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INFRASTRUCTURE FACILITIES AS A POTENTIAL FOR DEVELOPMENT IN SLOVAKIA

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Abstract: Infrastructural facilities of municipalities in the Slovak territory can be characterized by their higher rate of spatial variability. This can be used as a tool for the evaluation of the potential of regional development in the studied region. Based on the consequential potential, we can easily evaluate how propulsive or how attractive is the character of the studied region. The potential of infrastructural facilities can be studied in various ways. In this paper, the spatial demo-geographical approach is proposed and demonstrated. We have considered the studied region as the set of municipalities located in Bratislava and Košice functional urban regions (FUR), as a region based on daily commuting. Input data has been provided by the Statistical Office of the Slovak Republic (data related to 31 December 2009). In addition to the infrastructural facilities, we also considered the accessibility of the region centres – the cities of Bratislava and Košice - using route distance; accessibility by private transport and accessibility by public transport (morning mid-week). The resulting value for each municipality can be interpreted as a potential.

Key words: technical infrastructure, social infrastructure, accessibility, functional urban region, potential

Introduction

Infrastructural facilities of municipalities in the Slovak territory can be characterized by their high rate of spatial variability. At present, their absence or low level is considered to be one of the barriers to development, thus particular attention is given thereto. If the potential of the municipality is the ability to meet the requirements of the population in various dimensions, then just selected elements of technical and social facilities that are necessary for their daily lives can act as pull factors in the decision making process of potential migrants to these municipalities (Andráško & Ira, 2010, Tóth, 2010). Their absence may even be one of the aspects of the marginalization of a region in terms of geometry, economics, and perceptiveness (Poláčková, 2010). The regions of Bratislava and Košice in the nationwide scale can be characterized by the high daily fluctuation of their commuting population (Michniak, 2005). This causes increased demand not only for quantity but also quality of transport infrastructure, and its importance has even increased in recent years, when

Slovak towns have been affected by decentralization processes (decreasing population density in urban centres) and deconcentration (suburban areas grow faster than urban) of their population (Moravanská, 2010; Novotný, 2011).

The aim of this paper is to determine the potential of municipalities in the functional urban regions of Bratislava and Košice in terms of their infrastructure facilities, and accessibility of the centres of the regions and their mutual comparison. They may be ones of potential factors for their future development, not only in terms of population but also economics.

Definition of the investigated areas

The functional urban region (FUR) of Bratislava is located in the southwest of Slovakia, and it is the largest, most advanced and most dynamic region. The choice of a daily urban system as the observational unit is based on the need to maintain the coherence and closeness of the system of municipalities, in terms of their natural attraction area with the centre in the core of the region (Bezák, 2000). The FUR contains 125 basic regional units, including 17 districts of Bratislava, eight towns (not including the city of Bratislava), and one military district (Záhorie), while the number of permanent residents living in the city of Bratislava is 2/3 the population of the region. In terms of its administrative division, the functional urban region extends beyond the Bratislava region and enters the neighbouring Trnava region. The region includes all urban districts of Bratislava (Bratislava I - V), the whole districts of Malacky, Pezinok and Senec, 26 municipalities in the district of Dunajská Streda, seven municipalities in the Senica district, and four municipalities in the Galanta region. In terms of the physical and geographical point of view, the functional urban region is mostly in the flat terrain of the Vienna Basin, which is divided in the central part by the tip of the Carpathian Mountains. At the foot of the Carpathian Mountains and the Vienna Basin, the natural core of the region and the capital of the Slovak Republic - Bratislava - is located.

Bratislava is characterized by its excellent transport position and its economic importance as the "gateway" between Eastern and Western Europe. From the aspect of road transport, it is located at the junction of the highways D1, D2 and D4. The D1 highway is the most important road transport artery in Slovakia, and its completion it will directly join Bratislava with other major cities in Slovakia, including Košice. A section of the D1 highway is part of the European route E-75, which connects Northern Europe with the Balkan Peninsula. The D2 highway is the fastest road connection between Bratislava and the Czech

Republic, where it continues as the D2 to Brno, and to Hungary where it continues as the M15 expressway to the intersection Lével. The whole section of the D2 highway in Slovakia is part of the European route E-65 from the Swedish city Malmö through the western part of the Balkan Peninsula to Crete in Greece. Although the D4 highway is under construction, the completed section connects the D2 highway with the Kittsee border crossing, where the highway continues as the A6 in Austria. In addition to road transport, Bratislava is an important railway junction. Bratislava has direct rail connections to all major cities in Slovakia and abroad. Particularly important is the direct connection with Berlin, Belgrade, Brno, Budapest, Košice, Prague and Vienna. Considerably important is also inland water transport, especially dominated by the transport of raw materials and goods. In Bratislava is an international airport, but its importance is fading due to the proximity of Vienna Schwechat Airport and its significantly larger range of direct flights.

