THE DEVELOPMENT OF URBAN STRUCTURE OF BRATISLAVA IN THE TIME OF POST-SOCIALIST TRANSFORMATION

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Abstract. The submitted paper overviews the development of urban structure of Bratislava after 1989. The main attention is given to three key-reasons of the city. Transformation of the economy is presented in the first part of the paper. In the time of last twenty years significant changes have been observed in the size of Bratislava's population as well as in its structures. Development of the population of the city is described in second part of the paper. The last part of the paper is concentrated to disclose the trends of changes of inner spatial structure of Bratislava. To urban morphology change in Bratislava, spatial footprints 1991-2006, is the core theme in the frame of development of inner spatial structure of the city. In the paper there are analyzed some other relatively autonomous problems of the city, as a new geographical location of Bratislava, suburbanisation, energy demands of the city and others.

Key Words: post-socialist transformation, economy, population, urban morphology change, inner urban structure, Bratislava

Introduction

Bratislava is a special urban structure, with its unique geographic location and special features of the physical-geographical, urban-morphological, functional-spatial and socio-demographic structure. In the time of past fifteen years all main attributes of Bratislava (economy, population, inner urban structure, position of the city in Slovakia and Europe and others) rapidly changed. Bratislava like other cities arose and has been developing under diverse conditions, different political and social circumstances, with influence of various impulses. This gives every city a label of individuality and special position in inner urban system and international one. A series of studies dealing with new possibilities of Bratislava's development have appeared shortly after breakdown of political and economic barriers between the East and the West in 1989 (Paulov 1992, Dostál, Hampl 1992, Musil, Illner 1994, Gorzelak et al. 1994, Buček 1995 and some others). All of them noted to the unique geographical position of Bratislava and its great influence on the further development of the city.

Evaluation of geographical location of the city and its position in the country as well as in wider area around it belongs among the important characteristics of the studied city. The importance of position of the city is changed in the period of radical political, economic and social changes taking place in the country, respectively changes in the transnational scale. The political changes in countries of Central and Eastern Europe in 1989, a significant increased the importance of geographical location of Bratislava in relation to its development potential. In assessing the position of Bratislava, with direct consequences for its development potential can be made the following main reasons of the city: A) Bratislava has got permanently historically important geostrategic and geopolitical position. It is located right at the contact point of Slovakia, Hungary and Austria. Its cadastral lines are copying state boundaries at the same time. Bratislava, the capital of the Slovak Republic, is located 65 km from Vienna the capital of Austria only, and 193 km from Budapest the capital city of Hungary. Bratislava has a very favorable transport-geographical position towards the Czech Republic too. The highway distance between Bratislava and Prague is about 300 km, and between Bratislava and Brno 125 km only. B) Bratislava is situated at the contact point of eastern and western European countries (former communist and capitalist European countries). The city obtained a gateway position between these two different regions. C) Bratislava has an eccentric position within Slovakia. Through the city is implement a large volume of transit movement between Slovakia and western Europe including Czech Republic. The northeast is the dominant direction of links connecting the city with the territory of Slovakia. The great developmental potential for the city create river port and airport. D) The unique geographical micro-position of Bratislava (the Small Carpathians mountain, the Danube river, the border with Austria and Hungary) presents specific nature and political barriers for the development of spatial structure of the city.

Prior to performing an evaluation of the development of the city, it is necessary to explain the current territorial-administrative division of Bratislava. Since 1996, the capital has been divided into five administrative districts (Bratislava I, Bratislava II, Bratislava III, Bratislava IV and Bratislava V) and seventeen administrative city-parts (Staré Mesto, Ružinov, Vrakuňa, Podunajské Biskupice, Nové Mesto, Rača, Vajnory, Karlova Ves, Devín, Dúbravka, Lamač, Devínska Nová Ves, Záhorská Bystrica, Petržalka, Jarovce, Rusovce a Čunovo). Now, from 2004 only two levels of public administration of the city "the level of the city and the level of city-parts" is working.

The objective of the presented paper is an evaluation of three specific city attributes of Bratislava (economy, population, inner spatial structure) first of all. The economy transformation is focused in general deindustrialization process and growing importance of the service sector. We consider processes and factors influenced the transformation of economy of the city. The levels of importance of Bratislava's economy in the national scale is described too. Natural movement, migration and ageing of population are the central topics in the study of population processes. Urban morphology change in Bratislava in period of 1991 – 2006 is a central theme of the study of development of spatial structure of the city.

