Spatial differentiation and core-periphery structures in Romania

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Abstract

Our paper focuses on the spatial differentiation of economic development in Romania. We use spatial econometric methods (spatial autocorrelation) in order to determine the differentiation of the country in core regions and peripheries. The analysis is carried out on the regional spatial scale (NUTS 3 units or counties) and covers the period 2000-2011. The main results show a pronounced spatial polarization and spatial autocorrelation of economic development (proxied by GDP per capita) in Romania in some core regions (the capital Bucharest), while an extended periphery, comprising the eastern part of Transylvania, Moldova and northern Muntenia is lagging behind. The analysis of the multidimensional development (Human Development Index) has revealed the existence of some regional polarizing centres (Iași, Constanța), while the spatial configuration of cores and peripheries shows a different picture: beside the capital region, there is a second core area in the central part of Transylvania, while the eastern periphery is centred on the county Brăila.

Keywords: spatial economic structure, Romania, territorial autocorrelation, core and periphery

1. Introduction

The Romanian economy and society has experienced a major transformation over the last two decades, following the collapse of communism. The regions and cities have adapted in different ways to the major economic challenges represented by the increasing integration into the international production and consumption networks. While some areas have been successful (the capital city region București, some regional urban centres such as Cluj, Timișoara, Constanța) other areas have experienced a deep crisis (the rural peripheries, the mining areas) (Surd, Kassai and Giurgiu, 2011; Török, 2015). Processes like deindustrialisation, suburbanisation and out-migration have contributed substantially to the restructuring of the Romanian economic space (Popescu, 2014), marked by increasing spatial, economic and social

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inequalities (Ianoș, Petrișor, Zamfir, Cercleux, Stoica and Talanga, 2011; Sandu, 2011; Șoaita, 2014).

This paper aims at exploring one of the core problems in regional development research related to the existence and effects of the so called spatial interactions. There is growing acknowledgment in the international literature that neighbouring spatial units are strongly interconnected and that there are spatial interactions between them determined by distance and the way the concept of "neighbourhood" is understood (Feldkircher, 2006; Anselin, 2010). This question appears to be highly interesting considering the fact that Romania has registered important economic growth between 1999 and 2008 (Benedek and Veress, 2013). Using the tools of spatial econometrics we focus on two main goals: the determination of the spatial autocorrelation of economic and social development; and the interpretation of spatial structures on the basis of spatial clusters resulted from spatial autocorrelation. More precisely, we will look at the changes in the spatial clusters resulted from the calculation of Local Moran's I index for four different years 2000, 2004, 2007 and 2011.

The paper is structured as follows: in the first part we present the theoretical and methodological background of the study, followed by the second, empirical part, where the spatial autocorrelation will be examined from both its economic and multi-dimensional perspectives. The third part offers the evaluation of results in the general framework of economic development. The paper concludes with some final remarks.

2. Theoretical and methodological background

One of the main aspects (repetitive) of spatial economics and economic geography is related to the question of spatial interactions between different points of a space or between territorial units (Anselin, 2010; Fotheringam, 2009; Haining, 2009). It assumes a direct relation between distance and the intensity of spatial interactions and proposes the spatial autocorrelation as the main method of measuring spatial interactions. The spatial autocorrelation is a multi-dimensional concept which assumes inter-conditionality between the values of a certain variable registered in neighbouring spatial units. In case of no autocorrelation, the values of the considered variable are independent in the neighbouring spatial units, there is no spatial interaction between them, while the opposite happens in case of significant autocorrelation.

In the spatial autocorrelation analysis the most commonly used tool is the Moran's I index (Moran, 1948):

$$I = \left(\frac{N}{\sum D_{ij}}\right) * \sum\sum(x_i - x) * \left(x_j - x\right) * \frac{D_{ij}}{\sum(x_i - x)^2} \tag{1}$$

where N is the number of spatial units; D_{ij} is the contiguity matrix (describes the neighbourhood relations); x_i is the variable of interest in the given spatial unit; x is the mean value of the analysed variable. The values of the index range from -1 (perfect dispersion) to +1 (perfect correlation). The negative values of the index indicate a negative autocorrelation, and the positive ones indicate a positive autocorrelation. Zero indicates a random distribution and no spatial autocorrelation.

