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The Spatial Autocorrelation Analysis For Transport Accessibility In Selected Regions Of The European Union

Abstract

In view of the significant differences between the socio-economic regions, the level of development of transport is not homogenous. According to Tobler's law (1970) we can point out that all objects are related to each other, but the ones located closer are more dependent on each other than those farther away. Then we can identify the occurrence of spatial autocorrelation. For example, the European regions can assess whether the border regions of different countries show a similarity to each other.

The main purpose of this article is to assess and analyze the occurrence of spatial autocorrelation in connection with the transport accessibility (measured by density of a motorway network). The general hypothesis is: between European regions, there is a positive spatial autocorrelation in connection with the problems of transport accessibility. Research subjects are selected European regions at NUTS level 2. To evaluate the occurrence of spatial autocorrelation the classic Moran I statistic has been used.

Keywords: *spatial autocorrelation, transport accessibility, Moran's I statistic*

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1. Introduction

Dynamic economic and political changes result in the fact that more and more companies operate internationally (it is a part of the globalization process). For the movement to be possible, there have to be favorable conditions such as the development of the transport network which enables efficient flow. Development of the transport networks causes economic growth, higher employment rate and an increase in the quality of life of the population. The attractiveness of the area can be increased by upgrading the equipment in transport infrastructure, however it can get lower when distance, time and cost are taken into consideration. Areas which can be characterized as those with highly developed transport infrastructure, are more attractive for investors. Moreover the development of transport infrastructure and the decrease of efficiency in that branch are one of the important factors of economic growth.

European transport network is not in regular development. In many countries, which have recently become a member of European Union, there are too little motorways and high-speed railway lines. Transport networks in countries which have been a part of the European Union since 2004, are in weaker development than in the countries that represent the so called “Old Union”. The remedy for this problem is the development of Trans-European Network in countries of Central and Eastern Europe. One of the projects is Transport Infrastructure Needs Assessment (TINA). This process was designated to initiate the development of a multi-modal transport network within the territory of the candidate countries for accession: Estonia, Latvia, Lithuania, Czechia, Slovakia, Hungary, Poland, Slovenia, Romania, Bulgaria and Cyprus. TINA was initiated in 1996 and lasted until 2015 (Rosik, Szuster 2008, pp. 112–113). One of the crucial elements of creating the European network connection is the TEN-T program. It’s main purpose is modernization and connection of the transport system in European countries into one network. The aim can be achieved by creating a basic network of vital connections between the areas, the completion of the missing cross-border connections and redevelopment of the intelligent transport systems.

The main objective of this study is the evaluation of spatial interactions in regions of the level NUTS 2 in selected EU countries (measured by density of motorway network). The first assumption is that the spatial autocorrelation of transport accessibility between European regions is positive. The study covers years from 2004 to 2014. Seven European Union countries were selected for the analysis. The chosen countries are the ones located in Eastern and Central Europe (Bulgaria, Czechia, Hungary, Lithuania, Poland, Romania and Slovakia) which took part in process Transport Infrastructure Needs Assessment). Due to lack of data, Estonia, Latvia and Slovenia, and the island of Cyprus, were not included in the study.

2. Transport accessibility – the issues, definition, types

Concept of transport accessibility is used in many fields of economic and social studies. According to "Longman Dictionary of Contemporary English", the word "access" derives from the word "available" and means the possibility of getting near something, or the chance of using or getting a thing that is wanted. In context of the study "accessibility" can be seen as geographical, social or cultural. The study of accessibility is a wide field of research in social-economic geography, spatial economy and social sciences. On this basis two main features of accessibility (from point of view object) can be presented:

- When social and economic factors are considered, there are at least two elements which could be unilaterally or complementarily available (from the theoretical point of view they could influence to each other).
- There is medium of relation, which in the specific case can be defined as a mode of transportation (or communication if seen in wider context). In reality those relations could be impeded by many physical, political, social and economic barriers.

Definition of "accessibility" is commonly used in geography, spatial planning and urban planning. There are many definitions in literature and there is none that can be described as universal and common. Hansen (1959) presents "accessibility" as the ability to interact. Ingram (1971) chose to derive it into two separate concepts. The first one is relative accessibility, which is the distance between two places. The bigger the distance, the weaker the accessibility. It can be measured by physical distance or transport cost. The second type of accessibility is the total one. In this conception the measure is not reflexive. What is more accessibility conception has been analyzed by: Vickerman (1974), Dalvi and Martin (1976), Black and Conroy (1977), Burns (1979), Ben-Akiva and Lerman (1979), Ratajczak (1992), Geurs (2004), Koźlak (2012), Rosik (2012).

As was said before, if we analyze the subject of accessibility, it can be one of the following: social, economic or spatial. Social accessibility shows whether people have funds, status, social situation thanks to which they can get different goods and services. This type accessibility is an object research of sociology. Economic accessibility is connected with social aspects (because there have to be funds) and spatial aspects (because travelling a distance is connected with costs). Spatial accessibility can be defined as the ease to achieve aim (which can be measured by distance, cost or time). In literature there can also be found communication accessibility and transport accessibility (these definitions are exchangeable) which to connect elements three of types before. This type of accessibility is wider than spatial accessibility, because it combines transport and communication. What is more it includes the maximal capacity and accessibility of transport network. The last important type of availability is the typological accessibility which presents transport networks as an element of the graph theory (Guzik 2003, pp. 33–35).