The economy of Bratislava

There are some periods of the time in the history of the city when it is better from a methodological point of view speak about a transformation of its economy rather than about development (Korec 2002). In the case of post-socialist cities such a period of time are years following immediately after 1989. Over the past twenty years, there have been mainly four processes that caused the transformation of economy of Bratislava. The processes were (i) the political and social transformation of society (democratization of society, the transition of state command economy to the market economy), (ii) internationalization of economy and the impact of various processes associated with globalization, (iii) displacement of society from industrial to the post-industrial phase of development (industrial decline and increasing importance of the activities of tertiary and quaternary sectors), and (iv) the obtaining of the status of the capital city of an independent state. Important fact is that all these processes were very favorable for the transformation of the economy Bratislava and is still extremely favorable effects on socio-economic development of all region of Bratislava. The effect of a dominating metropolitan region linked with the consequences of the post-industrial phase in the evolution of society and globalization (Cox 1993, Haila 1996, Marcus and van Kempen 2000, Hampl 2005, Korec 2004 and 2007 and others) is obvious in the Slovak case, too.

After 1989, the region of Bratislava have got an extremely positive attitude of all the effects of the underlying factors caused success of the transformation process of the city and region: the factor of settlement hierarchy (i), the factor of macro-position attractiveness (so called west-east gradient) (ii), the factor of major transport infrastructure - highways and speedways, double-track electrified railways, airports, ports and terminals of combined transport (iii), the diversified economy of the city (iv), great human potential (v), the status of the capital (vi), historical and geographical evolution (vii) and others. In the past 20 years, Bratislava significantly dominant position in the regional structure of Slovakia. That dominance has no

population growth of Bratislava, but increasing of share of the GDP, economic aggregate and other synthetic values reflecting economic performance.

Bratislava gained a growth impulse of enormous importance in the year 1993 after the federation was divided. The city was suddenly set a hierarchy level higher among other state capitals. From this point, the area has been several times assigned as one of the most perspective emerging economic zones in Europe. But a surprising low level of activity, except the expected services growth and investment attraction in the most profitable fields of the new-created market infrastructure, stayed very stable, at least until the late 1990s. A problematic socio-political climate and international reputation of the country was abandoned. For the capital, the whole 1990s and the final redirection towards the EU entered half-decade later meant, that a full-scale urban development, even delayed, can be set in motion.

The fact that in 2006, the region of Bratislava increased its share of the economic aggregate of Slovakia in comparison with 1997 up to 7.07% reflects the lawful conditions economic development in Bratislava during this period. Increasing the share of 7.07% over 10 years, from 20.51% to 27.58% is really huge. The second most successful region in this period was the Trnava region, but it increased its share of economic aggregate Slovakia only 0.42%. Košice region has decreased in this period 10 years its share of Slovakia's economic aggregate of 0.97%, up from 8.75% in 1997 to the value of 7.78% in 2006. While in 1997 reached the relative value of economic aggregate per capita in the Bratislava region 178 (the value of Slovakia's 100), in 2006 it was already 245. The difference between the region of Bratislava and the second order was increased from 41 (Košice region in 1997 had a value of 137) to 100 (the region of Trnava has the relative value in 2006 145). In comparison, the relative value of economic aggregate per capita in Kosice region decreased from 137 in 1997 to 121 in 2006 (Korec 2009).

Fundamental changes in the economic base Bratislava illustrates the attached table. The year of 1985 can be considered as a year when the socialistic development culminated in Slovakia. The total number of employees in Bratislava increased from 279,122 in 1985 to 354,372 in 2006 (increasing about 75,250 employees). Regarding the fact that number of unemployed in Slovakia has increased from zero in the 1985 to almost 0.4 million in 2006 is the increase of employment opportunities in Bratislava interesting. Increasing the share of non-manufacturing activities in the occupational structure of the city from 54.90% in 1985 to 75.56% in 1998 to 81.07% in 2006 clearly shows the shift from the industrial city of Bratislava to the city of wide ranging services. The share of employment in industry out of the total number of employees in Bratislava decreased from 26.45% in 1985 to 13.29% in 2006.

In spite of this, three industrial branches increased job opportunities (publishing and printing with an increase of jobs from 2,835 to 4,583, food processing with 4,4777 to 8,123 and car industry with 2,045 to 8,719). Clear specialization of industry with dominance of car factory Volkswagen Slovakia, petrochemical plant of Slovnaft and companies producing foodstuffs with printing and publishing activities will take place in Bratislava for the future. The group of service-oriented activities employed 287,282 people in 2006 comparing 153,251 in 1985. Financial sector has been one of the most important sectors carrying on urban transformation within the city. Its influence has been manifold. The sector of financial intermediation reached remarkable increasing of employees from 0.70% in 1985 to 5.21% in 2006 (in absolute values from 1,956 employees to 18,452). Wholesale and retail trade increased its share from 11.14% in 1985 to 20.08 % in 2006, real estate, business and R&D from 9.46% in 1985 to 18.96% in 2006 and others.

