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Comparison of Changes in Urbanized Areas in Poland and Romania

Is urban growth a continuous process? What is the dynamics of urban growth? What are the directions of urban growth?

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Introduction

The 20th century was a period of dynamic evolution for European cities. In Europe, cities were established in different centuries, which contributed to variations in their architectural design. The structure of residential districts evolved over time to accommodate local needs (Bajwoluk 2008). The 21st century brought a host of new challenges for European cities, including globalization, economic restructuring, social change and social exclusion (Kowalczyk and Nowak 2015; Benedek 2016). Rapidly expanding cities also exert considerable pressure on the surrounding municipalities, and their administrative boundaries are expanded to incorporate the adjacent territories (Rząd 2005).

Rapid suburbanization is a relatively new phenomenon in urban development. During this process, low density development, in particular residential development, occupies increasingly more rural land, which leads to uncontrolled urban sprawl outside the ad-

ministrative boundaries of a city (Źróbek-Różańska and Źróbek 2017). Urban sprawl contributes to an increase in developed land (which is far more rapid than the corresponding increase in population or infrastructure), an increase in areas characterized by low density development and low population density, and an increase in residential floor area per capita (which can be partially attributed to the overestimation of residential needs at the planning stage) (Borsa 2014).

Suburban zones are closely linked to the urban core, and they are highly attractive for developers. Regardless of the adopted growth strategy, developers have a growing interest in suburban areas not only due to lower prices for land, but also due to the greater availability of land and new business opportunities. Urban dwellers are also increasingly likely to move to suburban areas in search of a dream home in attractive natural surroundings (Stachura 2012).

Inner-city development represents an opposite trend in urban planning. The term 'compact city' was coined in the 1970s by G. Dantzing and T. L. Saaty, American mathematicians who searched for a new model of urban development that would support a more efficient use of resources and curtail urban sprawl (Kowalewski 2006).

Researchers investigating both urban sprawl and inner-city development continue to search for answers to the following questions: Is urban growth a continuous process? What is the dynamics of urban growth? What are the directions of urban growth? The answers to the above questions have to rely on certain paradigms. Urban growth is undoubtedly influenced by the standard of living in cities. The concept of development is strongly linked with the quality of life, the residents' expectations and aspirations, their level of cultural and technological development and the fulfillment of their needs (Kowalczyk 2015). The first group of factors is correlated with the size of a city, the second group with its population, and the third with its social and economic development. Each group of factors should be analyzed to identify the current trends and phenomena in contemporary cities (Mironowicz 2010).

Demographic analyses of cities and urbanized areas in their historical context reveal specific trends in economic development, major historical events, long-term processes, and they further our understanding of the prerequisites for growth (Chandler 1987). Each year, Mercer Human Resource Consulting surveys the quality of life in cities based on 39 socioeconomic factors grouped in 10 categories, including: political and social environment, economic environment, socio-cultural environment, medical and health considerations, schools and education, public services and transportation, recreation, consumer goods, housing, natural environment.

Urban growth is manifested in numerous dimensions and spheres of human activity. Housing is a basic human need, and for many people a single-family

detached home is the ultimate dream. A home is the place where we sleep, work, eat meals and relax. A home provides its owners with a source of security, and it is the center of family and social life (Bartkowicz 2005). Residential floor area per capita is an indicator of the standard of living. For the needs of this study, it was assumed that changes in the above indicator reflect the growth dynamics of a city. However, analyses that focus solely on changes in floor area per capita can produce erroneous results because a decrease in population in successive years can be accompanied by an increase in floor area per capita. The above is not indicative of an improvement in the standard of living. On the contrary: the standard of living has deteriorated to the extent that urban dwellers begin to migrate and vacate residential areas in the city. To avoid interpretation errors, the urban population and total residential area should be analyzed jointly.

Research Area and Study Subject

The area was selected in such a way as to examine the conditions of urban development under various socio-economic and socio-cultural conditions. The selected cities have an area of 267 km^2 to 67 km^2 (see Table 1 for details).

Table 1. Specification of the surveyed cities—data for 2016

City	City area (km^2)	Floor area (m^2)	Population	Floor area per capita (m^2/person)
Białistok	102	7,690,741	295,981	26.0
Kielce	109	4,852,599	188,507	25.7
Lublin	148	8,842,939	340,466	26.0
Olsztyn	88	4,423,244	173,444	25.5
Braşov	267	5,993,726	290,955	20.6
Cluj-Napoca	180	7,260,025	321,916	22.6
Sibiu	121	3,422,395	169,880	20.1
Târgu-Mureş	67	2,841,457	150,290	18.9

Sources: Central Statistical Office of Poland—stan geodezyjny i kierunki wykorzystania powierzchni miasta; www.kielce.pl, accessed 19.08.2016; Powierzchnia i ludność w przekroju terytorialnym w 2016 r., gus, Warszawa, 2016; www.brasov.ro, accessed 18.08.2016; Romanian National Institute of Statistics.