The functional urban region of Košice is in the southeast of Slovakia, and is the second most developed region after Bratislava. Due to the location of Bratislava and the location of Košice as its counterpart, Košice is often considered as a secondary Slovak city at certain spatial positions representing the capital (Lukniš, 1985). The FUR has 119 municipalities, the city of Košice in this analysis is considered at the level of its 22 districts, and its population constitutes two-thirds of the population of the region. In addition to Košice, the region also includes the towns of Moldava nad Bodvou and Medzev. The FUR involves the urban districts of Košice (Košice I-IV), the whole district of Košice-okolie, three municipalities in the Prešov district and two municipalities in the Trebišov district. The core (centre) of the region is in the Košice Basin, while its peripheral parts are on the foothills of the Carpathian Mountains (on the east the natural barrier is formed by the Slanské vrchy, in the northwest by the Slovenské rudohorie).

The natural core of the region, the city of Košice, has a good transport location in terms of Slovakia (the D1 motorway connection to Prešov, the planned R2 expressway with the south and centre of Slovakia, the main railway corridor No. 180 Žilina - Košice) as well as the neighbouring countries (the connection to Budapest and Miskolc with the R4 expressway, the broad gauge railway line to Ukraine, the position on the 5th main international transport corridor). Košice also has an international airport.

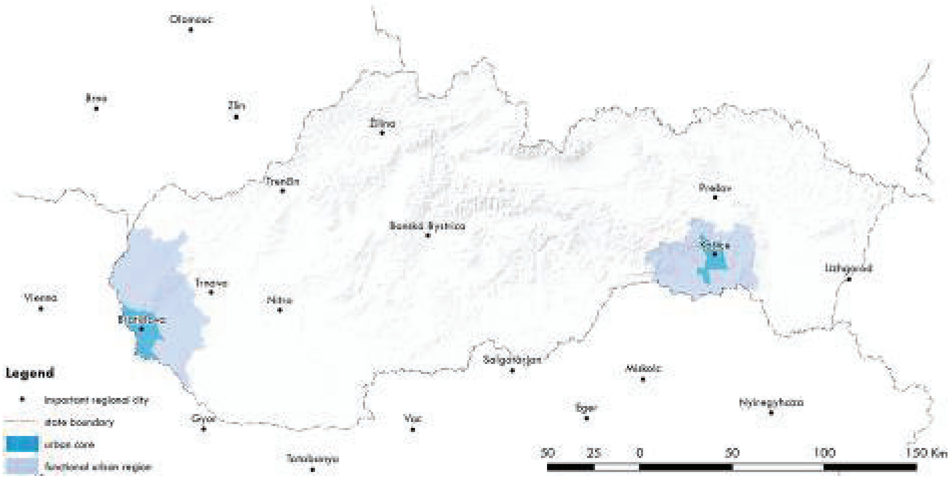

Figure 1. Location of the functional urban regions of Bratislava and Košice in Slovakia

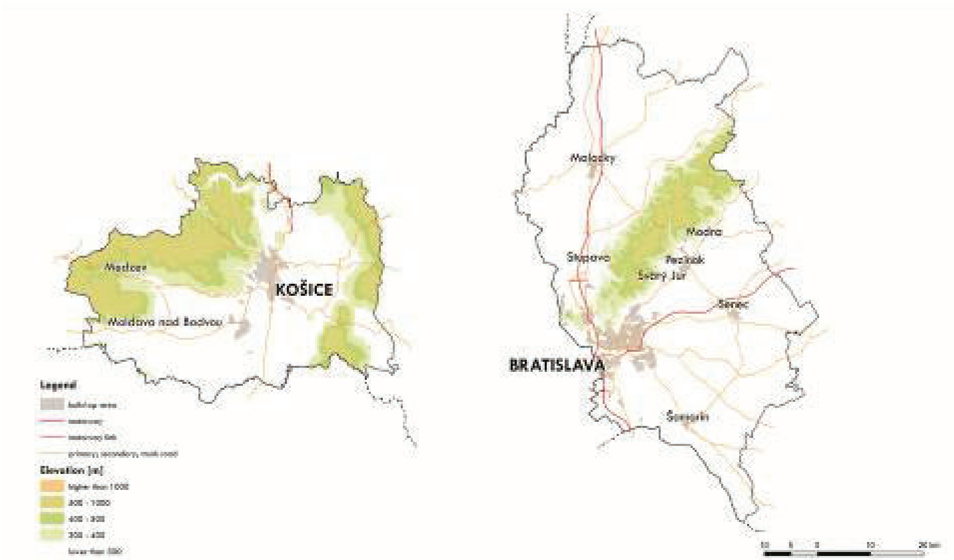

Figure 2. Physical and geographical conditions of the functional urban regions
of Bratislava and Košice

Theoretical and methodological basis

For the purposes of research, the term infrastructure is identified with the term facilities or infrastructure facilities (technical, social or economic) (Andráško & Ira, 2010). Connection to utility networks such as water, sewer and gas mains is understood as a basic technical infrastructure facilities, that increase the attractiveness (potential) of the municipality in terms of cost reduction, but also in terms of improving the living comfort and thus the quality of life of its inhabitants (Godor & Horňák, 2010).