| | 1985 | | 1998 | | 2006 | |
|--|---------|-------|---------|-------|---------|-------|
| Branches of economic activity | number | % | number | % | number | % |
| Agriculture, forestry, fishing (A+B) | 5 505 | 1,97 | 1 762 | 0,57 | 1 584 | 0,45 |
| Manufacturing (C+D+E) | 73 818 | 26,45 | 48 827 | 15,89 | 47 109 | 13,29 |
| Construction (F) | 46 548 | 16,68 | 24 513 | 7,98 | 18 397 | 5,19 |
| Production activities total | 125 871 | 45,1 | 75 102 | 24,44 | 67 090 | 18,93 |
| Wholesale and retail trade (G) | 31 103 | 11,14 | 56 105 | 18,26 | 71 147 | 20,08 |
| Hotels and restaurants (H) | 4 218 | 1,51 | 6 361 | 2,07 | 7 950 | 2,24 |
| Transport, storage, communication (I) | 24 892 | 8,92 | 31 041 | 10,1 | 29 628 | 8,36 |
| Financial intermediation (J) | 1 956 | 0,7 | 13 900 | 4,52 | 18 452 | 5,21 |
| Real estate, business, R&D (K) | 26 411 | 9,46 | 47 682 | 15,52 | 67 187 | 18,96 |
| Public administration, social security (L) | 9 851 | 3,53 | 18 174 | 5,91 | 32 253 | 9,1 |
| Education (M) | 23 776 | 8,52 | 24 705 | 8,04 | 22 105 | 6,24 |
| Health and social work (N) | 15 078 | 5,4 | 17 559 | 5,71 | 20 073 | 5,66 |
| Other community, social services (O) | 15 966 | 5,72 | 16 629 | 5,41 | 18 487 | 5,22 |
| Non-production activities total | 153 251 | 54,9 | 232 156 | 75,56 | 287 282 | 81,07 |
| Economic activities total | 279 122 | 100 | 307 258 | 100 | 354 372 | 100 |

Table 1: Employed by economic activity in Bratislava in 1985, 1998 and 2006

Source: Statistical Yearbook capital of the SSR Bratislava. Urban Report SPE, Bratislava 1986. Statistical Yearbook capital of the SR Bratislava. SPE Regional Report, Bratislava 1999. Statistical Yearbook capital of the SR Bratislava. Statistical Office of Slovakia, Bratislava 2007.

Finally, the evaluation of the historical formation of the economic base of Bratislava is worth noting some summarized comments: (i) In shaping the economic base of Bratislava in the period of modern development, we can identify four relatively independent phases, in which the economic base developed in specific political, economic and social conditions. Two of these phases (1948-1989 and 1989-2009) have produced such sharp changes in these times it is better to talk about economic transformation than the development, (ii) Bratislava throughout the all period after the onset of modern industrialization in Slovakia (period from

Austria-Hungarian treaty in 1867) acting as a leader and winner of innovation in the field of economic development; this feature of regional leader of economy has become an important particularly during the last stage, when the economy of the country received in the postindustrial stage of development, (iii) in the past of last twenty years, the economic base of Bratislava resolutely changed from production oriented to non-productive activities; that said, the economic base of Bratislava after 1989 successfully transformed, and Bratislava in this period benefited from a number of comparative advantages, which won after that, and (iv) that said, the Bratislava itself (national, regional, citywide and local institutions) did not have more or less "do nothing" for successful transformation of its economy after 1989; qualitative changes in the economy and its growth came at a quantitative account of the city's attractiveness; now, it seems, something must be done in the direction to progressive development of the economy of the city and the city itself; Bratislava should move its economy toward creativity and knowledge-based economic activities (universities, R&D, business, information technology and information services, financial sector, audit, marketing, public relations, market research, advertising and other development of culture, art and architecture, tourism development, development of selected industries with high value-added and others).

The population of Bratislava

Significant changes during last twenty years happened also in Bratislava's population development. After 1989, significant changes have been observed in the size of Bratislava's population as well as in its structures. Between 1991 and 2001, Bratislava witnessed the first population decline in between two official censuses after the first historical census in 1869, with index 0.97. The 1991 census showed 442,197 inhabitants living in Bratislava but only 428,672 in 2001 one. The four previous "communist" indexes equalled 1.25 (1961/1950, the population of Bratislava increased from 192,896 to 241,796), 1.18 (1970/1961, increasing to 285,448), 1.33 (1980/1970, increasing to 380,259) and 1.16 (1991/1980, increasing to 442,197). In comparison to Prague, the four its "communist" indexes were 1.07, 1.01, 1.09 and 1.03. Prague witnessed the first population decline between 1991 and 2001 in its modern history after 1869 too (0.98). In case of Bratislava, the year 1989 seems to be a breaking point when the dynamic post-war growth was finished.