The analysis covered four urbanized areas in Poland (East Poland) and Romania (Transylvania):

Białystok (municipalities of Choroszcz, Dobrzyniewo Duże, Juchnowiec Kościelny, Supraśl, Turośń Kościelna, Wasilków, Zabłudów);

Kielce (municipalities of Daleszyce, Górno, Masłów, Miedziana Góra, Morowica, Piekoszów, Sitkówka-Nowiny);

Lublin (municipalities of Głusk, Jastków, Konopnica, Niedrzwica Duża, Niemce, Skrzyżewice, Wólka);

Olsztyn (municipalities of Barczewo, Dywity, Gietrzwałd, Jonkowo, Purda, Stawiguda);

Braşov (municipalities of Săcele, Ghimbav, Predeal, Râşnov, Bod, Cristian, Hălchiu, Sânpetru);

Cluj-Napoca (municipalities of Apahida, Baciu, Chinteni, Ciurila, Feleacu, Floreşti, Gilău, Săvădisla, Tureni);

Sibiu (municipalities of Cisnădie, Ocna Sibiului, Cristian, Poplaca, Răşinari, Roşia, Şelimbăr, Şura Mare, Şura Mică);

Târgu-Mureş (municipalities of Corunca, Crăciuneşti, Cristeşti, Livezeni, Sâncraiu de Mureş, Sângeorgiu de Mureş, Sântana de Mureş).

The Romanian cities selected for this study (Cluj-Napoca, Braşov, Sibiu and Târgu-Mureş) are the most important cities of the historical province of Transylvania.

The surveyed areas are cities and their neighboring municipalities. The evaluated objects are similar in size, population and residential floor area. Their geographic location is presented in Figures 1 and 2.

Research Methodology

THE PROPOSED research methodology allows us to answer the following questions: What is the pace of change? How quickly the value of the dependent variable (living space per capita and the area of housing) changes over time? In statistics, an index is defined as a measure describing changes in a dependent variable in time or space, where time is the independent variable. Indicators of change dynamics are widely used in studies analyzing quantifiable social and economic factors (Timofiejuk 2006).

In this study, the selected indicators were relative and dimensionless quantities which are comparable regardless of the type and scale of the analyzed process, and are thus intuitive (Thompson and Cunningham 2002).

In the first stage of the study, chained volume series were calculated where the expression preceding the analyzed expression constituted the basis of a time series.

Fig. 1. Geographic location of the surveyed areas (Poland)

Fig. 2. Geographic location of the surveyed areas (Romania)

$$X_{\frac{1}{0}} = \frac{X_1}{X_0}; X_{\frac{2}{1}} = \frac{X_2}{X_1}; .....; X_{\frac{n}{n-1}} = \frac{X_n}{X_{n-1}}$$

where:

X_0 the analyzed phenomena (population, residential floor area per capita, total floor area) in the first year (1995) of observations;

X_n the analyzed phenomena (population, residential floor area per capita, total floor area) in successive years of observations;

$X_{n/n-1}$ the analyzed phenomena (population, residential floor area per capita, total floor area) in the period preceding the successive year of observations.

In the following stage, the rate of changes in the analyzed variables was determined over time, beginning from the first year of observations (chained volume series). It was assumed that in the first year of observations (1995), the analyzed phenomena (population, residential floor area per capita and total floor area) had the value of 1, and in successive years of observations, the value of the indicator was equal to the product of a dimensionless quantity in a given year and the change dynamics indicator.

TABLE 2. ALGORITHM FOR CALCULATING CHANGE DYNAMICS

Year	1995	1996	1997	…	2016
Observed value	X_1	X_2	X_3	…	X_n
Chained volume series	–	$X_{2-1} = \frac{X_2}{X_1}$	$X_{3-2} = \frac{X_3}{X_2}$	…	$X_n = \frac{X_n}{X_{n-1}}$
Change dynamics from the first year of observations	1	1^*X_{2-1}	$1^*X_{2-1}1^*X_{3-2}$	…	$1^*X_{2-1}1^*X_{3-2}1^*...^*X_n$

SOURCE: Kowalczyk 2014.