For services of daily needs, residents generally travel only short distances, while less frequent or occasional services are characterized by a higher degree of territorial concentration and longer commuting distance (Lovacká, 2007). In light of the above, basic services (or elements of social infrastructure) are considered to be health care as primary care of physicians for children and adults and primary school facilities (schools with classes 1 – 9.). As small municipality can cover only part of the demand for these services, these activities are usually located in larger municipalities, so that they become potential ancillary centres of the region in terms of service function.

For services and activities of a higher level such as state administration services, secondary and higher education, selected medical, cultural, sport and recreational facilities, a variety of commercial services (financial, banking, etc.) and finally, when commuting, people are willing to cover longer distances. Accessibility of a centre serving as a broad background can be monitored in many aspects, while the mutual accessibility of two cities can be impacted by various restrictions and barriers (speed limits, traffic jams, types of used vehicles, etc.), which in the research must be taken into account. The distance function thus can be the direct distance, the actual road distance, travel time, transportation costs, and others (Michniak, 2003).

The used data base was the Urban and Municipal Statistics provided by the Statistical Office of Slovak republic, with data on municipal infrastructure facilities valid at 31 December 2009. Absolute and relative distances between municipalities were obtained using the application *Google Maps,* taking into account the above mentioned conditions (the used means of transport, the exact time coordinates).

The resulting potential of the municipality i (P_i) in presented analysis consists of partial indexes of technical (a_i) and social (s_i) facilities of the municipality, and also the selected attributes of accessibility (d_i) of Košice and Bratislava as regional centres cumulating higher level services, so that together they can act as one of the factors influencing the migration behaviour of the population. Each of the monitored attributes has the same assigned weight.

$$P_i = a_i + s_i + d_i$$

The index of technical infrastructure facilities of the municipality was determined as the sum of its individual components (water distribution – a_i^v, gas distribution - a_i^p, sewerage - a_i^k), while their presence in the municipality was indicated with the value of 1, its absence with the value of 0. The resulting index thus acquires discrete values from 0 to 3.

$$a_i = a_i^p + a_i^k + a_i^v$$

The index of social infrastructure facilities of the municipality was determined as the sum of three elements – a general practitioner clinic (s_i^l), a paediatrician clinic (s_i^p), and an elementary school with classes 1 – 9 (s_i^s).

$$s_i = s_i^p + s_i^l + s_i^s$$

The value 1 indicated their direct presence in the municipality. However, we took into account that people are willing to travel short distances for selected parts of social facilities, so their absence in the municipality has been replaced by the shortest time accessibility of the services in the surrounding municipalities. Accessibility was measured in minutes, at 10.00 in the middle of the week, the used means of transport was a passenger car with legal speed limits on the roads. As a function of distance, decreasing exponential function was used with parameters that for modelling interactions at short distances reaches a good correspondence with reality (commute to work, school, or shopping within the urban region) (Bezák, 2011). After testing a set of parameters of the equation, the value 0.1 has been found to be the most appropriate parameter. For the selected parameter indexes s_i^l or s_i^p, s_i^s reached the most credible values appropriate for mutual comparison for individual municipalities:

$$s_i^l = e^{-0.1x}$$

where s_i^l is the accessibility of a clinic of a general physician for the residents of the municipality *i*, x is the shortest time accessibility of the clinic from the monitored municipality expressed in minutes. The resulting values for individual municipalities thus are in the interval (0.1>. Similarly, the values were calculated for the accessibility of a paediatrician clinic and primary school with classes 1-9.

With access to the centres of the region, the goal in Košice was Hlavná ulica (the Main Street) in the city centre, and in Bratislava Námestie Slovenského národného povstania (the Slovak National Uprising Square). The starting points are all municipalities of the monitored region (including the districts of Košice and Bratislava). Accessibility (d_i) was expressed by three partial accessibilities using several types of distances:

- d_i^c - partial indicator of road distance
- d_i^a - partial indicator of time road distance when using a passenger car
- d_i^v - partial indicator of the time distance when using combined public transport (in the middle of a standard mid-week morning with increased traffic demands)

$$d_i = d_i^c + d_i^a + d_i^v$$

Also in this case, the declining exponential function of distance with a parameter enters into the evaluation of accessibility. As this is a much greater distance than in the case of accessibility to social facilities, we have abandoned the parameter of 0.1 and chosen the parameter of 0.05, which was more useful for accessibility evaluation at greater distances. The choice of the most suitable parameter value has been done in both cases by testing employing a set of tentatively chosen values. The value, that made the set of output values from each municipality equation following the Guassian distribution, has been selected as most appropriate.