Total increase of population in Bratislava decline very quickly from 8,000 inhabitants per year in 1970's and first half of 1980's on 5,000 a year in 1987 and 2,000 a year in 1991. The

births (20.8 births per 1,000 inhabitants in 1977) and net migration rates (20.8 persons per 1,000 inhabitants in 1975) secured its long-lasting growth at the expense of the remaining territories of the state in its own hinterland and other regions. The negative population development of Bratislava continued after the year 1991. An interisting fact in relation to population development after 1991 from a spatial viewpoint is that the four city districts (Bratislava II, Bratislava III and Bratislava V) registered decrease in the number of inhabitants between the censuses in 1991 and 2001. Only in district Bratislava IV situated in the north-western part of the city (housing areas are situated in valleys of Small Carpathians mountain and in north-western disrection from the range) the population has increased during mentioned period. Morphological and climatic attributes suitable for residential function were important factor of positive population development in this district of the city.

Natural increase in Bratislava started to drop from 1977 yet. During the period of twelve years natural increase declined from 12.4 % in 1977 to 7.7 % in 1989. New economic and social conditions existing during transition period significantly influenced depresion in natality. Economic uncertainly, loss of social safety and new value hierarchy of life were typical signs of first phase of political transformation. Owing to a long-lastingly stable value of mortality (about 9 deaths per 1,000 inhabitants), natural population decrease ocured in Bratislava in 1995 for the first time (figure 1). Natural population decrease was realtive stable from 1996 to 2003 (about 1.0 - 1.8 persons per 1,000 inhabitants). From 2004 we observe a change in the development of natural movement of population mainly due to "delayed deliveries" from the 1990's. In 2007, we recorded in Bratislava, after twelve years, once a small natural population growth.

Migration movement had similar features as natural one after 1989. Number of emigrants was in long-term view stable since 1975 to 2007 about 3,000 to 4,000 persons a year. However, number of imigrants quite intensively has declined since 1987 and decreased on more than one half to 1997, from about 7,000 a year to 3,500 a year. Migration decrease as well as total decrease of population in Bratislava were detected here in 1997 for the first time in Bratislava's modern history after World War II. In this year, number of migrants declined by 393, natural decrease (declined by 500 persons) was a little higher than migration decrease. Number of population of Bratislava declined by 893 persons in 1997. From 1997 number of migrants as well as number of total population of Bratislava has decreased yearly up to 2004. From 2005 we observe again as migration as well as the total increasing of the population in Bratislava. Migration population growth is the result of the increasing number of migrants in

Bratislava. The process a significant increasing of immigrants is observed since 2000. From value of 3,657 imigrants in Bratislava in 2000, their number has risen to a value of 6,248 in 2007. In the same period the number of emigrants from Bratislava increased from 3,915 to 5,667.



Figure 1: Development of population of Bratislava in the years 1992 - 2007

The high number of emigrants from Bratislava is mainly the result of processes connected with suburbanization. In the case of Bratislava, we can conclude that after 1989, with a slight delay, began to operate in positive level practically all the fundamental factors supporting suburbanisation: a) bad living, residential and social environment in the city, particularly in the great socialist housing estates and search for better housing in respect of quality apartment and quality of the environment; b) raising the standard of living and expansion of upper-middle class and the establishment of numerous economically strong citizens in Bratislava, including foreign managers; c) create a new commercial banks offers financial products and state financial aid to support construction new residential houses; d) given the imbalance in the market, developed a comprehensive activity of some developers and municipal authorities towards the development suburbs construction, which must be added the activity of individual candidates themselves living in rural areas; e) the relatively low price of land in the hinterland of the city and to some extent mitigate the protection of agricultural land; f) improving the

Source: Bleha (2009)

housing market, facilitating the sale of an apartment in the city and then finished the purchase of land or house in the countryside; g) increasing the level of individual automotive and improvement of roads to allow daily attendance from suburbs to the central parts of the city; h) good spatial options for suburbanisation, when immigrants from Bratislava to move not only into nearby vacant rural areas but into smaller cities around (Svätý Jur, Senec, Pezinok, Stupava, Malacky) too. The three districts surrounding the city from north-west (Malacky), north-east (Pezinok) and East (Senec), have in the frame of Slovakia the highest long-term migration gain value.