Transport accessibility has an impact on the relative benefits of a given region and is associated with the decisions which are made in reference to investment locations. As a results, accessibility may be analyzed using a variety indexes (Rosik 2012, pp. 23–24):

- infrastructure-based accessibility,
- distance-base accessibility,
- cumulative accessibility (isochronic accessibility),
- person-based accessibility,
- potential accessibility.

In this article, the infrastructure-based accessibility was used. It has been estimated with the use of the indexes of equipment of a particular area with appropriate transport infrastructure. The examples are:

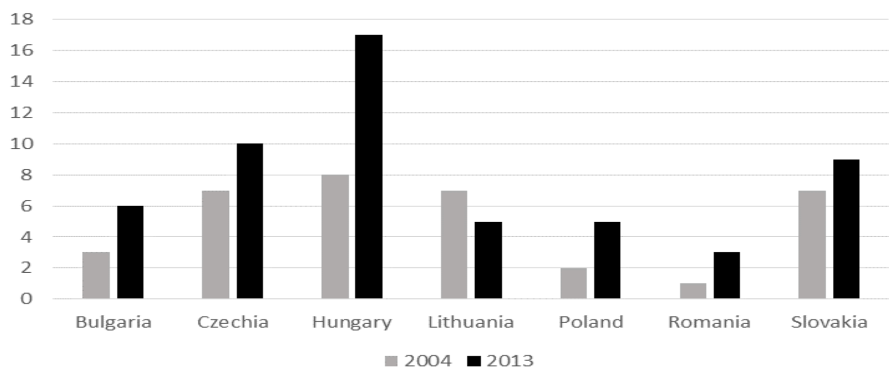
- number of infrastructural indicators: length of roads or railway lines, the number of airports and harbors,
- quality of infrastructural indicators: length of expressways, motorways and high-speed railways, average speed of transport branches which is taken from the traffic models on the specific regions, indicator of renovation needs, airport capacity,
- the level on transport congestion: it is the result of traffic and the quality of infrastructure, there can be a relation between transport congestion and quality of infrastructure, because heavy traffic affects the average speed and renovation needs. As a result these could be the factors which determine quality of infrastructure.

Transport can be seen as a base of European integration process. It is one of the first discipline to be included to a common policy of the European Union. In Treaty of Rome (1957) there was an information that transport will have a big impact for to guarantee three (which are: the free movement of goods, services and people) of the four freedom which it constitutes. Implementation of freedom could result in an effectively functioning transport network. The positive aspect is gradual disposal of the barriers and differences in technical and administrative standards, distortion of competition (for example: monetary policy, taxes and charges). Developed transport networks may support economic growth and trade, create new jobs and other favorable economic aspects. Transport networks are a very important part of the supply chain, because they are a basic influence for the economy in all countries and enable an effective movement of people and flow of goods. Convenient road, railway, air and water connections result in constant movement of people and goods and they tend to improve the quality of life.

2.1. Transport accessibility in selected European Union countries

Between countries, which are members of the European Union there are differences in the development of transport accessibility measured by density of motorway networks (figure 1). Countries which had the highest density of motorway network were Hungary, Czechia and Slovakia. The lowest levels of density were observed in Poland and Romania. The density of motorways in 2004 and 2013 in selected European Union countries increased, which is a positive phenomenon (only density of motorway in Lithuania decreased).

Figure 1. Density of motorway network in selected EU countries in 2004 and 2013 (in km per 1000 sq km)

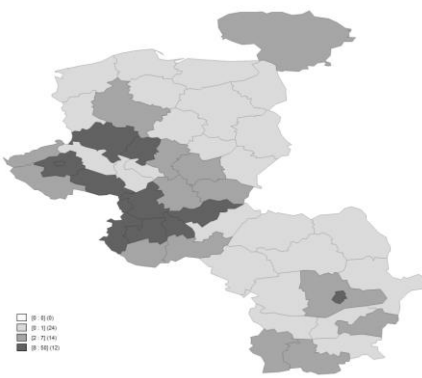


Source: author's own study based on the EUROSTAT.

The following maps show density of the motorway network in regions of the level NUTS 2 in selected European Union member countries in 2004 and 2014. The level of density of motorway network in analyzed regions of NUTS 2 varies. In 2004 (figure 2) the highest density of motorway network was in the following regions: Central Bohemia and Southeast (in Czechia), Central Hungary, Central Transdanubia, Western Transdanubia and Northern Hungary (in Hungary), Lower Silesian Voivodship and Opole Voivodship (in Poland), Bucuresti Ilfov (in Romania), Bratislava Region and Western Slovakia (in Slovakia). In 2014 (figure 3) situation of density of motorway was a little different. 5 of 7 Hungarian regions characterized by the highest density of motorway network. In 2014 the density of motorway network increased in Silesian Voivodship, Lodz Voivodship and Kuyavian-Pomeranian Viovodship (in Poland). Situation in Romanian regions improved. In Lithuania the level of density decreased. The level of density of motorway network is differential. Generally better situation can observed in south-western analyzed area.