$$d_i^c = d_{max}^c . e^{-0,05x}$$

where d_i^c is accessibility of the centres (Košice, Bratislava) from a municipality *i* when considering the actual road distance *x* given in kilometres, d_{max}^c is the maximum value of this indicator (i.e. 1). For indicators d_i^a and div the distances

are expressed in minutes. In the shortest time distance in urban areas of the two cities, the maximum accessibility was considered d_i^a, since they are served by the public transport system, making access to the city centres significantly improved. The values of accessibility of municipalities vary between (0; 1>.
The values of the resulting potential of municipalities vary between (0; 9>. Final as well as partial results are then presented by cartographic output.

Results and discussion

Based on the used methodology, the research of the potential per each municipality in the selected temporal and spatial pattern has been done. One of the basic indicators of the potential was the technical infrastructure of the municipalities. Looking at Figure 3, it is clear that the technical infrastructure facilities of the municipalities is variable in the area, and differs in the two considered urban regions.

In the case of Bratislava, the dominant municipalities have technical infrastructure with an index reaching the value of 3, which can be interpreted as *technically well equipped municipalities*. Almost 80% of the population lives in municipalities with all the technical elements of the infrastructure. In the case of Košice, the number of municipalities with this value is considerably lower, and they produce only small agglomerates along main roads, which also confirms the importance of communications in regional development. The situation is the opposite with the appearance of municipalities where their technical infrastructure index reaches the value of 2, i.e. we consider the municipalities *as technically better equipped*. They dominate in the Košice region, while in the Bratislava region they form only few agglomerates off the main roads. *Technically poorly equipped municipalities* and *municipalities without any infrastructure* include in both cases only municipalities under 1,000 people. In the case of Bratislava, ongoing suburban processes also have to be considered, as they lead not only to an increase in the number of people living in municipalities, but also to increase in demands, new requirements, and therefore to priority construction and improvement of technical infrastructure.

The second indicator is the reference set of indicators called social infrastructure facilities. The set of municipalities in the functional urban regions was divided into three intervals according to the index values of social infrastructure facilities. For this indicator, we can also conclude that municipalities in the Bratislava region offer better social infrastructure facilities than municipalities in the FUR of Košice (Figure 5), the proportion of people living in municipalities with index values <2; 3) is in the FUR Bratislava almost 95%. In both regions, municipalities with poor social infrastructure are isolated or occur in small aggregates in the periphery of the investigated area (western and northern part of the FUR of Košice). We consider it appropriate to refer specifically to the different levels of social facilities of different districts of core cities; worse results are obtained in suburban part of cities, particularly those less numerous and elderly population. Because of the fact that time accessibility in the neighbouring municipalities is included in the index of social infrastructure facilities, accessibility and attributes may be a partial cause of the spatial delimitation of the manifestation of social infrastructure facilities. To some extent, the individual development, population structures, and policy of the authorities of each municipality are responsible for the differentiation of symptoms of the observed indicator.

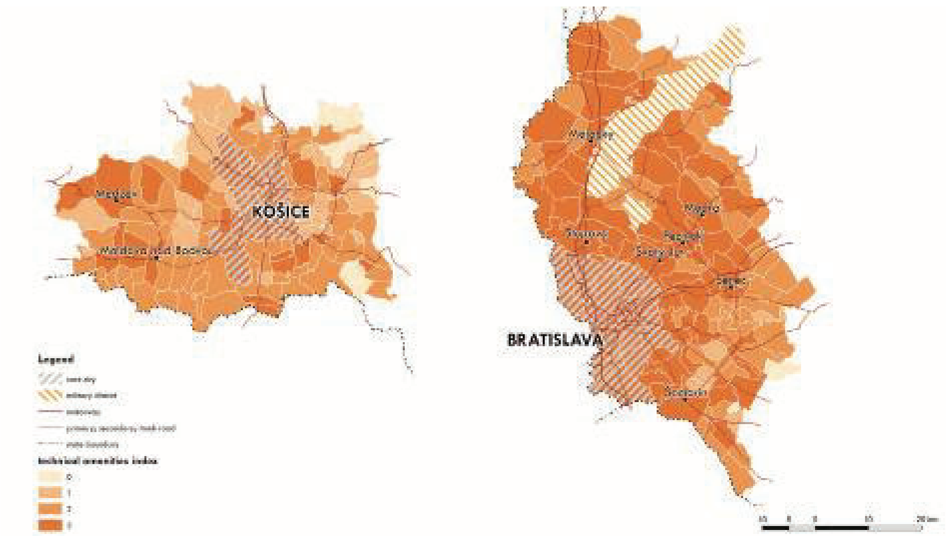

Figure 3. Index of technical infrastructure facilities in the functional urban regions (at 31 December 2009)