In consequence to described development in natural and migration motion the age structure of Bratislava population has been significantly changed. During one decade from the year 1991 to the year 2001 the number of children (age 0 - 14) decreased from 102,784 to 59,866. The portion on the total population of Bratislava has also decreased from 23.24 % in 1991 to 13.96 % in 2001. The number of children in Bratislava decreased to 50,659 in 2007, the portion on total population decreased to 11.87 % in the same year. The number of productive age categories of population (age 15 - 59) increased in the period 1991 - 2001 from 261,342 to 285,846. The portion on the total population of Bratislava increased in this census period from 59.11 % in 1991 to 66,68 % in the year 2001. An interesting feature of the evolution of the population age structure of Bratislava after 2001 is the decline in this age category to the value of 278.279 in 2007 (65,18 % on total population). The dynamic development is observed in older inhabitants. The number of inhabitants in older age (age 60+) increased from 78,070 in 1991 to 82,960 in 2001. The portion on the total population of Bratislava has increased in the same period from 17.65 % to 19.36 %. The population of Bratislava is ageing rapidly. The number of older people increased to 97.989 in 2007, the portion of older people on the total population of Bratislava reached 22.95 % in 2007. Regarding the population development of Bratislava alarming is above all sharp decline in the youngest category. In the time of seventeen years (from 1991 to 2007) the number of children decreased from 102,784 to 50,659, more than half.

Inner spatial structure of Bratislava

Bratislava is an mono-centric urban structure that has developed around the strong location of the city center determined by physiographic reasons of territory. Urbanization area of the city is clearly defined by the configuration of the Danube river, Podunajská plane, Záhorská plaine and jagged terrain of the Small Carpathians mountain, acting in the territory of the city several

valleys separated by higher massifs. The spatial structure of the city has long been organized around a relatively simple center in the form of clusters concentrated mainly along several axes, again determined by particular shapes of relief, especially in the western part of the city and the historically-based sub-regional transport routes.

With respect to the development of the inner spatial structure of the city after 1989 we have to emphasize the following features of its inner spatial structure just in 1989: (i) The city center was functionally and physically underdeveloped. In the fact it was a cluster of devastated buildings, without any signs of reconstruction or suitable exploitation. City center was spread on very small area. (ii) Large zones of industry with low land-use intensity were located in central parts of the city, close to the city centre. (iii) Extensive mono-functional housing complexes were built on the margin of the city offering only a very limited spectrum and standard of services to its inhabitants. (iv) The main road network, which would support local exchange within the city, regional and transit transport, was not built in the city. (v) As a consequence of large-scale integration of surrounding villages (thirteen villages were joined to the city after 1946), cadastral territory of Bratislava increased from 58.5 square kilometers in 1989. Large share of territory of Bratislava was covered by agricultural land (approximately 40 % of the city area) and forest (21 %). There is a great extend of classical village settlements in the city.

In the period of social transformation in Bratislava was also initiated its renovation, which was to replace the old image of the city without investment, with great mono-functional housing estates, with simple retail network to city with new image of vigorously growing metropolis with a prestigious location and national and international functions necessary for current business, "high-tech" activities, retail and services and others. The historic core of the city relatively quickly changed to the attractive area, rather than for business, both in terms of housing and tourism. Similar, though less concentrated forces operate in the inner city, which is part of the town and areas along the main traffic arteries forming a linear clustering of commercialization. Construction of predominantly office and mixed-use buildings fill the relatively large proportion of free space in those locations.

Breaking point in the construction and development of economy of Bratislava occurred around the turn of the century. The early constructions of mostly office and mixed-use objects in-filled a part of a relative large space, cleared during the previous period with the infrastructure improvements and left for many years empty. Probably complicated ownershiprelated and planning reasons are responsible for numerous valuable plots staying unused or with low intensity for another decade. A breaking point appeared only in the last years, when the investment pressure has located a number of new objects in locations long attended by the architects but far from the realization. The development process in the zone encircling the old-town gained new dimension. The river Danube with its discreetly built-up banks touching the old town and expanding the CBD became, thanks to its centrally located open spaces, a primary focus of the real-estate capital. Two development clusters in construction or before start-up provide a good example of recent dynamics in the Bratislava's central city.