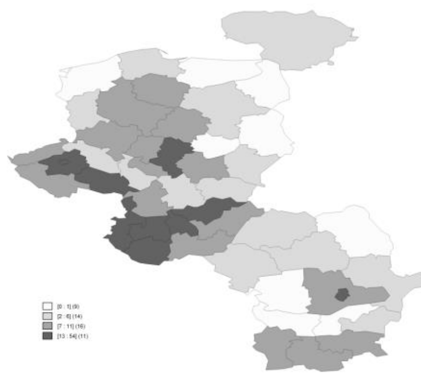
Differences between regions should not be taken into consideration (according to economy convergence criteria). Integration between the transport in different branches (in the main: maritime transport, high-speed railway network for passengers and the development of new and big infrastructural investments in Trans-European Transport Network – TEN-T – and Transport Infrastructure Needs Assessment – TINA – this study is based on process TINA) is very important from point of view European Commission. Safety is also of a great importance in the functioning of transport, and for that reason European Union is trying to improve this aspect.

Figure 2. Quantile map of density of motorway network in regions NUTS 2 in selected European Union member countries in 2004 (in km per 1000 sq km)



Source: author’s own study based on the EUROSTAT.

Figure 3. Quantile map of density of motorway network in regions NUTS 2 in selected European Union member countries in 2014 (in km per 1000 sq km)



Source: author’s own study based on the EUROSTAT.

3. The theoretical background

Exploratory Spatial Data Analysis is technique, which uses maps, charts, indicators and plots. That aim of the analysis is to detect, describe and present the variables in space, identify outliers, test spatial interaction and groups. Typically is a research which consists of three parts (Suchecki 2010, p. 100):

- Data Integration – integration set which is taken from various databases,
- Exploratory Data Analysis – characteristics of variables, their type and strength of spatial autocorrelation, hot spots,
- Confirmatory Spatial Data Analysis – verifying hypotheses, regression models.

Typically spatial effects can describe spatial heterogeneity and spatial autocorrelation (that phenomenon was described in article). Spatial heterogeneity is described as changes of structural relation and connections between observations. Spatial autocorrelation can be seen changes in space, it may be observed as clusters. Spatial autocorrelation is a degree of correlation of the observed values of variable in a given location with the values of the same variable in another location. This means that the tested variable at the same time determines and is determined by its implementation in other locations. These interactions have effects on a group of similar values in the space. When testing for spatial autocorrelation, two types of relations are considered (Suchecki 2010, pp. 103–105):

- positive – considered in terms of location, the spatial accumulation: high or low values of observed variables,
- negative – high values of observed variables adjoin to low and vice versa.

3.1. Global spatial autocorrelation

Global spatial autocorrelation is synthetic measure for all samples, it analyzes global tendency between observations. One of the measures to assess spatial autocorrelation is Pearson's linear correlation coefficient and gamma's statistics. Join-count, *Moran I*, *Geary C* are the most common measures to assess global spatial autocorrelation (table 1).

Positive spatial autocorrelation groups regions about similar value (high or low), negative spatial autocorrelation groups regions about different value (high and low). The results of global spatial autocorrelation present on to scatter plot. Table 2 present relationship between points located on the scatter plot.

Table 1. Types of global statistics spatial autocorrelation

Spatial autocorrelation	Formula	Interpretation
Moran I	$I = \frac{\sum_i \sum_j w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{S^2 \sum_i \sum_j w_{ij}}$ where: $S^2 = \frac{1}{n}\sum_i (x_i - \bar{x})^2$	*I*>0 – positive spatial autocorrelation, value in distance *d* are similar *I*<0 – negative spatial autocorrelation, value in distance *d* are different *I*=0 value in distance *d* are random
Geary C	$C(d) = \frac{(n-1)}{(2\sum_i^n \sum_j^n w_{ij})} \cdot \frac{\sum_i^n \sum_j^n w_{ij}(x_i - x_j)^2}{\sum_i^n (x_i - \bar{x})^2}$	0<*C*<1 – positive spatial autocorrelation, value in distance *d* are similar 1<*C*<2 – negative spatial autocorrelation, value in distance *d* are different
Join-count	$BB = \frac{1}{2}\sum_i^n \sum_j^n w_{ij} x_i x_j$ $WW = \frac{1}{2}\sum_i^n \sum_j^n w_{ij}(1 - x_i)(1 - x_j)$ $BW = \frac{1}{2}\sum_i^n \sum_j^n w_{ij}(x_i - x_j)^2$ BB – black-black WW – white-white BW – black-white	H_0 – spatial autocorrelation are not exist [*p*>0,05] H_1 spatial autocorrelation are exist [*p*<0,05]
Legend: *n* – number of observations, x_i, x_j – values of variable in locations *i* and *j*, $\bar{x}$ – mean value of *x* variable, w_{ij} – element of spatial weight matrix **W**.		

Source: author's own study based on Kopczewska 2011, pp. 71–89.

Table 2. The relationship between regions and neighbouring regions

	Value low in regions surrounding (L)	**Value high in regions surrounding (H)**
Value high in region *i* (H)	**HL** negative spatial autocorrelation	**HH** positive spatial autocorrelation
Value low in region *i* (L)	**LH** positive spatial autocorrelation	**LH** negative spatial autocorrelation

Source: Kopczewska 2011, p. 74.

