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the Soviet legacy and current paths of change

Ubareviciene, Ruta

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City Systems in The Baltic States: The Soviet Legacy and Current Paths of Change

Abstract

This paper analyses the development of city systems in the Baltic States (Estonia, Latvia and Lithuania). These countries have experienced a shift from the relatively isolated realm of the Soviet Union to the European Union, one of the most liberal economies in the world. The aim of this paper is to analyse how the transition from a centrally planned economy to a market-led economy influenced how the city systems changed. The study uses annual data on the population dynamics of the cities from 1989-2015. Zipf's law serves as a reference point to explore and compare the city-size distribution as well as the regularity and stability of this distribution in the Baltic States. A linear regression is employed to determine the impact of relevant factors that lead to city system change under market economy conditions. The results show that although the current paths of development are different in the Baltic States, the countries illustrate similar trends towards metropolisation and spatial polarisation. The results of this research suggest that spatially uneven development will continue in the Baltic States, and regional development policies should be aligned with the ongoing trends. The findings of the research encourage the development of greater cooperation between the Baltic States in creating regional policies, in particular those related to their shrinking cities and regions.

Baltic States; post-Soviet development; city systems; shrinkage

Zusammenfassung

Stadtsysteme in den baltischen Staaten: Das sowjetische Erbe und gegenwärtige Wege der Wandels

Diese Arbeit untersucht die Entwicklung von Stadtsystemen in den baltischen Staaten (Estland, Lettland und Litauen). Die betroffenen Länder haben einen Wandel von einem Raum der relativen Isolation hin zur Europäischen Union erfahren, eine der liberalsten Wirtschaften der Welt. Ziel dieser Arbeit ist es zu untersuchen, wie der Übergang von einer zentralen Planwirtschaft zu einer Marktwirtschaft den Wandel der Stadtsysteme beeinflusst hat. In der Studie werden jährliche Zahlen zur Bevölkerungsdynamik in den Städten zwischen 1989 und 2015 verwendet. Bei der Untersuchung und dem Vergleich der Verbreitung von Städten sowie der Regelmäßigkeit und Stabilität dieser Verbreitung in den baltischen Staaten diente das Zipfsche Gesetz als Bezugsrahmen. Zur Ermittlung der Auswirkung relevanter Faktoren, die unter marktwirtschaftlichen Bedingungen zum Wandel der Stadtsysteme geführt haben, wird eine lineare Regression angewandt. Die Ergebnisse zeigen, dass sich die gegenwärtigen Wege des Wandels in den baltischen Staaten zwar unterscheiden, in den Ländern jedoch ähnliche Tendenzen der Metropolenbildung und räumlichen Polarisierung erkennbar sind. Die Ergebnisse dieser Untersuchung legen nahe, dass sich die räumlich uneinheitliche Entwicklung in den baltischen Staaten fortsetzen wird und die regionale Entwicklungspolitik an diesen nachhaltigen Trend angepasst werden sollte. Die Erkenntnisse der Untersuchung bestärken die Entwicklung einer engeren Zusammenarbeit der baltischen Staaten bei der Ausarbeitung regionaler Strategien, besonders solcher, die auf ihre schrumpfenden Städte und Regionen ausgerichtet sind.

Baltische Staaten; postsowjetische Entwicklung; Stadtsysteme; Schrumpfung

Introduction

Changes in political, social, economic and environmental conditions lead to the constant redistribution of the population both worldwide and nationwide. As an outcome, the size distribution of cities within an urban hierarchy can also change over time (ROSEN & RESNICK 1980). It is important to understand the direction of these changes to effectively tap the demographic, social and economic potential of countries and cities. In many countries, major cities are increasingly coming to dominate the wider region, concentrating human and economic resources (SCOTT & STORPER 2007). In contrast, a large body of literature has examined urban shrinkage – a recent phenomenon found in many developed countries around the world (HAASE et al. 2016; MARTINEZ-FERNANDEZ et al. 2012). Such polarisation, manifest in the growth of one area and the decline of another, encourages the exploration of city systems and their development trajectories in the national and cross-national contexts.