The primary location in focus is the new CBD cluster located next to the old town, expanding eastwards in the original city's manufacturing zone, the inner city and the Ružinov estate with large reserves among its functionalist blocks. The zone around the central bus station started to transform in a new, office-based form since the 1990s. A number of large office complexes, the bank tower, small shopping center and other business objects set the future of the area planned for the new center even during the socialism. Steep acceleration of development is observed in the last period with further, even larger business centers, the second tower erected, the massive socialist press tower refurbished and the public project in construction for years, the new national theater opened recently. The big actors arrived here recently, too. The largest project in construction in the city in this time is an Irish investment with a background in the London's Docklands, taking shape of several mixed-use city blocks located in the contact to the river. In fact, this project will in several months fulfill the projections originated decades ago and materialized fragmentally by the theater. Another significant construction will soon elevate the skyline even higher with the new twin towers.

The development of inner spatial structure of Bratislava since 1989 we have described in detail in several previous papers (Korec 2006, Ondoš, Korec 2006, Ondoš, Korec 2008 and others). Now we will describe two reasons of evolution of the inner spatial structure of the city: the increasing energy demands of the city and the new opportunities of the development of the city in direction to Austria and Hungary.

The problem of energy efficiency center is hierarchical. From energy-inefficient designs of buildings to more energy-inefficient arrangement of parts of the city and the city as a whole. Given the rising cost of energy in the future is a critical moment of sustainability such as the location. Incremental generation dispersal morphology, the new functional sites within the city surrounding the residential area, the area between the built-up areas of the city and rural area is a potential source of several problems. If this trend is directly or indirectly, consciously or unconsciously encourage, without close coordination of the spreading danger of spatial expansion of the city, including suburbanisation city turned into urbanized region depends only on individual services. It is therefore logical that the process of suburbanisation was (and

still is) in the last period of very robust. Paradoxically, it is clear that suburbanisation negatives outweigh the positives in relation to the city itself, namely to Bratislava. Perhaps most serious is the negative right of the increasing energy intensity of the operation of the city and excessive loading of the road network not only at the edges of the city, but practically the whole city.

The evolving urban composition of the city is noted for significant change and it expected the consequences. After loosing of barrier effect of the state border with Austria, the urban expansion can start in so called southwest quadrant of the city. The territory of Austrian border villages has got a very suitable environment for this development. South development axis is practically open for human settlement in the beginning of the 1970's by the construction of great housing complex Petržalka. From this time the right-bank expansion of the city started. After almost four decades has been the axis of this full-bodied and leaving the city in three branches: two directions Wolfsthal-Hainburg and Jarovce-Kittsee are moving to Austria and one of them, the direction of Rusovce-Rajka to Hungary. In particular, directions to Austria in the future appear very promising area for development of the city.

Urban morphology change in Bratislava: spatial footprints 1991-2006

Several paths in the research of various aspects of dynamic urban reality rely on a widespread idea of a self-organizing urbanization driven by general rules linked to the human society behind it. Support for that has been found in geometrical fractal nature of urban morphology (Shen 2002, Barredo et al. 2003, Thomas et al. 2008). In consequence of high complexity and multitude of actors involved in it clarification of these rules remains a challenging task (Fujita et al. 2004). Urban space design is among others a subject of planning efforts, focused by responsible authorities at several self-government levels. A good design should respect the rules driving the urban change. A bad design potentially leads to physical structures problematic in terms of sustainability. There are examples of both with well known consequences (Brueckner 2000). The post-socialist cities are among other things specific from the viewpoint of a reserved planning involvement in urban change (Sailer-Fliege 1999, Gentile et al. 2006). After decades of centrally managed development the transition led practically into unplanned growth distribution. The last two decades therefore represent a unique chance to observe how dynamic urban reality behaves if extracted from rigid limits in more mature planning intensive contexts.

The ground under the late-socialist urban structures was suddenly removed at the beginning of the 1990s. The urban-creation mechanisms constructed from the new economic and social relationships being established were restored on a different basis and respecting different principles. Some forces appeared working immediately, others needed more than a decade to get in motion and some have even not appeared yet (Van Kempen et al. 2009). A common part for at least some of them is reestablishment of the market. Urban space became a commodity commercialized at the real estate market, a source of wealth itself again. The complex urban structure consists of several anthropogenic layers cross-connected with different capabilities to absorb the change. Urban society, economy and architecture have reacted with a different pace concerning self-adaptation to the new context. Material structure of urban built environment is considered the least elastic from the layers. Any change within urban morphology represents a reaction on the change in other layers, namely urban functions linked to the economy and urban society linked to the demography, expanding or shrinking demand at the real estate market. Households create demand for the residential space and firms for the commercial space. The supply response then drives the amount of investments in built environment using the temporally existing gap offering a chance of profit creation.