3.2. Local spatial autocorrelation

Local spatial autocorrelation is used to analyze spatial relationships of value of variable in region *i* with the surrounding regions. *Moran's I*, *Geary C* and *Getis-Ord* use the most often. Local *Moran's I* statistics measure if region *i* is surrounded by regions with similar or different value. Local *Geary's C* statistics show similarity and differences between region *i* and neighboring regions. Local *Getis-Ord* statistics identify spatial agglomeration of effects. *Getis-Ord G** statistics is modification from G_i statistics. The difference between that type of statistics is structure matrix of weight.

Table 3. Types of local statistics spatial autocorrelation

Spatial autocorrelation	Formula	Interpretation
Local *Moran* I_i	$I_i = \frac{(x_i - \bar{x}) \sum_{i=1}^{n} w_{ij}(x_j - \bar{x})}{\sum_{i=1}^{n}(x_i - \bar{x})^2/n}$	$I_i<0$ – negative spatial autocorrelation, region is different than region surrounding (outliers) $I_i>0$ – positive spatial autocorrelation, region is similar to region surrounding (cluster) $\|I_i\|>\|I_j\|$ – region *i* is similarity or dissimilarity to surrounding regions
Local *Geary* C_i	$C_i(d) = \sum_{j\neq 1}^{n} w_{ij}(Z_i - Z_j)^2$	$C_i>1$ – negative spatial autocorrelation, region is different than region surrounding (outliers) $C_i<1$ – positive spatial autocorrelation, region is similar to region surrounding (cluster)
Local G_i, G^*	$G_i(d) = \frac{\sum_{j,j\neq i}^{n} w_{ij}x_j}{\sum_{j,j\neq i}^{n} x_j}$	$G_i>0$ – region is surrounding by regions with high value (cluster with high values) $G_i<0$ – region is surrounding by regions with low value (cluster with low values)
Legend: Z_i, Z_j – standardized values. The others descriptions are the same such as table 1.		

Source: author's own study based on Kopczewska 2011, pp. 71, 89–99.

4. Research assumptions

This study covered regions on the level NUTS 2 in selected European Union countries in the years 2004–2014 (50 regions – table 4), in order to analyze and observe changes in spatial interaction in terms of transport accessibility. The European Union countries (selected to analyze) took part in process identification network – Transport Infrastructure Needs Assessment. The study utilized the mid-year data from the EUROSTAT. Variable, which assess transport accessibility is density of motorway network (km per 1000 square km). The imperative aim is to present the dynamics of change in spatial dependence determining development of motorway network in regions NUTS 2 in selected European Union countries from 2004 to 2014. This paper is set out to identify regions with high degree of proximity which could be grouped into clusters. The hypothesis assumes that there is positive spatial autocorrelation in terms of the transport accessibility (measured by density of motorway network) between regions NUTS 2 in selected European Union countries.

Table 4. European Union member countries and their regions NUTS 2 which analyzed

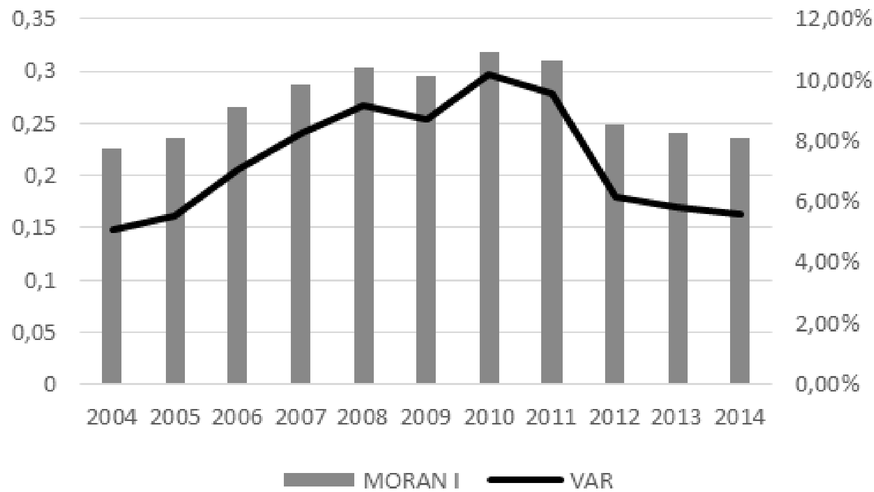
No.	Country	Number of regions NUTS 2
1.	Bulgaria	6
2.	Czechia	8
3.	Hungary	7
4.	Lithuania	1
5.	Poland	16
6.	Romania	8
7.	Slovakia	4
Total		**50**

Source: author's own study.

5. Results

Autocorrelation relationships between regions were identified in respect of the density of motorway network. To verify the hypothesis for spatial dependence, univariate *Moran's I* statistics were calculated and results are presented below (figure 4). The weight matrix was created according to queen contiguity of the one nearest neighbours.