It is of interest to explore the city systems of three Baltic countries due to their specific historical-geographical contexts. Estonia, Latvia and Lithuania have experienced a complete shift from being part of the Communist Soviet Union (USSR) to becoming a part of the European Union (EU), one of the world's most liberal and open economies. This shift has had consequences for the political, economic and social spheres, as well as for spatial planning and development policies. The transition to a market led neoliberal economy resulted in a new stage of socio-spatial development in the Baltic States. For example, previously controlled flows of internal migration changed direction, and many people moved towards the larger cities. This led us to hypothesise that population redistribution in the Baltic States since the 1990s has been greater than in any other Former Soviet Union (FSU) or Central and Eastern European (CEE) country. In addition, the Baltic States have experienced one of the highest rates of population decline in the world in recent decades (UNITED NATIONS 2015), which also suggests that the city systems have undergone significant transformations. Moreover, the Baltic States inherited different types of city systems from the Soviet period: it is polycentric in Lithuania, monocentric in Latvia and partly monocentric in Estonia. This is the great 'paradox' of the socialist world, considering that the FSU countries were supposed to be subject to the same planning principles.

Despite the significant macro-level transformations in the Baltic States, very few comparative studies have analysed how their city systems changed. Existing studies have focused on the Soviet period (KRUPICKAITĖ 2003; VANAGAS et al. 2002), although it is now known from the statistics that the greatest changes in the population and its redistribution started after the 2000s. This paper attempts to fill this gap by examining the city systems of the Baltic countries to uncover the trends in these changes in the post-Soviet period. The aim of the paper is to analyse how the transition from the centrally planned Soviet economy to a market-led economy influenced how the city systems changed in the Baltic States. The paper addresses the following questions: Did the systemic changes affect different city systems in the same way and to the same extent? What is the impact of the factors analysed (location, past growth, etc.) on changing urban

hierarchies under the conditions of a market-led economy? The hypothesis is that the different city systems of the Baltic States experienced reverse trajectories of change after market forces took over. If this hypothesis is confirmed, it implies that the different types of city systems in the Baltic States are ultimately becoming more similar. It is expected that such a perspective should lead to greater cooperation between these countries, particularly in creating common regional policies.

In this paper, the term 'city system' refers to the distribution of city size (measured by the number of people) within a given country. Research on city systems started almost a century ago, with studies by CHRISTALLER (1933) and LÖSCH (1940) possibly the first and most influential attempts to formalise a theory of city system formation in the form of *central place theory*. The parallel approach used for macro-spatial analysis is known as *rank-size regularities*, which is used to describe the form of the hierarchy within the urban systems (COFFEY 1998; ZIPF 1949).

Regional policy and urban growth regulation during the Soviet period

Regional (spatial) policy was an integral part of the centrally planned economy in the Soviet Union (SU) (STANILOV 2007). It was directed towards the balanced territorial development and implemented through the spatial distribution of human and economic resources (BERTAUD & RENAUD 1997). According to GENTILE et al. (2012, p. 292), the ideology of the socialist system, in contrast to the capitalist, aimed to 'annihilate social, economic and regional differences and inequalities, effectively pushing for complete social, economic and spatial homogenization over time'. One of the most important goals of regional planning in many socialist countries concerned the constrained growth of a few major cities and enhanced development of regional centres (CLAYTON & RICHARDSON 1989). In this respect, socialist planning doctrine even extended to controlling the size and hierarchy of cities. This was implemented through the centralised allocation of housing and employment as well as social and cultural infrastructure (SÝKORA & ČERMÁK 1998). As a result, the tight control of population movements and occupations could be carried out (BATER 1980). The Soviet period had a significant impact on the socio-spatial organisation of the Soviet republics and, compared to capitalist countries, resulted in very different development paths (DEMKO & REGULSKA 1987). On the other hand, some authors argue that socialist planning had little influence on actual migration flows, and that some cities were growing much faster than was expected and spatial as well as social disparities remained (BUCKLEY 1995). Nevertheless, urban and regional developments and policies differed between countries, which can be explained by differences inherited from former times, as well as different ideological approaches (MUSIL 2005).