Another form of measurement of spatial interactions is the Local Moran's I, developed by Luc Anselin, which creates clusters of spatial units (Anselin, 1995). The index outlines the homogenous areas with a high level of development (high-high clusters) or those with a low level of development (low-low clusters). We use this later version of the index in order to determine whether economic development is spatially auto correlated or not. For this purpose, as proxy for the economic development, we analyse the GDP per capita. In addition, we will determine the spatial autocorrelation for a more complex situation, where the development level of the spatial units is interpreted from a multidimensional perspective, using the Human Development Index (HDI). The later was calculated for the NUTS 3 units (counties or "județe" in Romanian), using the methodology proposed by the United Nations Development Programme (UNDP, 1996). We have used three sub-indicators: the GDP per capita, the life expectancy at birth and the student's participation ratio at school (the enrolment levels) from the database of Eurostat.

The spatial autocorrelation was calculated with the GeoDa program, developed by Luc Anselin (Anselin, Syabri and Kho, 2006). The Local Moran's I index was calculated by the k-nearest neighbour's method with 5 neighbours and 999 permutations. These permutations have the role of testing the normality and significance of the model.

3. Spatial autocorrelation and spatial structure

Our main assumption is that economic development in Romania is spatially differentiated and auto correlated and that we can identify local clusters of spatial autocorrelation. We use the Local Moran's I index in order to identify the areas with significant spatial autocorrelation for the GDP per capita. The added value of this analysis comes from the fact that we will try to determine Romania's spatial structure by means of the above mentioned method (table 1). The Local Moran's I attributes a concrete value to each spatial unit and indicates those areas where high or low values are clustering (HH–LL), respectively those areas where there are important differences between neighbouring spatial units (HL–LH). The resulting cluster categories and the corresponding types of spatial structures can be seen in Table 1.

Table 1. The correspondence between Local Moran's I clusters and spatial structure typology

Cluster	Interpretation	Type of spatial structure
High-high	NUTS 3-regions (counties) and their neighbours register GDP per capita or HDI values significantly above the national average	Fragmented spatial structure, establishment of a large core region
High-low	NUTS 3-regions have GDP per capita or HDI significantly above the average, while their neighbours register values significantly below the national average	Polarized spatial structure, with one dominant regional core area
Low-high	NUTS 3-regions have GDP per capita or HDI significantly below the average, while their neighbours register values significantly above the national average	Spatial structures with reversed polarization
Low-low	NUTS 3-regions and their neighbours register GDP per capita or HDI values significantly below the national average	Fragmented spatial structure, establishment of a large peripheral region