TABLE 3. AN EXAMPLE OF CALCULATING THE DYNAMICS OF POPULATION CHANGE IN BIAŁYSTOK

Year	1995	1996	1997	…	2014	2015	2016
Population	278,489	280,592	282,530	…	295,459	295,981	296,628
Chained volume series	…	1,008	1,007	…	1,001	1,002	1,002
Change dynamics from the first year of observations	1	1,008	1,015	…	1,057	1,059	1,065

Results

In the first stage a comparison of dynamics in Polish and Romanian cities was made. The results are shown in Figures 3 and 4.

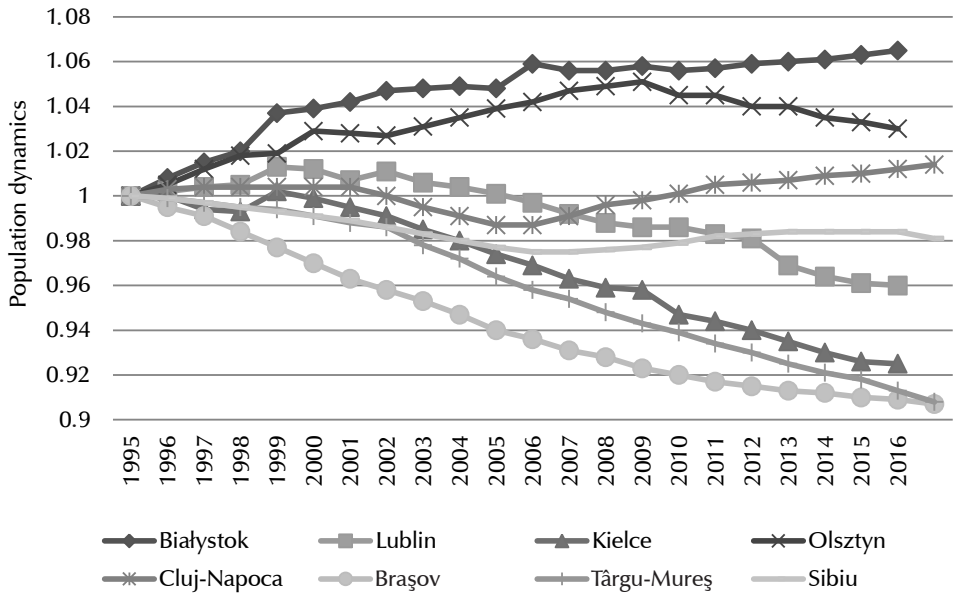
In general it can be stated that only 3 of the 8 analyzed cities show positive dynamics for the period 1995–2016, including two from Poland. In 1995–2016, the most dynamic population increase of 6.5% was noted in Białystok. Olsztyn's population increased by around 5% between 1995 and 2009, after which the evaluated parameter continued to decrease in successive years. At present, Olsztyn's population is only 3% higher than in 1995. The population of Kielce decreased by 7.5% and the population of Lublin by 4% in the analyzed period. The decline in population in these two cities is due to job cuts.

Analyzing the population dynamics in Cluj-Napoca and neighboring communes, we find that between 1995 and 2017 the city of Cluj-Napoca experienced a slight increase in population of about 1.4%, four communes showing population declines between 6% and 15% (Tureni, Ciurila, Săvădisla and Feleacu), the rest of the communes registering population increases between 4 and 441% (Chinteni, Gilău, Baciu, Apahida and Floreşti). The insignificant growth in the population of Cluj-Napoca, a city which nevertheless creates many well-paid jobs (especially in IT&C), is due first and foremost to the very high price of construction land, the very high price of dwellings, and to the population who, although coming in very large numbers to work and study in the city (Cristea et al. 2017), prefer to live in communes near the city. The decline may also be ascribed to the closure of the major industrial sites after 1990 and the relocation of industrial production outside the city.

Some explanations regarding the decrease of the population in the neighboring communes of Cluj-Napoca, besides the decreases related to natural causes and emigration, specific to the Romanian rural area, could be related to the orographic factor represented by the Feleac Hill, the poor road connection of these communes with the city and the lack of infrastructure in general. However, although Feleacu commune is located in the immediate vicinity of the city, it seems that its inhabitants prefer to move to the city or other communities where housing and work offer is better. A relatively small population growth is recorded in Chinteni commune, which, although located in the vicinity of the city, seems to fail to attract many people mainly due to the lack of infrastructure.