Urban morphology is a traditional urban studies discipline focusing on various aspects of urban form (Gauthier et al. 2006). Historical urban plan analysis resulted in one of the discipline's paths to an outstanding idea of spatiotemporally varying morphogenetic change following a conceptual cycle. According to Conzen's concept urban form evolves through several stages localized across the urbanized territory (Whitehand 2001). The process underlying the rule flows wavelike across space, not only diffusing the urban organism in a wider area but also updating the existing urban landscape to the current demand situation constantly (Li et al. 2003). Morphology then has the ability of reflection. With a certain delay it mirrors economic performance and distribution of wealth. Therefore it may be of significant interest to a wider audience then urban morphologists.

The morphogenetic cycle is theoretically measured by the coverage of a representative plot inspected in a historical series. There is a striking similarity with the property cycle dynamics and some connections between the two have already been done (Whitehand et al. 2006). The cycle consists of an expansion phase when the density grows. After the culmination is reached contraction phase begins. The plot gradually gets cleared and from any reasons it may follow further recession and end as open land. If attractive for urbanization again a new cycle starts with recovery phase. In spatial perspective while some parts of the urban territory upgrade in expansion others may fall deep in recession. This perception

instead of current state of morphological structure reflects its change. It's nature is dynamic and if measured in subsequent periods it may capture the change in dynamics and spatial flow of morphogenesis.

Urban plan is a common source of information if available in time series. It's considered an adequate generalization for built environment's territorial footprint. Urban plots are according to the plan divided into segments partially covered by architectural structures and segments of open land. The question of recognition between the two segments however is another methodological problem. The plan analysis usually looks at the relationship between the covered and open land area within territorial elements. Addition of temporal dimension allows definition of the difference in coverage rate for territorial element and to compare territorial elements in space and potentially in time.

Depending on the nature of determination under study, urban change may be portrayed in a number of frameworks. Since we don't have any specific and further analytical steps prefer simplicity we will keep our approach using a regular grid despite we deal with a highly irregular urban plan geometries. The grid delimits the urban area into the square elements 100.0 m wide. The area of our interest within the administrative boundaries of Bratislava is covered by 37,463 cells arranged in 252 columns and 311 rows. This cellular space is intersected with the vector representation of urban plan in two stages. The first captures the state of morphology as it appears in 1991 and the second reflects the transformed situation 15 years later. The vector database is based on multiple resources to reflect the changing urban reality as close as possible: commercial vector layer from 2006, military aerial photography from 1991 and public ordnance survey maps dated around 1991. The temporal change represented by these resources in the same time covers the period during which the postsocialist transition is expected to provoke a significant reaction within morphological spatial structure. Since the morphological change displays a highly scattered spatial pattern in raw form in following we present an original analytical strategy allowing a better way of not only visualization but also interpretation.

The descriptive analysis relies on the concept of spatial autocorrelation. The motivation for it is unknown significance of the role of space assumed to be witnessed in the spatially differentiated footprint. Spatial autocorrelation is a characteristic of some spatial data if location matters in the process from which they come from. The observations in individual grid cells are not independent from each other but depend on their neighbors instead: the more distant the cells are the less dependence in between. In order to evaluate the role of Euclidean distance one must follow the statistical relationship between cell values and mean values in

cell's neighborhoods. There are various neighborhood constructions available but we will use one of the simplest definitions, distance thresholds. The 100.0 m threshold results in a neighborhood of four cells surrounding the central cell. In case of such weight matrix applied to the data in Geoda 0.9.5.-i5 the standard spatial autocorrelation measure Moran's I gets for plan distribution in 1991 the level of $I_{1991} = 0.7000$. This indicates a high positive spatial autocorrelation, clustering present in space. Measuring the same index in 2006 we get to an even higher level of $I_{2006} = 0.7060$. This result suggests that the spatial pattern during the period under inspection is changing towards more spatially clustered. Lower but still indicating positive spatial autocorrelation is the measure in case of morphological change $I_{1991-2006} = 0.4953$.

Approaching the actual distribution of varying spatial autocorrelation phenomenon closer we have a possibility to estimate local version besides global spatial autocorrelation (Anselin 1995, Le Gallo et al. 2003). Local Moran's I enables to find different classes of cells corresponding with a specified pseudo-significance level. We will use a standard level of 0.05. Based on local Moran's I separate clusters of cells with high values within high cell's neighborhood values (HH). Analogically, other clusters are those with high values in low neighborhood (HL), low values in high neighborhood (LH) and low in low neighborhood (LL). Only two of these, approximating hot and cold spots will be used here. In order to analyze the phenomenon across different scales we repeat the procedure in nine 100.0 m step enlargements of the former distance threshold up to 1 km. Then we may sum the frequencies of HH and LL cluster memberships shown in the Figure 2. Such conceptual dataset allows us to visualize the spatial distribution answering the question which parts of the urban area were in morphological expansion and which in contraction in terms of the cycle.