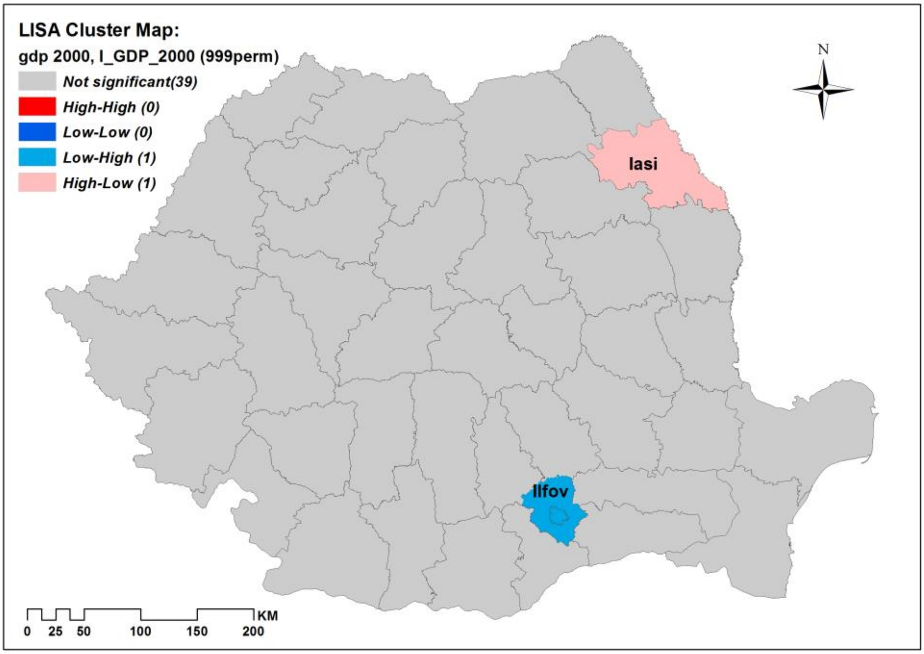
Source: author

3.1. Local Moran's I index for GDP per capita

In table 2 we can notice the values for the Local Moran's I index for four different years. These years were chosen according to their role in the recent economic development of Romania: 2000 was the first year with significant economic growth after the system change in 1989; 2004 was significant in terms of economic growth in Romania, when the strong inter-regional polarization process started, due to the high rates of economic growth in the capital region București; 2007 is the year when Romania became a EU member, and 2011 is the most recent year with available data at NUTS 3 level. A particular emphasis has been given to the notion of probability (p). We have analysed if the observed spatial pattern is the result of random processes. In this case, p has low values and there is no spatial correlation. At high values of p (above 95%), we assume that there is a significant spatial autocorrelation.

For 2000, we found two counties with significant spatial autocorrelation: București-Ilfov (p=95%) and Iaşi (p=99%) (Figure 1). The first county belongs to the low-high cluster, while the second one to the high-low cluster, being a core area which is strongly polarising the neighbouring peripheral regions. The first situation is particular and is explainable by the fact that in 2000, Ilfov county (completely surrounding the capital city București) had lower GDP per capita values than the neighbouring counties. In the following years, as we will see, this situation disappears/ changes due to the fast economic development of Ilfov County.

Figure 1. Significant GDP per capita clusters, 2000

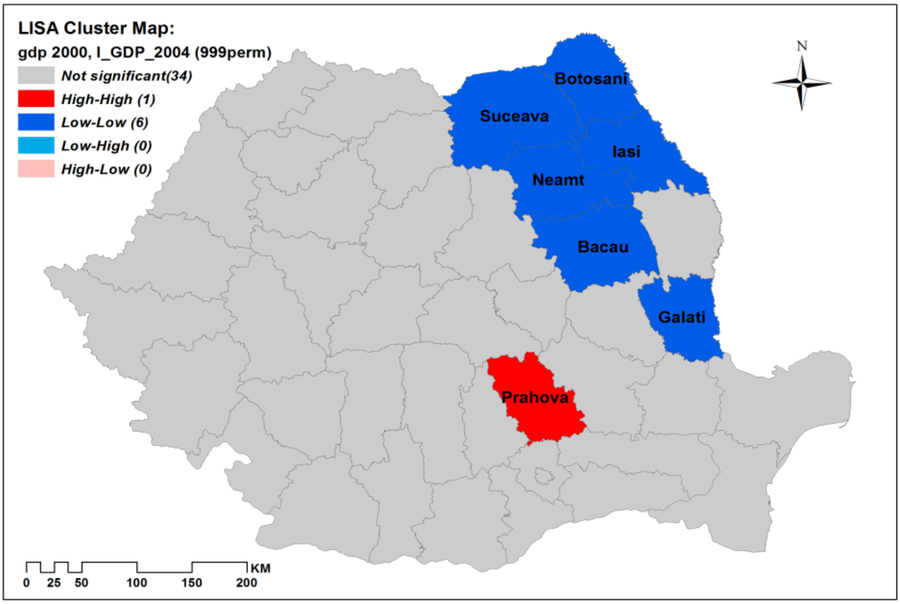


Source: author

For 2004, seven counties show significant autocorrelation, six of them belonging to the low-low cluster, only one to the high-high cluster (fig. 2). Both the members of the low-low cluster and their neighbours are peripheral regions with low values of GDP per capita. The level of significance for the spatial autocorrelation is high: for Iaşi and Botoşani, p=99% while for the rest of the counties p=95%. Prahova belongs to the high-high cluster, with high values of GDP per capita (above the national level).