The population increases experienced by the other communes (Gilău, Baciu, Apahida and Floreşti) are due to their proximity to the city, a good road connection with the city (E60, E81, E576 and city bypasses), the low price of the land for construction, the cheap housing stock (half, or even less, the prices the city) and good infrastructure in general.

Fig 3. Population dynamics in the urban core (excluding the neighboring municipalities)



Analyzing the population dynamics in Braşov and the neighboring municipalities, we find that between 1995 and 2017 the city of Braşov registered a decrease in population of 9.3%, a decrease in population being also registered by the town of Predeal (23%) and Halchiu commune (13%). A population increase was recorded in the city of Săcele, the towns of Râşnov and Ghimbav, as well as in the communes of Bod, Cristian and Sânpetru. The decrease in Predeal's population was caused by the lower efficiency of tourism services, which decreased the tourist attractiveness of resort towns (Ilinca 2003), by natural causes and emigration.

The decrease in population of Braşov and Târgu-Mureş can be ascribed to the economic restructuring, the regress of the urban economy and services, starting with the second half of 1990, marked by the partial or total closure of the branches of the large industrial units, the reduction in industrial production, the dismissal of the working staff, their withdrawal to the villages of origin (Ilinca 2003) and migration to the neighboring areas.

The increase registered by Sibiu is generated mainly by two causes: attracting labor from other parts of the country (especially from the less developed South) and natural causes.

The data presented in Figure 4 indicate that total residential floor area in the evaluated cities increased between 1995 and 2016 regardless of the nature of the

observed change in population (increase or decrease). In the analyzed period, the greatest increase in total floor area was observed in Olsztyn (60%), and the smallest increase was noted in Kielce (41%). In Polish cities, total floor area increased most dynamically in 2001–2002 due to the rapid growth of the housing market, the high availability of mortgage loans and public housing programs for young couples. Comparing the dynamics of population change presented in Figure 3 with the observed positive dynamics of changes in the area of apartments, the question is: Does the change in the number of inhabitants of the city prove its development if we are dealing with the simultaneous expansion of housing. Can any decrease in population show the "extinction" of the urbanized area?

The analyzed data did not reveal direct correlations between population dynamics and urban growth within the administrative boundaries of the city. Further analyses were carried out to determine factors responsible for an increase in residential area in cities with a dwindling population, as well as factors that could be indicative of urban growth or decay.

The rate of changes in residential floor area per capita is presented in Figure 5. Similarly to Figure 4, a significant increase in floor area per capita was observed in every analyzed city between 1995 and 2016. The dynamics of changes in floor area per capita was highly similar in Polish cities. The greatest increase in the analyzed parameter was noted in Olsztyn (55%), and the smallest increase was observed in Białystok (49%).

After 1990, Romania experienced a decrease in the birth rate and an increase in the death rate, which led to a natural decrease of the population. At the same time, the number of emigrants exceeds that of immigrants, leading also to a decrease in population of Romania, including at the present time (Romanian National Institute of Statistics 2017). Two million Romanians intend to move to one of the country's major cities over the next five years, while 1.1 million want to leave the country, according to a poll cited in the World Bank's report from 2017, "Magnet Cities: Migration and Commuting in Romania."

In the case of Romanian cities, they have been affected by the economic (especially industrial) restructuring, the regress of the urban economy and services, starting with the second half of 1990, marked by the partial or total closure of the large industrial units, the decrease industrial production, the dismissal of the working staff and its withdrawal to their places of origin (Ilinca 2003). The regions that have developed the fastest are the dynamic cities and the areas around them, this being in fact the essence of development: concentration in a few growth centers and the diffusion of growth to surrounding areas, until every corner of the country is reached (Ionescu-Heroiu et al. 2013). The performance of each city is likely both the result of a set of givens (e.g. size, proximity to the