The map values span theoretically between 10 for the cells identified in hot or cold spots down the complete scale hierarchy tested and 0 for the cells not identified in any of the scales. The hot spots are spatially defined in several separated clusters with a clear connection to the explanation from the urban change evolving during the last decades. Most of them are easily attributed with the residential construction in few attractive localities. Hot spots of this type of morphological activity can be found in the western part of the Staré Mesto district, Kramáre and Koliba at the southern Carpathian slopes, and selected parts of Záhorská Bystrica, Devínska Nová Ves, Rusovce and Rača. A specific cluster in Karlova Ves points at the ongoing construction at the Dlhé Diely housing estate. Commercial activities are responsible for creation of other clusters. In the north-west part of the territory we can see the cluster of cells



Figure 2: Bratislava, urban form measured by coverage change 1991 - 2006. The frequency of LISA: (a) HH and (b) LL cluster membership across ten analytical scales 100 m - 1,000 m.

covered by expanding car-assembly plant. Commercial stripes appear to get formed along Einsteinova and Panónska streets in Petržalka and Vajnorská street in the Nové Mesto district. A specially clustered area is found in the contact space of the former industrial eastern part of the city with the freeway corridor and the Bratislava airport. The pattern of cold spots offers a different, but also not a simple mirror image. The most interesting and surprising feature in the map is the linear cluster spanned north-south, dividing the central part from the eastern part of the urban territory. There is no significant transport infrastructure corridor following its trace, which would be the first possible explanation. Also the functional structure is mixed. Another large cold spot appears to cover the area of oil refinery in the south-east part of the area. There are many smaller clusters in the edge locations. In the same time, there are many locations across the city area, even highly urbanized, not appearing neither on hot spot nor on cold spot side of the approached dynamics.

The existence of both clustering types across the urban space points at the fact that urban form change is neither a spatially independent nor homogeneous process. Its description and attempts of explanation must count with a significant effect of spatial or spatially varying driving forces. The visualization using spatial autocorrelation measures demonstrates how territorially differentiated footprint was left by the transition period experienced during the last two decades. Bratislava consists of the zones with a relative high concentration of additions to the existing morphological structure and also the zones of concentrating removal. These are separated by belts of relative morphological stability during the period observed. Addition of more historical horizons extending the historical period under focus here or decomposition in shorter phases could shed some light on the question what happened to this spatially varying dynamics with ongoing transition process and strengthening market forces in play.

Conclusion

On January 1st, 1993, Bratislava obtained the role of the capital of an independent state. This new key function has called for a fundamental transformation of the city's roles and highlighted the prestige of Bratislava in central Europe. Within the last twenty years, a relevant shift from production towards nonproductive activities has been detected in Bratislava. Business and financial activities, retail and services became the base of economy of the city. The car industry represented by company Volkswagen Slovakia and petrochemical plant Slovnaft play the important role in the economy of the city too. Without any doubts, the most important reason of the population development of Bratislava in past twenty years has been changes in age structure of the population of Bratislava. For example, the portion of children on the total population of the city declined from 23.24 % in 1991 to 11.87 % in 2007. The urban dynamics in Bratislava during the post-socialist development has received a series of transition impulses. The market principles introduced in the earliest phase created first signs of change, immediately present in form of changed nature of functional relationships but not much later materialized in new physical structures. The political changes of 1989 with subsequent complex of shifts were those that enabled the creation of an environment truly opening new trajectory for city development moving the society between industrial and postindustrial economy. Current input of global forces in development of individual cities and regions worldwide is enormous. Globalization performs its crucial role either in development of regions within the individual states. Another transition impulse had its origin in the new status of the capital. But only the political stabilization and improvement of the international position in the late 1990s together with the neo-liberal reforms were responsible for qualitatively new framework conditions. The actors actively stepping in the post-socialist urban development have entered the local market under strong external influences. More

networking in terms of current global economy and more integration through the EU accession were the moments responsible for the acceleration of spontaneous changes in evolution of the internal spatial structure of this city.

Bratislava is a place of dynamics recently accelerated. Cyclical aspects of the market are a necessity recognized by the experts, but unfortunately not by the responsible framework institutions. The lack of the city-wide modern strategic documents has been compensated on an ad hoc basis during last time. The waves of public discussion with every new-appearing larger project create frequently a platform unsuitable for rational solutions. Fitting in the mosaic of democratization and liberalization of the Slovak society, probably with responsibility little lower than it would be welcome by later generations, this temporal state should be taken with understatement. A sharp contrast with the style of urban development before 1989, although not always ideally resulting, has to be perceived patiently and with certain amount of optimism.

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