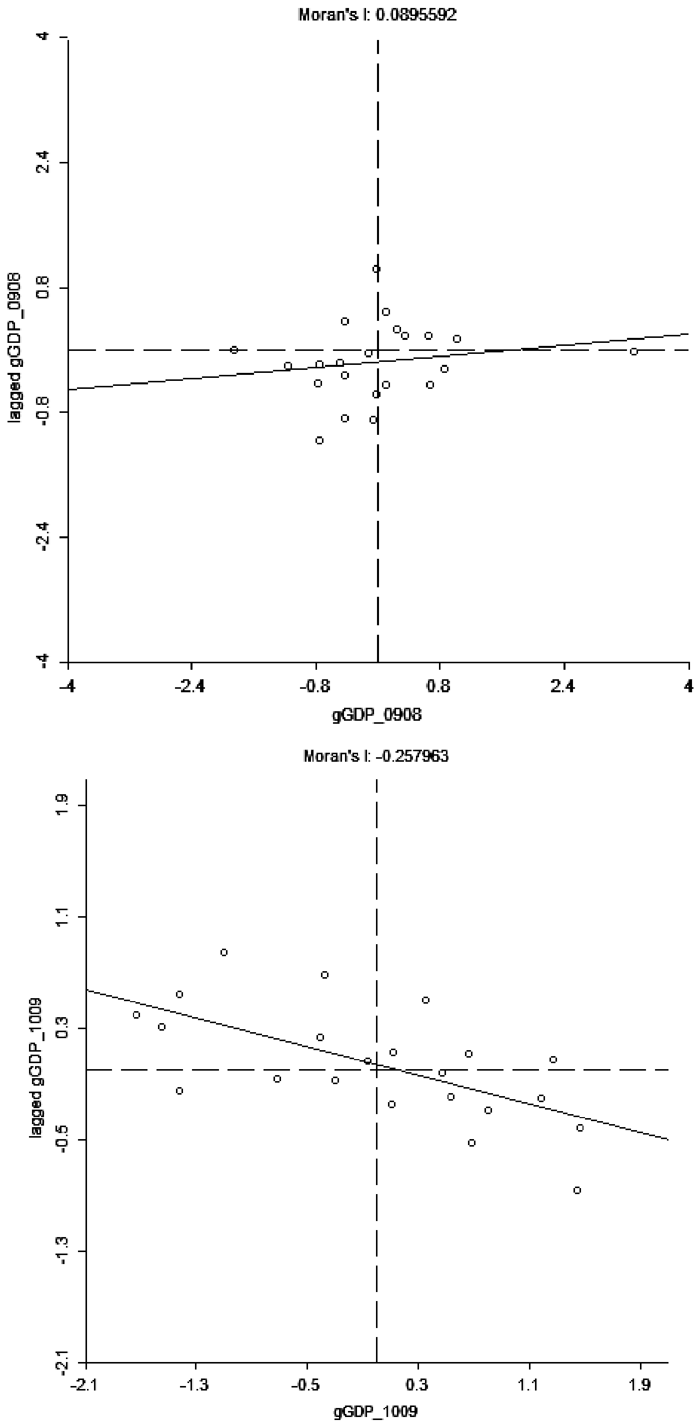


Fig. 4: Moran's *I* scatterplots for individual periods
Source: own charts from software GeoDa