Fig. 4. Change dynamics in residential floor area in the urban core

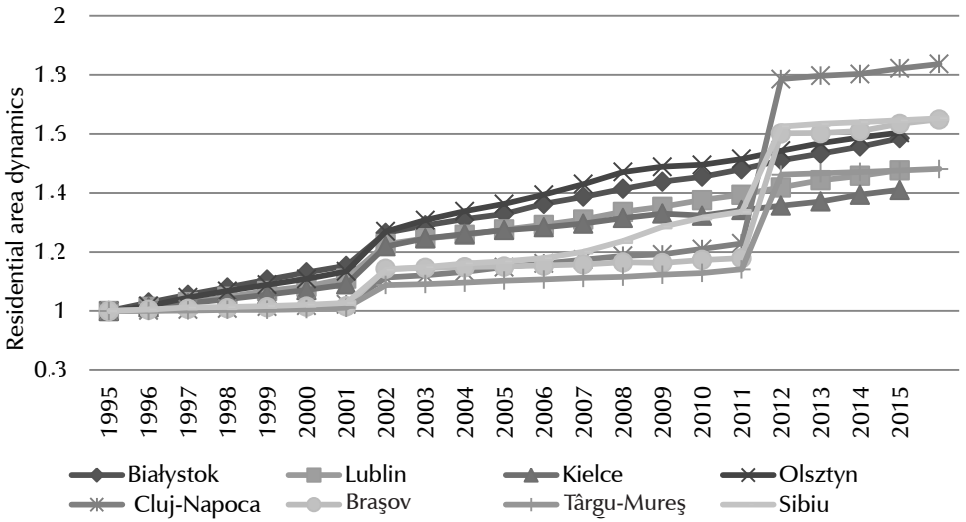
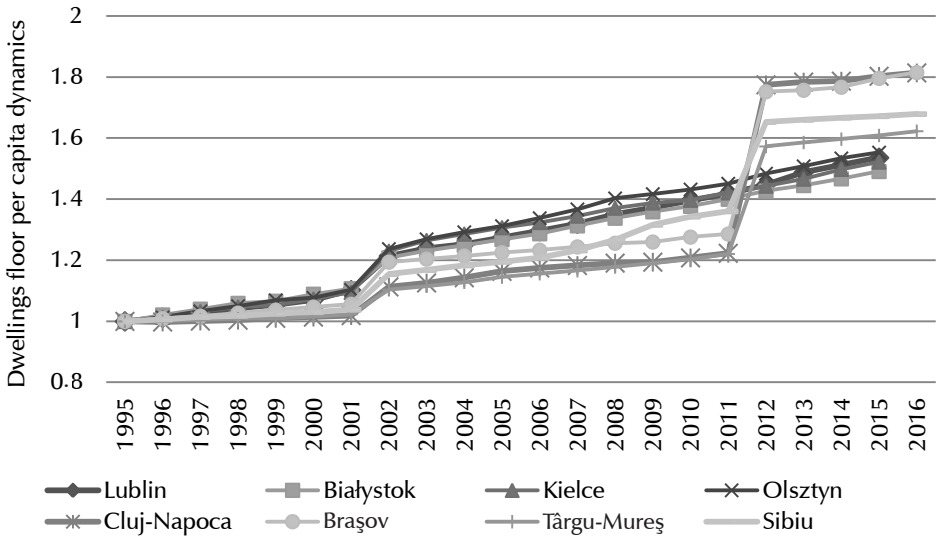


Fig. 5. Change dynamics in residential floor area per capita in the urban core

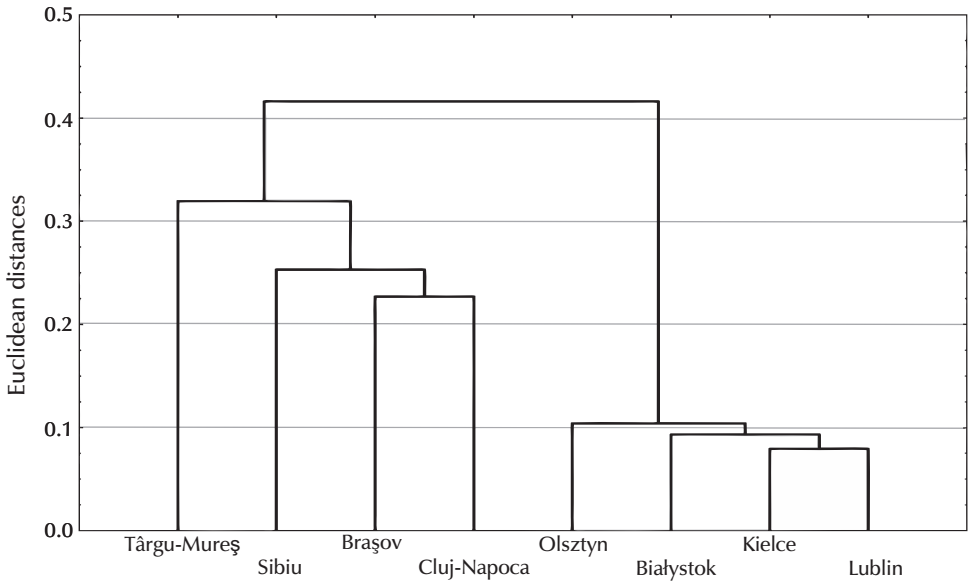


West, distance from Bucharest), but also the result of conscious interventions (e.g. strong local leadership, the development of metropolitan infrastructure, investments in business parks, or the increase in the quality of life) (Cristea et al. 2017). Analyzing the population dynamics in the most important four cities of Transylvania (Cluj-Napoca, Braşov, Sibiu and Târgu Mureş), we find that between 1995 and 2017, only Cluj-Napoca registered a slight increase in population (1.4%), Sibiu registered a slight decrease in population (-1.9%), while Braşov and Târgu-Mureş experienced population declines of over 9%.