The Baltic States were under the Soviet regime and subject to a command economy model for five decades – from the Second World War until 1990 in Lithuania and Latvia and until 1991 in Estonia. Considering that Estonia, Latvia and Lithuania are relatively similar in their geographical location, history, size of their

territory and population, and given the fact that the FSU countries were subject to the same planning principles, it would be reasonable to expect that the territorial organisation of the Baltic States developed in the same direction. However, in fact, the opposite has happened and this could be considered the 'paradox' of the Soviet legacy. Differences in the initial settlement systems and in the roles of local planners and economic actors determined the development of different types of city systems in the Baltic countries by the end of the Soviet period (Fig. 1).

Fig. 1: Urban hierarchies in the Baltic countries in 1989 and 2015

Regional planning in Latvia and Estonia was very similar during the Soviet period. The Soviet authorities took advantage of the favourable geographical locations of Riga and Tallinn and their well-developed infrastructure and tradition of industry, allowing them to grow and further concentrating industry and military facilities (VANAGAS et al. 2002). The major source of urban population growth was immigration from other Soviet republics (GRAVA 1993; MÄGI et al. 2016). Tallinn and Riga accounted for over one-third of the total population of each country and nearly half of the urban population of each country by the end of the Soviet period. This clearly contradicts Soviet planning regulations, which aimed to reduce the dominance of the major cities (CLAYTON & RICHARDSON 1989). Indeed, the planners were concerned about the excessive dominance of the capital cities; however, the universality of the urbanisation process and economic interests took over (TAMMARU 2000). Balanced development did not occur in Latvia, and Riga remained very dominant. For example, the second largest city, Daugavpils, was 7.3 times smaller than Riga in 1989. Policy implementation was more successful in Estonia, which helped to balance the urban system. Part of Tallinn's growth was directed to the satellite towns within its urban agglomeration. Tartu, the second largest Estonian city, strengthened its role as a traditional university city as well as a regional industrial centre. In addition, regional centres were created throughout Estonia to facilitate political management (or to gain better control) at the local level. Consequently, an industrial cluster emerged in northeast Estonia, consisting of several industrial towns (e.g. Narva and Jõhvi). However, apart from this cluster, the newly established regional centres remained relatively small.

In Lithuania, Vilnius was never as prominent as Riga and Tallinn, accounting for only 15.7 percent of the total population of Lithuania in 1989. This was determined by the historical circumstances (Kaunas was the temporary capital city during the interwar period), its geographical location (Vilnius is located close to the Belarus border and is not a seaport) and Soviet planning. During the Soviet period, unified settlement planning was implemented in Lithuania. This meant that part of the potential growth of the largest cities was distributed to other regions of the country, thereby creating a polycentric urban system (ŠEŠELGIS 1996; VANAGAS et al. 2002).

Changing city systems in the market economy

After the demise of the Soviet Union there was no more government intervention in relation to residential mobility and the location of economic activity. The development of the city systems thus became dependent on market forces. Location, which had little influence in the planned economy, became one of the most important factors in the market-led economy (BERTAUD & RENAUD 1997). Thus, it could be expected that the city systems would start to change. In this respect, there are three major groups of interrelated processes that contributed to changes in the city system, discussed separately below.

Fig. 2: Population change in the Baltic countries in 2000/2001-2011

Demographic changes. The population of all three countries started to decline soon after the reforms (BERZINS & ZVIDRINS 2011). In the last decade, they were among the world's fastest shrinking countries (UNITED NATIONS 2015). This decline affected both rural and urban areas (Fig. 2), with 95 percent of all cities losing population between 1989 and 2015. The capital cities were not an exception; for example, according to the statistics, Riga lost as much as 29.6 percent of its population after 1989 (Figs. 1 and 2, Tab. 1). Moreover, the range of the population change varied significantly between different cities: from minus 61 to 89 percent. Even greater variations can be found between the LAU 2 regions (Fig. 2, left). Moreover, the patterns of population change are very similar across the Baltic countries.