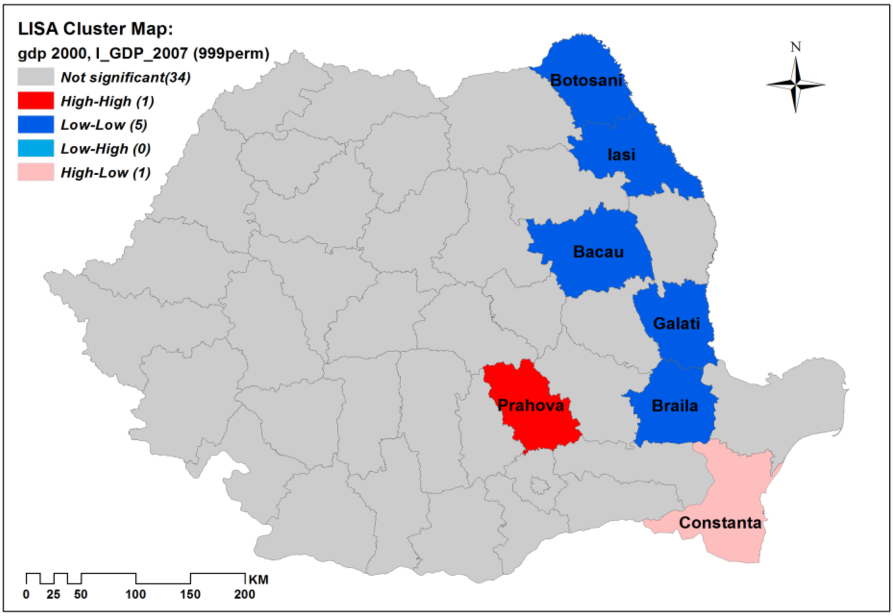
In 2007, seven counties had significant spatial autocorrelation (two counties p=99%, the remaining counties p=95%) (Figure 3). The high-high cluster contains (similar to the situation in 2004) only one member, Prahova. The low-low cluster (peripheral regions) contains five Moldavian counties: Botoşani, Iaşi, Bacău, Galaţi and Brăila, all having strong local autocorrelation in earlier periods as well. Finally, we found spatial autocorrelation for Constanţa, which belongs to the high-low cluster, functioning as a polarising centre (we prefer British spelling to keep an unitary style) for the neighbouring counties.

Figure 2. Significant GDP per capita clusters, 2004



Source: author

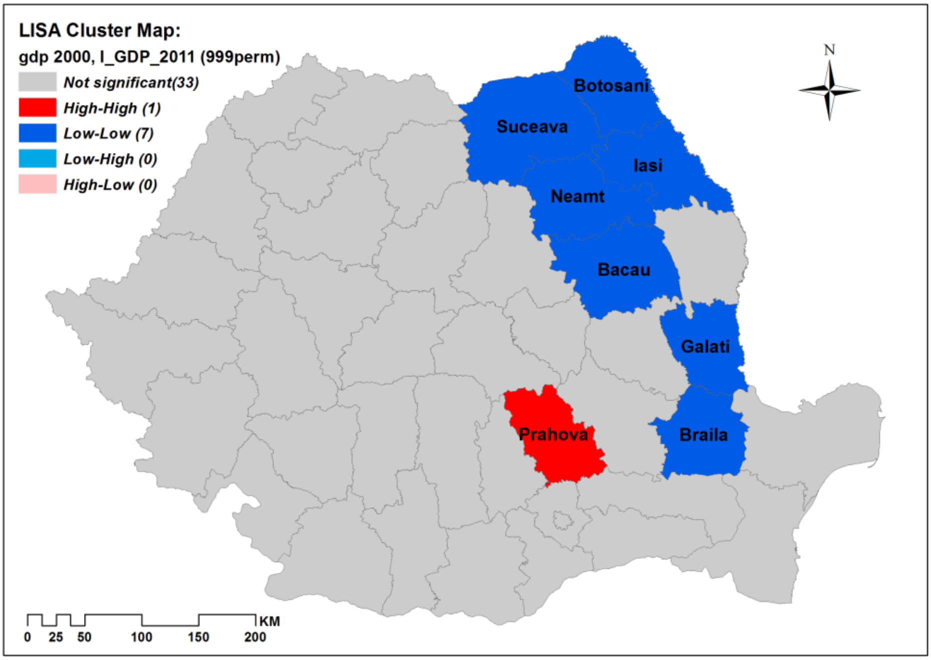
Figure 3. Significant GDP per capita clusters, 2007



Source: author

In 2011, eight counties registered significant autocorrelation. Just like in the previous period, the high-high cluster is formed only by Prahova county (p=95%) (Fig. 4). Other counties with significant autocorrelation belong to the low-low cluster. Their GDP per capita is below the national average, and the same observation is true for the neighbours as well. These counties – with one exception, Brăila – are situated in the eastern, less developed part of Romania (Moldova historical region): Botoşani, Iaşi (for both p=99.9%), Bacău, Galaţi (p=99%), Suceava, Neamţ (p=95%) and Brăila (95%).