The decline of Sibiu, Târgu-Mureş and Braşov, may be also ascribed (obviously after the causes of natural decline of the population and emigration mentioned above) to the closure of the major industrial sites after 1990 and nowadays, the relocation of industrial production outside the city, obviously followed by the move of the workers outside the city (in majority of cases in the neighboring communes) (Petrovici 2013). For Romania, the period 2000–2008 saw an economic boom, not necessarily characterized by high growth in employment (just 6%), but rather by the increase in productivity and, implicitly, in income. The minimum wage increased from 28 euros in 2000, to 142 euros in 2008. All this has been manifested in the growing expectations of the population for a new home (especially the middle class), and with demand comes the offer. The number of building permits for residential buildings increased exponentially during the boom, but with the onset of the economic crisis at the local level, entrepreneurs with no demand and no financial resources available postponed the completion of the construction for a period of 1–2 years, which resulted in the spectacular growth of the residential area in general and obviously also of the per capita residential area, starting with 2011, despite the fact that the number of new building permits issued was less than half of the maximum reached in 2007–2008. Starting with 2013, the number of new building permits has been rising, and since 2014 we are witnessing a slight but constant increase in the residential area. However, the results of the analysis cannot be used to reliably determine the rate and direction of changes in urban growth because the observed increase in floor area per capita could result from a decrease in population, which is the case in Kielce and Lublin or in Romania.

The analysis of the dynamics of changes in three areas of interdependent variables indicates a great variety of variables. In order to distinguish groups of most similar cities, factor analysis was performed, i.e. the geometric distance was determined in multidimensional space (distance (x, y) = $[i (xi - yi) 2]^{½}$). Note that Euclidean distances (squares of Euclidean distances) are calculated on the basis of raw data, not on the basis of standardized data. This method has some advantages (for example, the distance between two objects is not affected

FIG. 6. DYNAMICS OF CHANGES IN RESIDENTIAL FLOOR SPACE PER PERSON IN CENTRAL CITIES



by adding new objects that may be outgoing objects). However, distance differences are influenced by the differences in units between the dimensions from which the distances are calculated.

Factor analysis shows that per capita living space dynamics is similar across countries. This confirms the distinctness of the changes in both countries. Changes in cities in Poland have a lower distance between them, which may be more coherent than in Romanian cities. Based on the assumption that the urban area is not only within the administrative boundaries, but also municipalities directly adjacent to the city, an attempt was made to compare the dynamics of the changes taking place on the basis of the bag charts. The bag graph is a two-dimensional version of the mustache frame. The basic concept of a bag chart is to ditch a point in the bag, i.e. its 'half' position relative to the total data. It is based on the extension to the two dimensions of the notion of rank. The bag graph illustrates the basic features of two-dimensional probability distribution of two variables (population dynamics and dwelling floor per capita), i.e.: location (Tukey median), spread (bag size), correlation (bag orientation), asymmetry (bag shape and envelope shape) and tails (shell size and standing points).