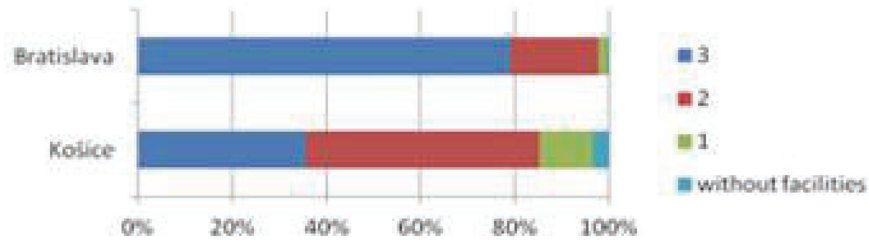

Figure 4. The proportion of the population living in municipalities according to their index of technical infrastructure facilities (31 December 2009)

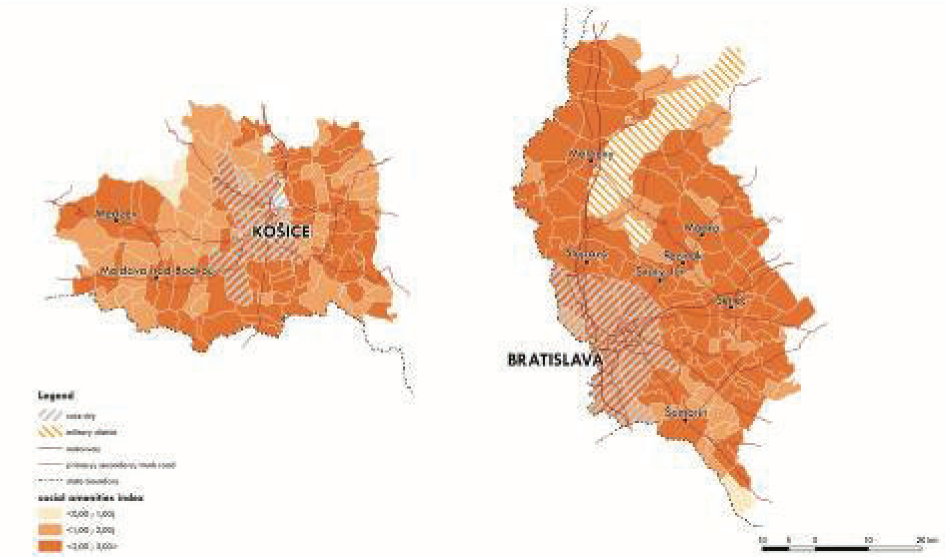

Figure 5. Index of social infrastructure facilities of the functional urban regions (at 31 December 2009)

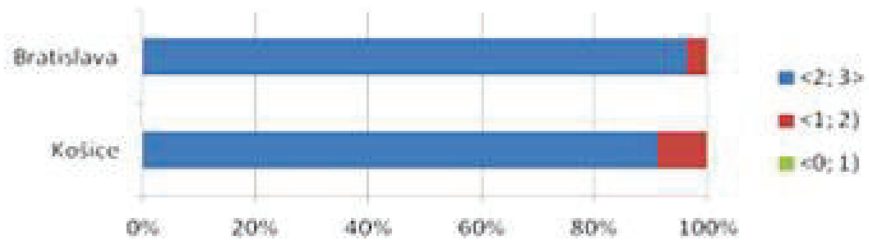

Figure 6. The proportion of the population living in municipalities according to their index of social infrastructure facilities (at 31 December 2009)

Another monitored indicator is the accessibility of the core city divided into individual accessibility, and accessibility by public transport. In the first case, the level of accessibility in the municipalities is dependent on the progress of the road network and its hierarchy. The investigated regions have road networks that are striking with their varying size and shape as well as quality, which is also reflected in the number of people living in the accessibility areas of both cities (Figure 8). For the FUR Košice, the fact that the eastern part of the area is characterized by a denser network of roads, which creates positive conditions for accessibility, may be also emphasized, despite the expected barrier effect of the Slanské vrchy mountain range (Figure 7).