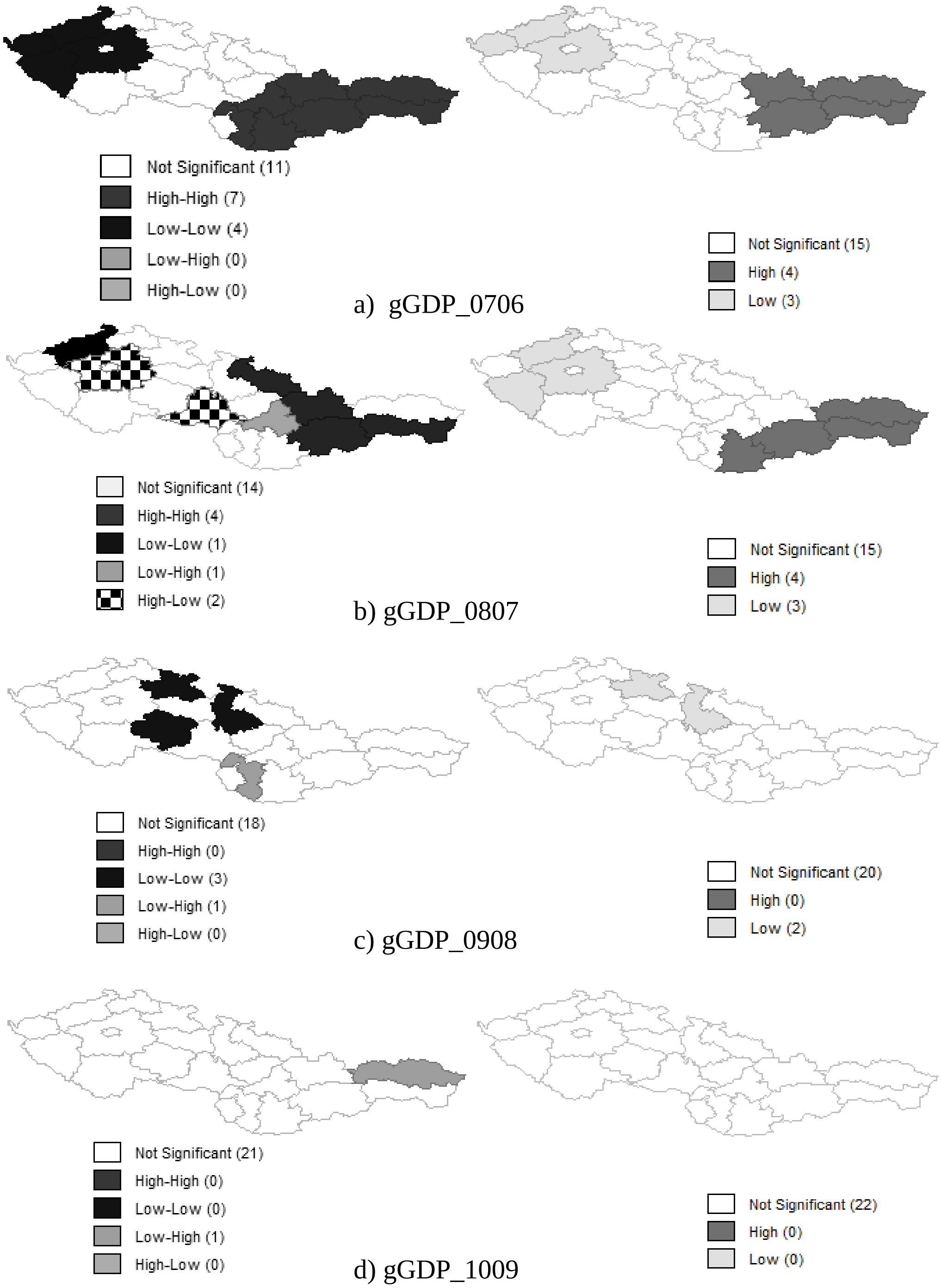


Fig. 5: Cluster Maps based on local Moran's *I* and local Getis-Ord G_i
Source: own maps from software GeoDa

Although the global Moran's *I* indicated in the next analysed pre-crisis period 2008/2007 the presence of positive spatial autocorrelation, based on local version of this statistic, besides regions with significant positive autocorrelation HH (CZ080 - Moravskoslezský kraj, SK031 - Zilinský kraj, SK032 - Banskobystrický kraj, SK042 - Kosický kraj) and LL (CZ042 - Ústecký kraj) also the regions with negative autocorrelation LH (SK022 - Trenciansky kraj) and HL (CZ020 - Stredoceský kraj and CZ064 - Jihomoravský kraj) were identified. Based on local Getis-Ord G_i statistics significant positive spatial autocorrelation of type HH was detected for 4 Slovak regions (SK023 - Nitriansky kraj, SK032 - Banskobystrický kraj, SK041 - Presovský kraj and SK042 - Kosický kraj). The type LL was detected for 3 Czech regions (CZ020 - Stredoceský kraj, CZ032 - Plzenský kraj and CZ042 - Ústecký kraj).

During the crisis period 2009/2008 only very low positive spatial autocorrelation was detected. Association LL based on local Moran's *I* identified 3 statistically significant regions (CZ052 - Královéhradecký kraj, CZ063 - Kraj Vysocina and CZ071 - Olomoucký kraj), two of them (CZ052 - Královéhradecký kraj and CZ071 - Olomoucký kraj) detected also the local Getis-Ord G_i statistics. In case of one region (SK021 - Trnavský kraj) significant association of type LH was confirmed based on local Moran's *I*.

In the post-crisis period 2010/2009 local Moran's *I* identified one region (SK041 - Presovský kraj) with significant negative association LH. Getis-Ord G_i statistic identified no region with significant positive spatial autocorrelation.

Regions with HH and LL relationships indicate the similar level of GDP growth rates as their neighbours, while regions with the LH and HL relationship indicate different (dissimilar) level of GDP growth rates from their neighbours.

Conclusion

In general, as it has been already mentioned in section 1, the use of individual global and local statistics has its advantages and disadvantages. The use of specific type of statistic and spatial weight matrix depends inter alia also upon the possibilities of the used type of geostatistical software, but in order to achieve more complex interpretation of the results it seems to be suitable to use more than one statistic.