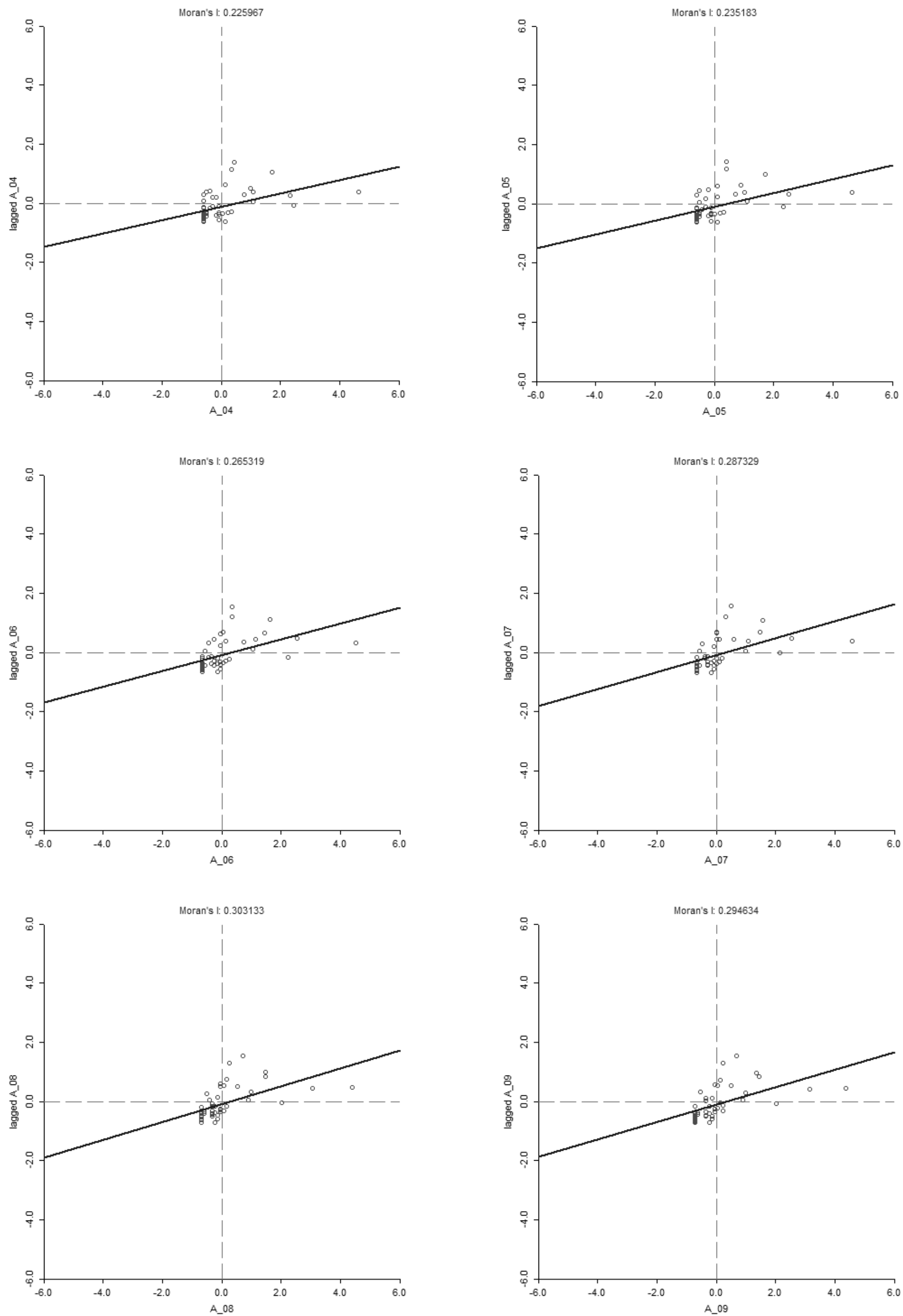
Figure 4. *Moran's I* statistics and variability for density of motorway network in years 2004–2014