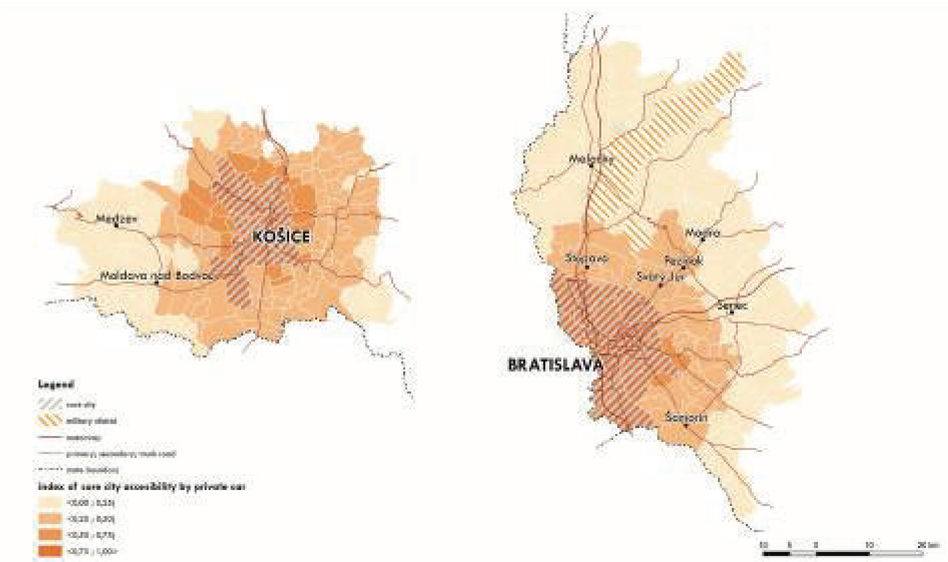

Figure 7. Accessibility of Bratislava and Košice by individual car transport for each municipality in the functional urban region (at 31 December 2009)

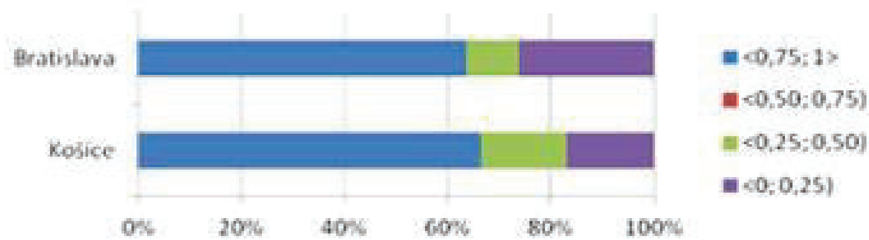

Figure 8. The proportion of index of people living in the road time accessibility of the core of the region - individual car transport (31 December 2009)

The absence of individuality in the use of public transport allows the assumption that the level of accessibility of a particular municipality by public transport is significantly lower compared with the level of accessibility by individual transport. This assumption is confirmed for both functional urban regions. In addition to the road network topology, the level of accessibility by public transport is remarkably influenced by the demand and supply of transport services. Nevertheless, it is possible to see a certain geographical nature in the form of dependence on the distance, and especially the quality of the road network. Exceptions are districts of Bratislava and Košice with the highest level of public transport route network.

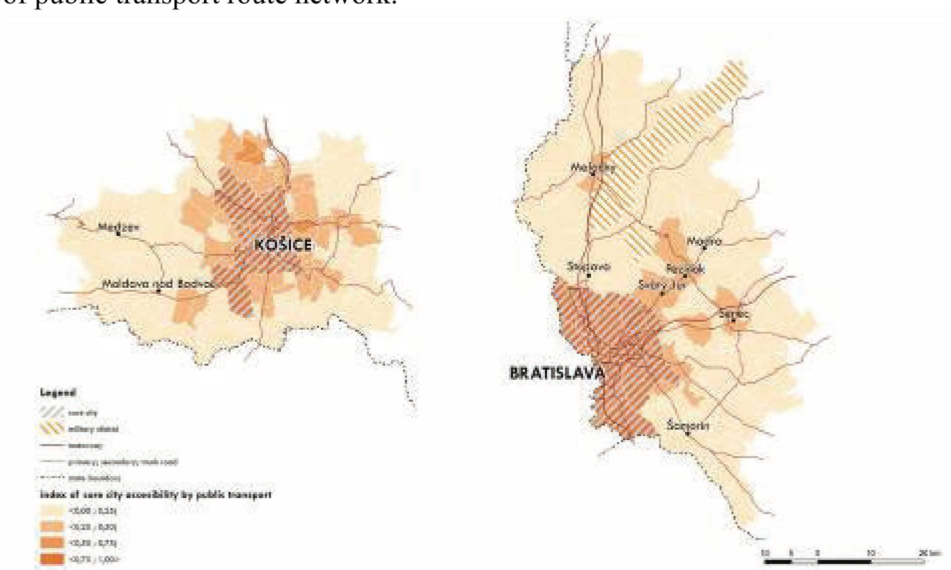

Figure 9. Accessibility of Bratislava and Košice by combined suburban public transportation for individual municipality of the functional urban region (at 31 December 2009)