The primary purpose of this paper was to perform the spatial analysis of regional GDP growth rates for 22 NUTS3 Czech and Slovak regions in order to test the hypothesis that regions with high GDP growth rates are more spatially clustered than could be expected from pure chance. In order to accomplish this task, we used the following commonly known test statistics for spatial autocorrelation, the global and local Moran's *I* statistics and the local Getis-Ord G_i statistic. The spatial weight matrix was defined as a queen's case matrix of the first order. It should be mentioned that the definition of neighbours, i.e. the specification of the spatial weight matrix is an important issue in spatial analysis, since the results can differ for different definitions of this matrix. The analysis was done for the pre-crisis, crisis and post-crisis periods, i.e. for periods 2007/2006, 2008/2007, 2009/2008 and 2010/2009. Based on the global Moran's *I*, its positive value in the first three periods indicate the existence of positive spatial autocorrelation, i.e. it can be concluded that regions with similar GDP growth rates are

more spatially clustered than could be caused by pure chance. Concerning the values of the local Moran's *I*, positive spatial autocorrelation was during the first three periods detected for 11 (HH – 7, LL – 4), 5 (HH – 4, LL – 1) and 3 (HH – 0, LL – 3) regions, respectively. Taking into account the local Getis-Ord G_i statistic significant positive autocorrelation was detected for a slightly different number of regions, i.e. 7 (HH – 4, LL – 3), 7 (HH – 4, LL – 3) and 2 (HH – 0, LL – 2) regions, respectively. During the pre-crisis period 2007/2006 and 2008/2007 the significant HH spatial relationships were identified with one exception for Slovak regions indicating high GDP growth rates similar as in neighbouring regions, while the LL spatial relationships were significant for Czech regions indicating low GDP growth rates similar as in neighbouring regions. For a quite large number of regions the spatial randomness was detected. The crisis period 2009/2008 was characterized only by 3 and 2 statistically significant Czech regions, respectively, with LL type of relationship, i.e. with low GDP growth rates similar as in neighbouring regions.

In the last analysed period (post-crisis period 2010/2009) the global Moran's *I* proved negative spatial autocorrelation, but its local version identified only one Slovak region with significantly negative spatial autocorrelation. The complementary Getis-Ord G_i statistic identified no region with statistically significant spatial association.

To analyse the regional GDP growth by taking into account the spatial aspect is nowadays an important issue in order to detect the regional disparities and to develop adequate arrangements to remove them. Concerning the results of this type of analysis, governments have information how to distribute the limited resources in order to improve the economic development in individual regions. Since the higher GDP growth rates in individual regions can in case of positive spatial autocorrelation positively influence the GDP growth rates in neighbouring regions.

Key words

regional GDP growth, spatial analysis, spatial autocorrelation, NUTS3 regions

JEL Classification

R11, R12, C21

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RESUMÉ

Predmetom príspevku je problematika regionálneho rastu HDP s dôrazom na nástroje priestorovej analýzy. Analýzy týkajúce sa regionálneho rastu HDP sú v poslednom období veľmi populárne s cieľom identifikovať regionálne rozdiely a prijať vhodné opatrenia na ich odstránenie. Dôležitým aspektom takejto analýzy je uvažovanie priestorovej dimenzie a špecifikácia susediacich regiónov na základe vhodnej definície matice váh. Testovanie priestorovej autokorelácie je možné pomocou rôznych štatistík, v príspevku sú aplikované globálna a lokálna Moranova *I* štatistika a lokálna Getisova-Ordova G_i štatistika.

Analyzovaných bolo 22 NUTS3 českých a slovenských regiónov v predkrízovom, krízovom a pokrízovom období. Kým v obdobiach pred krízou, t.j. v obdobiach 2007/2006 a 2008/2007 bola potvrdená štatisticky významná pozitívna priestorová autokorelácia, v krízovom období 2009/2008 veľmi slabá pozitívna priestorová autokorelácia, v pokrízovom období 2010/2009 išlo o negatívnu priestorovú autokoreláciu. Na základe

lokálnych štatistík bolo možné určiť konkrétne regióny so štatisticky významnou priestorovou autokoreláciou vrátane typu tejto autokorelácie. Kým pozitívna autokorelácia indikuje zhlukovanie regiónov s podobnými hodnotami rastu HDP, negatívna autokorelácia naopak indikovala, v ktorých regiónoch je rast HDP nižší, resp. vyšší ako v regiónoch, ktoré ho obklopujú.

SUMMARY

This paper concentrates on the issues of regional GDP growth with orientation on instruments of spatial analysis. Analyses dealing with the regional economic growth have become very popular during the recent years in order to identify the regional disparities and to adopt appropriate steps to remove them. The important issue of this analysis is consideration of spatial dimension and specification of neighbouring regions based on appropriate definition of spatial weight matrix. Testing of spatial autocorrelation is possible through different statistics, in this paper we applied the global and local Moran's I statistics and local Getis-Ord G_i statistic.

The analysis dealt with 22 NUTS3 Czech and Slovak regions in pre-crisis, crisis and post-crisis period. Since in periods before crisis, i.e. in 2007/2006 and 2008/2007 the statistically significant positive spatial autocorrelation was confirmed, in the crisis period 2009/2008 was the spatial autocorrelation slightly positive, in post-crisis period 2010/2009 there was a negative spatial autocorrelation. Based on local statistics it was possible to detect concrete regions with statistically significant spatial autocorrelation including the type of autocorrelation. Since the positive autocorrelation indicates clustering of regions with similar values of GDP growth rates, on the other hand the negative autocorrelation indicated, in which regions is the GDP growth lower or higher in comparison to neighbouring regions.

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