FIG. 7. BAG CHARTS OF SELECTED CITIES AND ADJACENT IN POLAND

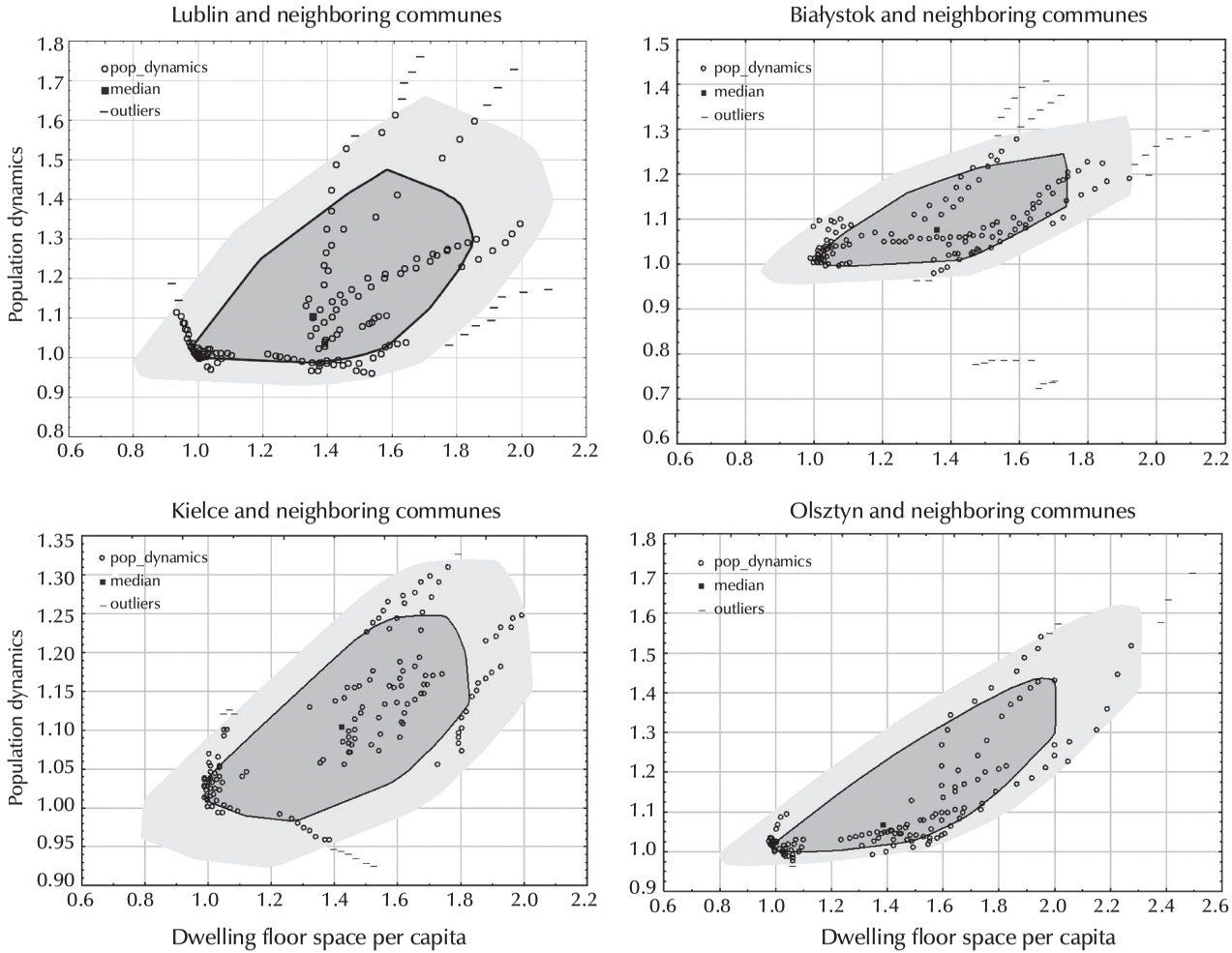
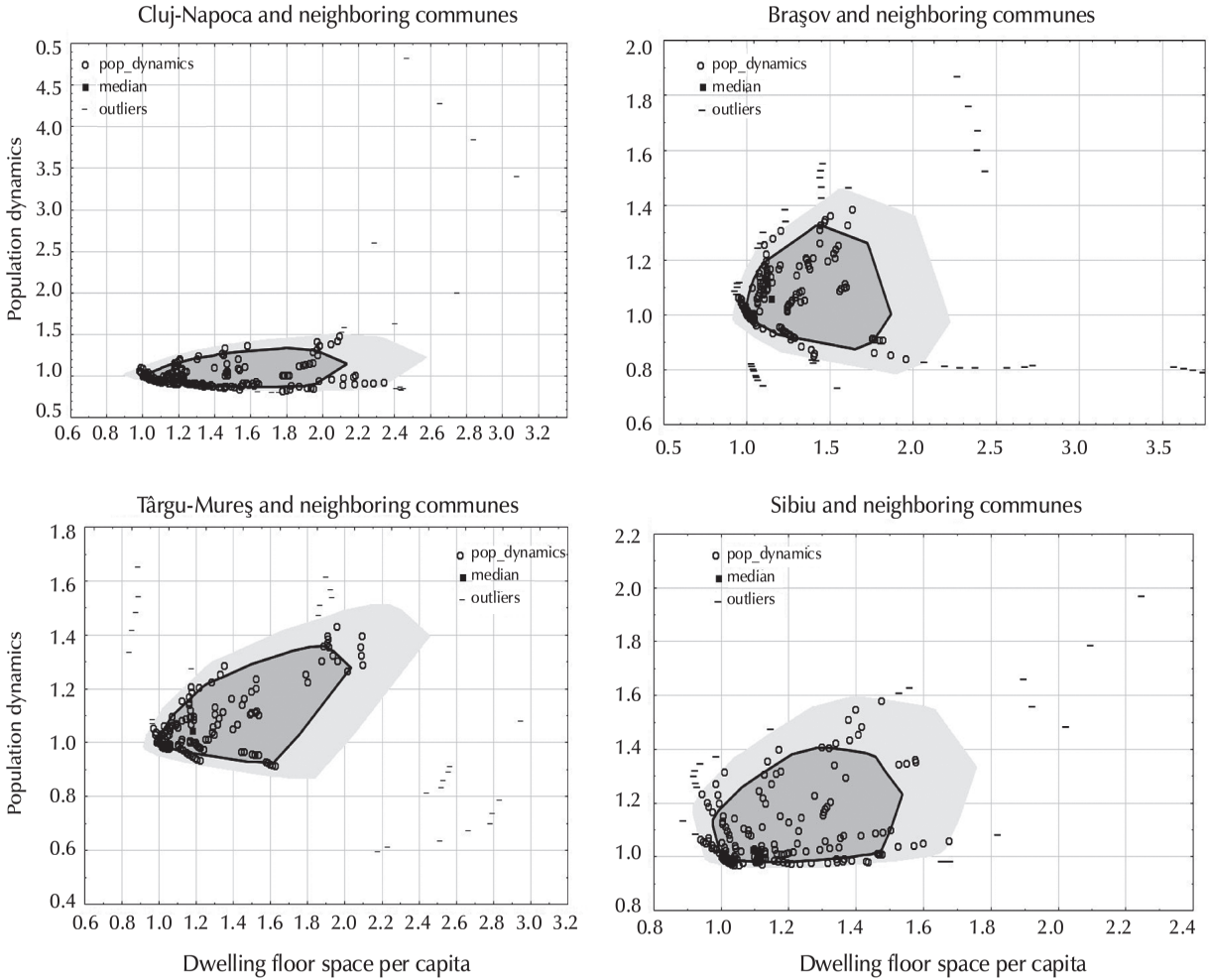