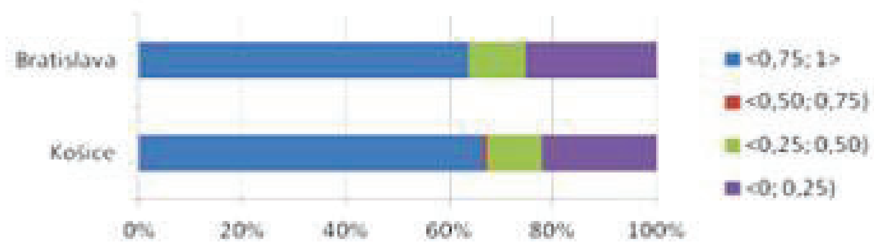

Figure 10. The proportion of index of people living in the road time accessibility of the core of the region - combined public suburban transportation (at 31 December 2009)

The set of all these attributes of each municipality may be seen after quantification and mutual comparison as an aggregate potential of the particular municipality. Prediction of the future migratory behaviour is supposed to being based on the spatial research of the potential of municipalities in the functional urban region Spatially it is possible to observe a dependence in the distribution of the resulting potential for municipalities, both on the position to the centres with larger population (towns and larger municipalities excl. the core cities) and major roads.

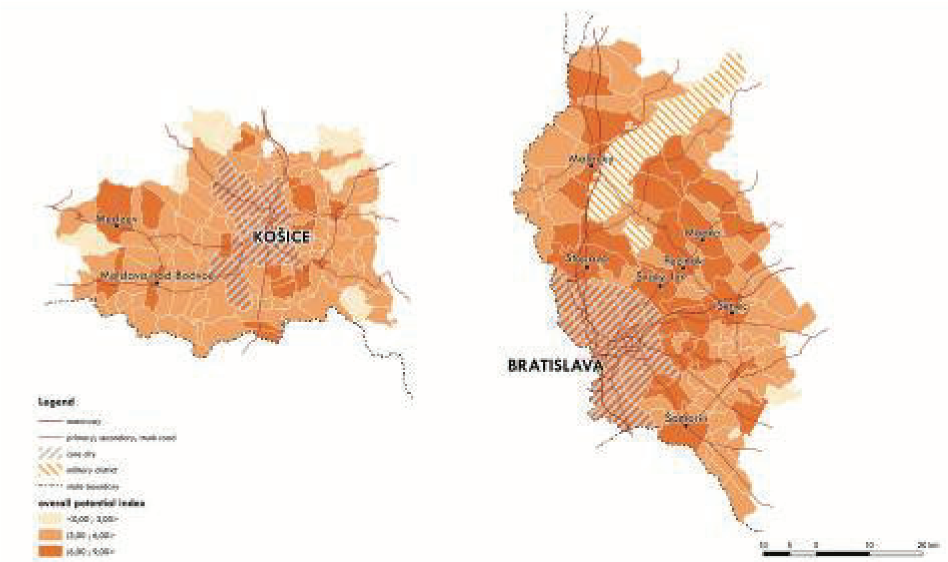

Figure 11. Index of social infrastructure facilities of the functional urban regions Bratislava and Košice based on their technical and social infrastructure facilities and accessibility of the core city (at 31 December 2009)

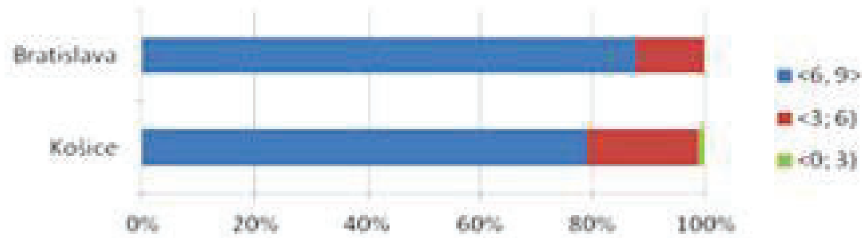

Figure 12. The proportion of the index of population living in municipalities by the resulting potential (at 31 December 2009)