Figure 4. Significant GDP per capita clusters, 2011



Source: author

Table 2. Local Moran's I for the GDP per capita (k-nearest neighbours, 999 permutations)

Cluster	2000	2004	2007	2011
high-high (significancy)	-	Prahova (95%)	Prahova (95%)	Prahova (95%)
low-low (significancy)	-	Iaşi (99%) Botoşani (99%) Suceava (95%) Neamţ (95%)	Iaşi (99%) Botoşani (99%) Bacău (95%) Galaţi (95%)	Botoşani (99.9%) Iaşi (99.9%) Bacău (99%) Galaţi (99%)

		Bacău (95%) Galaţi (95%)	Brăila (95%)	Suceava (95%) Neamţ (95%) Brăila (95%)
high-low (significancy)	București-Ilfov (95%), Iaşi (99%)	-	Constanţa (95%)	-
low-high (significancy)	-	-	-	-

Source: author

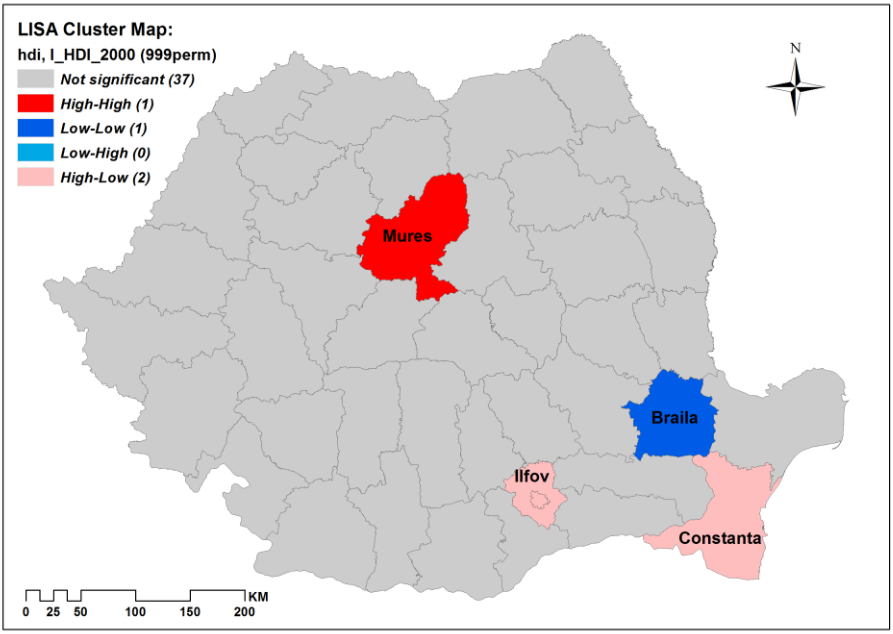
3.2. Local Moran's I Index for HDI

We have calculated the Local Moran's I index for HDI (see table 3) as in the case of GDP per capita. For 2000, we found four counties with significant autocorrelation. Mureș (p=95%, high-high cluster) is outstanding, because it is the core county of a larger area (its neighbours: Cluj, Alba, Sibiu, Brașov, Harghita, Bistrița-Năsăud) where the HDI is above the national average. The low-low cluster contains one peripherical region - Brăila (p=95%). Other two counties form the high-low clusters. They can be interpreted as regional polarizing areas, their HDI being above the national average, but their neighbours are performing poorly, both socially and economically. This cluster is formed by Constanţa (p=95%) and București-Ilfov (p=99%).