FIG. 8. BAG CHARTS OF SELECTED CITIES AND ADJACENT IN ROMANIA



Summary

The changes taking place in the urbanized area are a very complex process, influenced by various factors. Research has shown that the directions and speed of change in cities located in different countries can have a distinct dynamics. The general tendency in Polish and Romanian cities is the decreasing population within the administrative boundaries of the city (the core of the urbanized area), with a rapidly increasing population and dwellings in neighboring municipalities. As an exception can be Cluj-Napoca, where in the city there is a very dynamic population growth, much larger than in the neighboring municipalities.

The process of developing urban areas in municipalities surrounding cities in Poland is positively correlated. On the bag charts we observe a small number of elements departing from the general trend in the presented urbanized areas in Poland. Conversely, changes occurring in the area of neighboring towns and cities in Romania are characterized by high dynamics within particular areas (large number of out-of-pocket observations). The biggest swing of trends occurs in the municipalities of Târgu-Mureş and Braşov. An in-depth analysis of spatial determinants is required to exclude the impact of terrain and natural conditions on the search for answers, which may be the reason for swaying trends in Transylvanian urban areas.

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Abstract

Comparison of Changes in Urbanized Areas in Poland and Romania

The main aim of this study was to examine the co-existing phenomena that occur dynamically in an urbanized area. This goal was achieved by analyzing trends and the rate of changes in geolocation data. The input data were obtained from statistical registers kept for administrative units (municipalities). The method was verified for a group of municipalities forming a cohesive urbanized area (a city and neighboring municipalities). The rate of changes was compared in two countries, including four cities in eastern Poland (Olsztyn, Białystok, Kielce and Lublin) and four cities in the region of Transylvania in Romania (Cluj-Napoca, Braşov, Târgu-Mureş and Sibiu). The studied areas encompassed the territories within the administrative boundaries of the analyzed cities as well as their neighboring municipalities in 1995–2016. The surveyed objects were characterized by a similar area, population and residential floor area per capita.

Keywords

population changes, change dynamics, comparison of growth rates, residential floor area per capita, rate of changes in urban areas