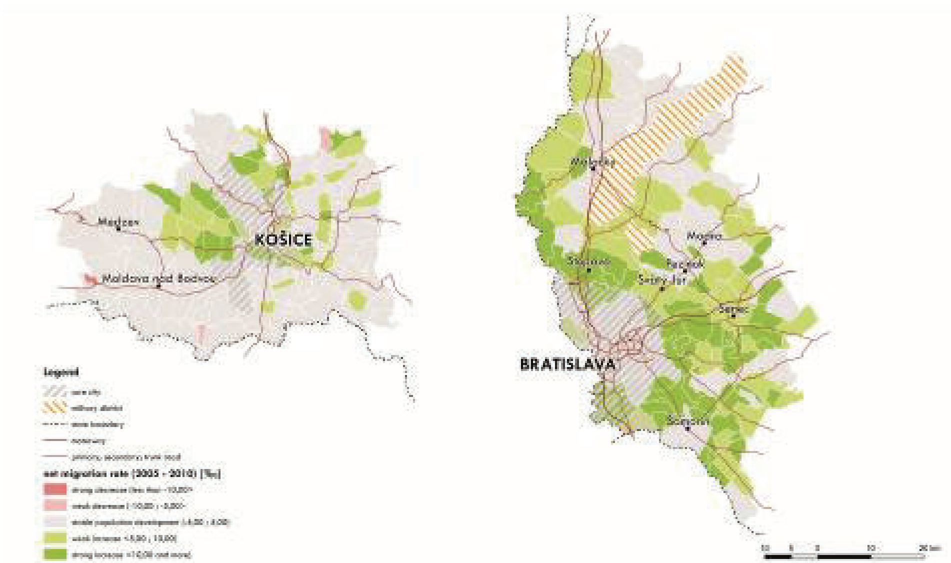

Figure 13. The net migration rate in the functional urban regions Bratislava and Košice during 2005 to 2010

At the end of the paper, the potential of municipalities from the functional urban regions created on the basis of data from 2009 could be verified by the gross migration balance rate for the exposed period 2005 to 2010. The municipalities of the functional urban regions of Bratislava and Košice are distinguished on the basis of data on the balance of the population in the exposed period into five groups by the level of gross migration balance rate. For this purpose, two gain intervals (remarkable and moderate gain), two loss intervals (remarkable and moderate loss), and one stationary interval (created from the values near 0%) have been created. After the results relating to the potential and gross rates of net migration in each municipality of the investigated territory are compared, assumptions proclaimed in the introduction of this paper can be confirmed to have not been met.

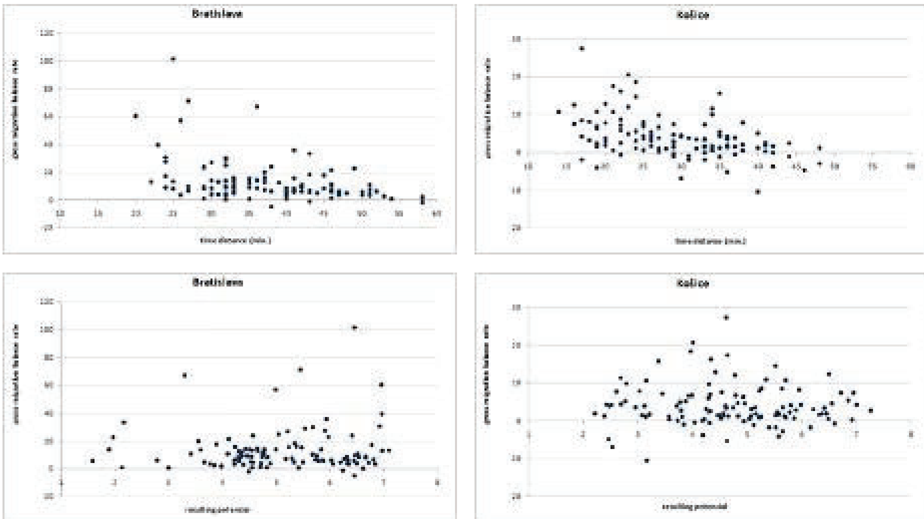

Figure 14. Dependence of the gross migration balance rate and the resulting potential and time distance of the municipalities from the functional urban regions of Bratislava and Košice from the core cities[1] (migration gain for the period 2005-2009 to 100 people at 01 January 2005, the resulting potential at 31 December 2009, time distance referred in minutes)

Conclusion

Decision-making processes of individual participants of migration probably contain other individual factors, which in spatial and scientific or behavioural approaches cannot be discerned and applied. Based on the analysis of migration gains or losses, the explanation of economic theories such as the theory of compromise (*trade-off theory*) dependent on distance from the core city cannot be considered as sufficient. In the case of the migration behaviour of the population of the functional urban region of Košice, the specific effects of the demographic behaviour and social situation of the Roma minority cannot be excluded, as they occur in this area. In the background of the functional urban region of Bratislava, some suburban symptoms that significantly determine the spatial deconcentration of the population can be seen. In the case of suburbanisation, potential participants are assumed to seek areas of lower rents that are characterized by lower levels of infrastructure facilities, which may be the basis for the discrepancy with our hypothesis. In none of those explanations, however, can the issue of potential *vs.* migration behaviour be considered with

[1] Without districts of Bratislava and Košice

empiric generalization, while the use of the concept of a reasonable human can in this case lead only to erroneous interpretations.

Interesting in this context could be a comparison of the results obtained using the same methodology for other functional urban regions in other cities (possibly in other countries). Using the methodology in other territorial units could lead to its adoption or rejection. Alternatively, the different level of results in the level of potential and migration behaviour can lead to further research, focused mainly on the possible causes of the individual symptoms of demographic behaviour in functional urban regions.

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