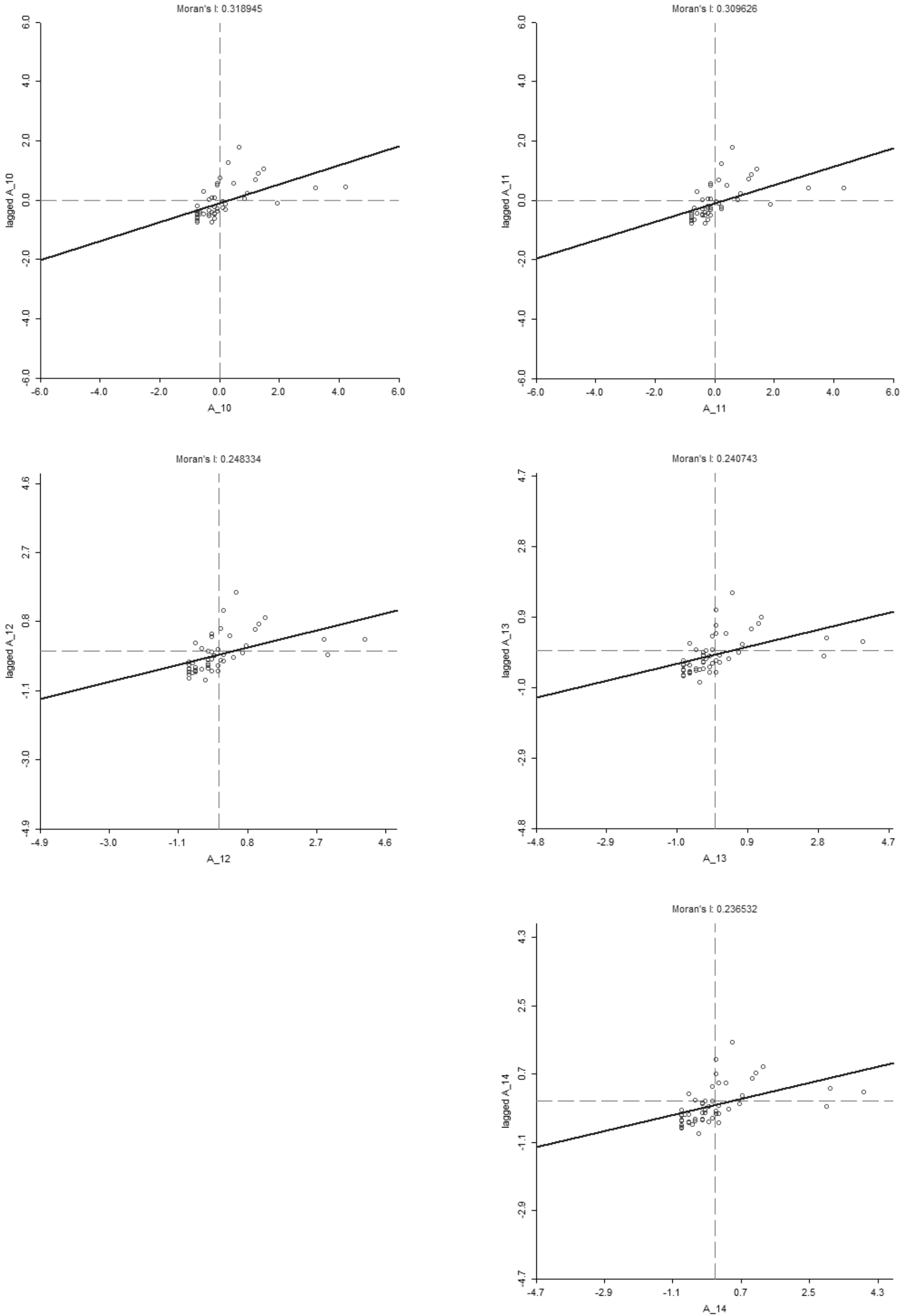


Source: author's own study.

The results gave the reason for a conclusion that spatial autocorrelation was positive, so there should be clustering of similar values of mentioned spatially observed variable. That led to further local indicators for spatial association and *LISA* was calculated. In years 2004–2008 the values of *Moran's I* statistics increased, in 2009 the value decreased and from 2010 to 2014 the values also decreased. The global *Moran's I* statistics has been graphically represented by scatter plot (figure 5). It enables the visualization of local spatial relationships (clusters). The relationships in coordinate system across the OX axis is where standard value of given variable is marked. Standard value of spatially lagged variable is marked across the OY axis. The plot is divided into quadrants relative to the origin (0, 0).

Figure 5. ***Moran's I*** **scatter plot for density of motorway network in years 2004–2014**

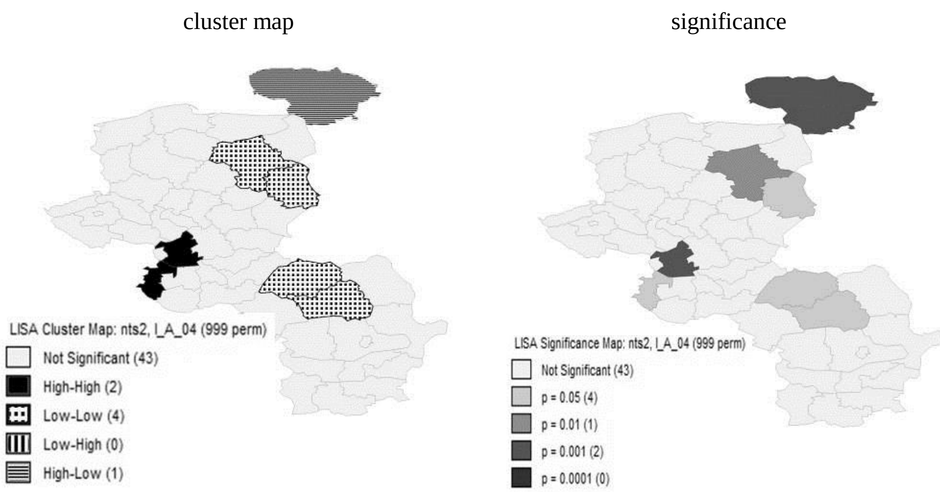




Source: author's own study in GeoDa program.

In order to identify spatial regimes, different regions were plotted on maps. Figures 6–8 show distribution of regions NUTS 2 of selected European Union countries according to the density of motorway network (in years 2004, 2009 and 2014).