In 2004, six counties had significant autocorrelation. Two counties belong to the high-high cluster, Mureș and Alba (p=95%). The less developed low-low cluster is built, as in 2000, by Brăila (p=95%). Other three counties belong to the high-low cluster: Iaşi, Galaţi (p=95%) and București-Ilfov (p=99%).

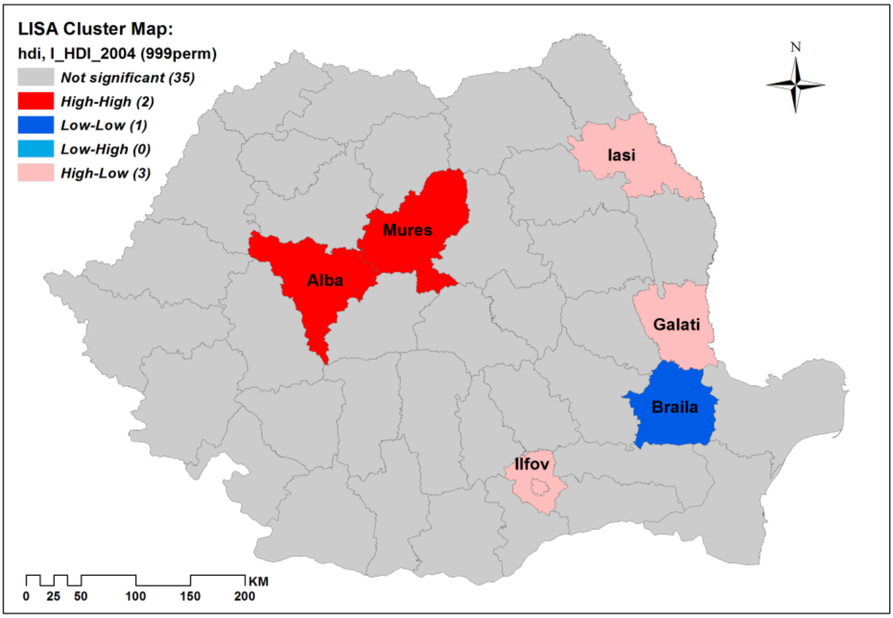
In both years, 2007 and 2011, six counties registered significant autocorrelation. Mureș represents the high-high cluster (p=95%), while the low-low cluster remains stable, being represented by Brăila (p=95%). The high-low cluster is the only one which registered changes in comparison to 2004 or 2000. It now contains four counties, the previous group of Iaşi, Galaţi (and București (p=95%) being completed by Constanța (p=99%).