Figure 6. Local *Moran's I* statistics for density of motorway network in 2004 – cluster map and significance



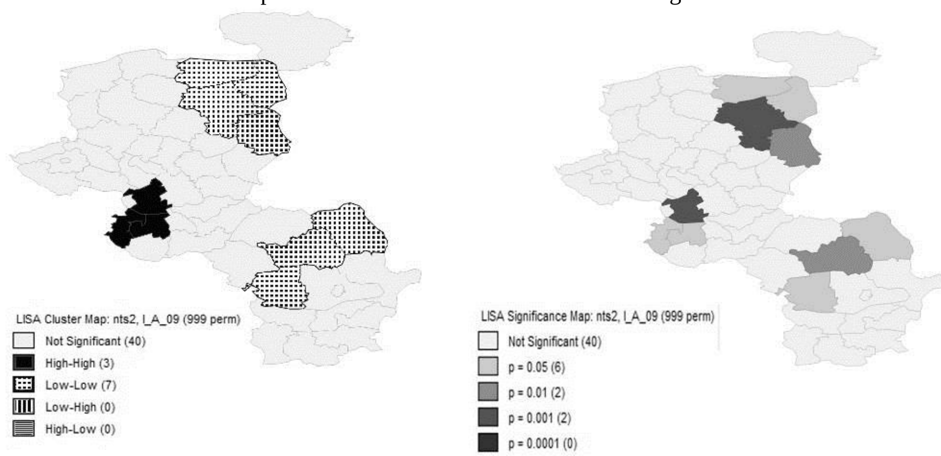
Source: author's own study in GeoDa program.

In 2004 (figure 6) the regions with a low density of motorway networks were pointed out in north-east Poland (Mazovian Voivodship and Lublin Voivodship) and in north and central Romania (North-Western and Central Region). Regions characterized by the highest level of that variable grouped into high cluster, in 2004: Western Slovakia Region and Western Transdanubia Region in Hungary. Lithuania is shown to have a high value of that variable, even though it is neighboring with region displaying low value of the mentioned variable.

In 2009 (figure 7) the lower value of *Moran's I* statistics can be observed in comparison to the years before (2008) and after (2010). Three groups can be seen. First group consists of three regions: Western Slovakia Region (in Slovakia), Central Region and Western Transdanubia Region (in Hungary). There is a high possibility (in comparison to 2004) that the group will expand. Unfortunately groups with lower value also expand. Regions located in north-east Poland create group with low value of density of motorway network. Three regions located in Romania (such as: Central Region, North-Easter Region and South-Western Otelina) can be characterized by low value that variable.

Figure 7. Local *Moran's I* statistics for density of motorway network in 2009 – cluster map and significance

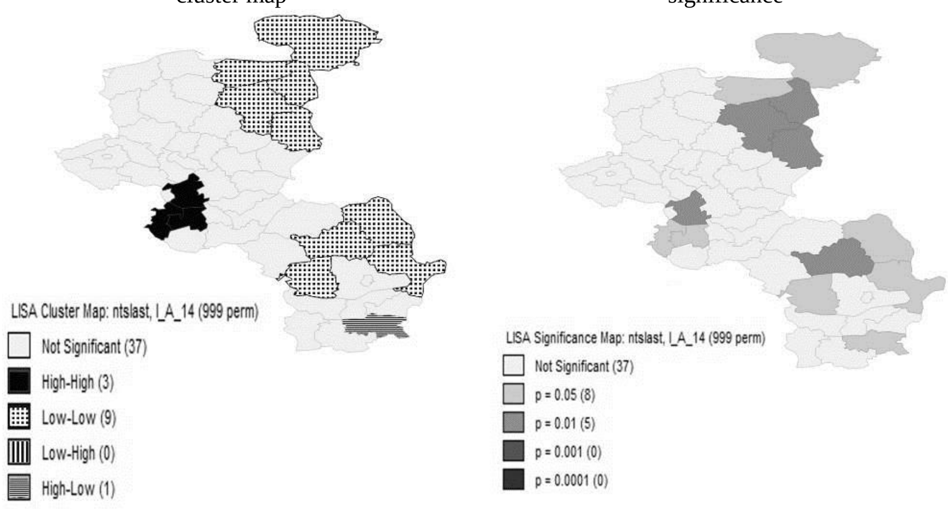
cluster map significance



Source: author's own study in GeoDa program.

Figure 8. Local *Moran's I* statistics for density of motorway network in 2014 – cluster map and significance

cluster map significance



Source: author's own study in GeoDa program.

In the last analyzed year (2014 – figure 8), there are none big changes. Group with a high values of density of motorway network is the same. New groups with low values that variable are created by:

1) north-east Polish regions (Mazovian Voivodship, Lublin Voivodship, Podlachian Voivodship, Warmia and Mazury Voivodship) and Lithuania,
2) Romanian regions: Central Region, North-Eastern Region, South-Eastern Region and South-Western Otelina.

Moreover in Bulgaria is the only region which is characterized by a high-low value. It means that this region (South-East Planning Region) is surrounded by regions with low value of variable density of motorway network.

Diversification of regions NUTS 2 of selected European Union countries measured by density of motorway network is significant. In years 2004–2014 spatial interaction between that regions was positive, but changes was very insignificant. The biggest clusters was found with low value of density of motorway network. That clusters generally group regions from the same countries. On this basis one might say that process TINA didn't work according to their objectives. TINA assumed that Central and Easter European countries will be development of transport. Development was observed, but analyzed regions didn't similar to each other.

5. Conclusion

Development of transport network is a very important element fot effective functioning of European countries and regions. The increasing demand for goods and movement of people is the reason of successful expansion and modernization of transport infrastructure. Generally it is very important to connect all the regions of EU countries into a functioning system or, in other words, a transportation network. It will promote to movement of people and flow of goods (with consideration of distance). Differences in the levels of accessibility (measured by density of motorway networks) in regions NUTS 2 in selected Central and Eastern European Union countries are significant. These regions vary in economic, geographic, environmental and social terms.

The methods for revealing the spatial dependence allowed to identify the areas of occurrence of spatial autocorrelation for the density of motorway network. Between analyzed regions there is a positive spatial autocorrelation (measured by density of motorway network). It is similarity between regions with high-high value and low-low value and this groups of region create clusters. Unfortunately in analysis not all regions turned out to be significant. In years 2004–2014 the changes between analyzed regions were little. The increase of density of motorway networks was observed, but analyzed areas didn't create a big cluster with values high-high.

References

Black J., Conroy M. (1977), *Accessibility Measures and the Social Evaluation of Urban Structure*, 'Environment and Planning', A 9.

Cocdeco-Melhorado A., Reggiani A., Gutierrez J. (2014), *Accessibility and Spatial Interaction*, Edward Elgar, Cheltenham, Northampton.

Dalvi M.Q., Martin K.M. (1976), *The measurement of accessibility: some preliminary results*, Transportation, 5.

Geurs K.T., van Wee B. (2004), *Accessibility evaluation of land-use and transport strategies: review and research directions*, 'Journal of Transport Geography', 12.

Geurs K.T., Krizek K., Reggiani A. (2012), *Accessibility analysis and transport planning.* Challenges for Europe and North America (Nectar Series on Transportation and Communications Network Research). Cheltenham, UK: Edward Elgar Publishing Ltd.

Guzik R. (2003), *Przestrzenna dostępność szkolnictwa ponadpodstawowego*, Instytut Geografii i Gospodarki Przestrzennej UJ, Kraków.

Hansen W. (1959), *How Accessibility Shapes Land-use*, 'Journal of the American Institute of Planners', 25 (2).

Ingram D.R. (1971), *The concept of accessibility: a search for an operational form*, 'Regional Studies', 5.

Kopczewska K. (2011), *Ekonometria i statystyka przestrzenna z wykorzystaniem programu R CRAN*, CeDeWu, Warszawa.

Koźlak A. (2012), *Nowoczesny system transportowy jako czynnik rozwoju regionów w Polsce*, Published by Uniwersytet Gdańskiego, Gdańsk.

Longman Dictionary of Contemporary English (2014), Longman.

Rosik P. (2012), *Dostępność lądowa przestrzeni Polski w wymiarze europejskim*, Instytut Gospodarki i Przestrzennego Zagospodarowania Kraju, Warszawa.

Rosik P., Szuster M. (2008), *Rozbudowa infrastruktury transportowej a gospodarka regionów*, Wydawnictwo Politechniki Poznańskiej, Poznań.

Rydzkowski W., Wojewódzka-Król K. (2010), *Transport*, PWN, Warszawa.

Spiekermann K., Neubauer J. (2002), *Accessibility and Peripherality: Concepts, Models and Indicator*, Nordregio.

Suchecki B. (2010), *Ekonometria przestrzenna. Metody i modele analizy danych przestrzennych*, C. H. Beck, Warszawa.

Suchecka J. (2014), *Statystyka przestrzenna. Metody analizy struktur przestrzennych*, C. H. Beck, Warszawa.

Vickerman R.W. (1974), *Accessibility, Attraction and Potential: a Review of Some Concepts and Their Use in Determining Mobility*, 'Environment and Planning', A 6.

Załoga E. (2013), *Trendy w transporcie lądowym Unii Europejskiej*, Wydawnictwo Naukowe Uniwersytetu Szczecińskiego, Szczecin.

Streszczenie

AUTOKORELACJA PRZESTRZENNA DOSTĘPNOŚCI TRANSPORTOWEJ W REGIONACH WYBRANYCH KRAJÓW UNII EUROPEJSKIEJ

W związku z istotnymi różnicami społeczno-gospodarczymi pomiędzy regionami, poziom rozwoju transportu jest niejednolity. Według prawa Toblera (1970 r.) wskazać można, iż wszystkie obiekty są ze sobą powiązane, jednak obiekty bliższe są bardziej uzależnione od siebie niż obiekty położone dalej. Wówczas zidentyfikować można występowanie autokorelacji przestrzennej. Na przykładzie regionów europejskich można przykładowo ocenić, czy regiony przygraniczne, leżące na obszarach różnych krajów, wykazują względem siebie podobieństwo.

Głównym celem niniejszego artykułu jest ocena oraz analiza występowania autokorelacji przestrzennej w ramach dostępności transportowej. Hipoteza ogólna brzmi następująco: pomiędzy regionami europejskimi występuje dodatnia autokorelacja przestrzenna w ramach problematyki dostępności transportowej. Podmiotami badania są wybrane regiony europejskie na poziomie NUTS 2. Do oceny występowania autokorelacji przestrzennej wykorzystano statystki klasyczne Morana.

Słowa kluczowe: *autokorelacja przestrzenna, dostępność transportowa, statystyka Morana I*