Figure 5. Significant HDI clusters, 2000



Source: author

Figure 6. Significant HDI clusters, 2004



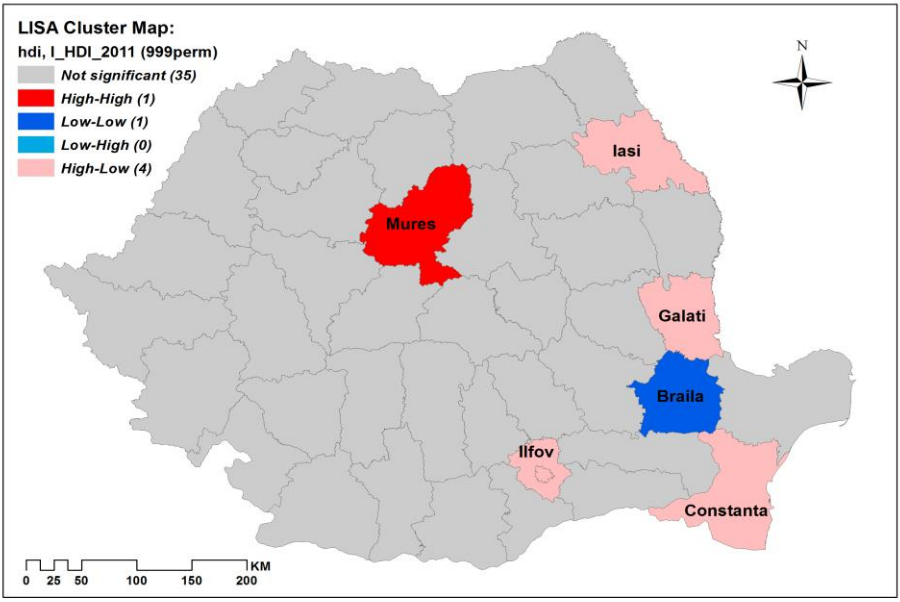
Source: author

Table 3. Local Moran 'I for HDI

Cluster	2000	2004	2007	2011
high-high (significancy)	Mureş (95%)	Alba (95%) Mureş (95%)	Mureş (95%)	Mureş (95%)
low-low (significancy)	Brăila (95%)	Brăila (95%)	Brăila (99%)	Brăila (95%)
high-low (significancy)	Bucureşti-Ilfov (99%) Constanţa (95%)	Bucureşti-Ilfov (99%) Galaţi (95%) Iaşi (95%)	Bucureşti-Ilfov (99%) Constanţa (95%) Galaţi (95%) Iaşi (95%)	Bucureşti-Ilfov (95%) Constanţa (95%) Galaţi (99%) Iaşi (99%)
low-high	-	-	-	-

Source: author

Figure 7. Significant HDI clusters, 2007, 2011



Source: author

3.3. Evaluation of results

The calculation of the Local Moran's I index has enabled us to determine spatial structures with strong spatial associations, in a longitudinal analysis, which started in 2000 and ended in 2011. The results for the GDP per capita and HDI show some divergences and some overlapping as well. In the case of GDP per capita, the results underline the regional differentiation process which started in 2004: for 2000, there is no high-high cluster member, but starting with 2004, we have identified a constant high-high cluster member: Prahova county, which builds together with his neighbours (București-Ilfov, Prahova, Brașov, Dâmboviţa, Ialomiţa and Buzău) a high-developed cluster-region. The emergence of this cluster can be interpreted as a clear sign of the spatial polarization of economic development. On the opposite position, there are the counties from the Moldova historical region, which, starting with 2004, have built the low-low cluster, initially with six members and in 2011, with seven members. If we take into account their neighbours, we can identify an extended peripheral region which comprises the entire region of Moldova, the northern part of the region Dobrogea and Muntenia, and the eastern part of Transylvania (the counties Covasna, Harghita, Mureș, Bistrița-Năsăud and Maramureș).

In the case of HDI, we have a different picture. On the one hand, the year 2004 has no importance for the evolution of the HDI. The clusters are stable, they have the same composition for each year. On the other hand, in contradiction to the clusters based on GDP per capita, we have identified a high-high HDI based cluster in the central part of Transylvania, around Mureș County. In addition, we have identified more high-low HDI based clusters, with no exception in the eastern and south-eastern part of Romania. They are regions with strong regional polarization, being cantered on the following core areas: București-Ilfov, Constanţa, Galaţi and Iaşi. Similarly to the GDP based clusters, we have one stable low-low cluster, represented by Brăila. Therefore, it is very interesting that in the case of HDI based clusters, Moldova does not appear as a large peripheral region, as in the case of GDP based clusters. This role is (please replace the phrasal verb – the meaning is unclear) a region which stretches from the southern part of Moldova to northern Muntenia (Brăila and its neighbours).

4. Conclusions

The calculation of the Local Moran's Index for the GDP per capita and HDI has allowed the analysis of spatial interconnections of economic and social development. We have demonstrated the existence of spatial autocorrelation for two basic variables used in regional development studies, GDP per capita and HDI, in the Romanian national and spatial context as well. We have identified those areas were the GDP per capita and HDI show significant (p>95%) spatial autocorrelation, and we have added specific types of spatial structures to the identified clusters. We have seen that the regional divergence process has created its correspondent spatial structures in the form of highly polarized spatial structures (high-low clusters).Therefore, in the less developed eastern and southern parts of Romania, a strongly polarised spatial structure has emerged, with few developed core areas and a large periphery. The capital region București-Ilfov has emerged as a core area, while Moldova builds a peripheral region, and, above all, the GDP per capita of the counties from this region OR these regions are spatially auto correlated, which means that the change of the values of this variable in one county will go hand in hand with the change of the values of the same variable in other counties of the same region. This method has brought evidence regarding the spatial outcome of the strong internal regional differentiation process started in 2004, resulting in the establishment and reinforcement of a large eastern periphery (Moldova) and a southern core region centred on the capital București.

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