Tab. 1: Comparison of the Baltic countries, 1989 and 2015

Population redistribution. The major factor causing the decline was emigration, accounting for around 70 percent of the decrease in the population (EUROSTAT 2016). However, some studies have found that internal migration was the main cause of spatially uneven population change (AMBINAKUDIGE & PARISI 2015; UBAREVIČIENĖ 2016). In the Baltic States, as in other post-socialist countries, an increasing concentration of population can be observed in the major metropolitan regions (Fig. 2) (BORÉN & GENTILE 2007). However, this increase occurred solely through suburban development, while the population in the inner cities continued to decrease (LEETMAA & TAMMARU 2007; UBAREVIČIENĖ et al. 2016). Suburban rings are almost the only areas in which the population has been growing since the 1990s, while the sharpest population decline can be observed in the most peripheral rural and urban regions.

Economic changes. The economies of the Baltic States were challenged by deep recession and belated deindustrialisation at the beginning of the transition period. The larger and more diversified cities were able to adapt to the market economy and global competition with greater ease than the smaller and mono-functional cities (CINIS et al. 2008). According to EHRLICH et al. (2012, pp. 78), the metropolitan regions can be called the 'winners' of the post-socialist change, while other areas experienced adverse developments.

Today, a massive job-seeking out-migration of the working-age population (which intensified after accession to the EU in 2004) is again challenging the economies of the cities.

The influence of these processes manifests itself differently in different cities, depending on their size, location, inherited economic base and other factors. As a result of these differences, the city systems and their hierarchies might have started to diverge, as would be expected. Indeed, Tab. 1 indicates that the trajectories of change were slightly different between the countries. The share of the total population significantly increased in Vilnius (from 15.7 % to 18.2 %). In Tallinn, this increase was very modest, while Riga experienced a decrease. The primacy index (the ratio of the largest city to the second largest city) significantly increased in Lithuania, while in Latvia and Estonia the increase was marginal. These figures suggest that the Lithuanian city system started evolving towards a model where the capital city has a strong dominant role, as in the case of Latvia and Estonia. However, deeper analysis is needed to better understand the changes in the city system.

Hypotheses

More than a decade ago, a comparative study of the Baltic States (VANAGAS et al. 2002, pp. 97) concluded that the city systems in the Baltic countries were more likely to develop in different directions in the near future. However, considering the current trends towards centralisation and spatial polarisation in the post-socialist countries (LANG et al. 2015), it can be expected that the opposite scenario is equally likely. Figure 3 illustrates hypothetical models with three different scenarios for the development of the city systems in the Baltic States. 'Scenario 0' assumes that all cities in each of the Baltic countries will decline at the same rate. In this case, there is no change in urban hierarchies, and the city systems retain their different characters: monocentric in Latvia and Estonia and polycentric in Lithuania. This is the least likely scenario, since it has already been declared that market forces affect different cities to different degrees. 'Scenario I' reflects centralisation and spatial polarisation trends and it predicts an increasing dominance of the capital cities in the urban hierarchies. 'Scenario II' is the opposite, predicting an equalisation (balance) of the urban hierarchies – declining dominance of the capital cities and increasing importance of other cities. Considering that different city systems were formed in the Baltic States during the Soviet period, different paths in their recent development might be expected. However, the character of the city systems should eventually resemble each other due to the unifying nature of market forces; therefore, it can be expected that the Lithuanian city system will change according to 'Scenario I' and the Latvian city system according to 'Scenario II'. Meanwhile, the Estonian city system can be assumed to be in the intermediate position, and thus 'Scenario 0' is the most likely.

Fig. 3: Hypothetical models of city system change in the Baltic countries

The problem of observation units and the definition of a city

Studies of city systems often address the question of the units of observation (Berry & Okulicz-Kozaryn 2012; Pumain et al. 2015; Soo 2005). Parr (2007, pp. 382) clearly describes the concerns that arise in the comparative urban studies and brings together four perceptions of cities: the built city, the consumption city, the employment city and the workforce city. However, these perceptions have so far been little used in empirical studies. Alternatively, 'city proper' data is used, which means that cities are analysed within their administrative boundaries. However, the definition of 'city' varies from country to country (Dijkstra & Poelman 2014). These national definitions usually rely on the population size, but this parameter is strongly linked to the country's size and population density. For example, in the Netherlands the lower threshold is 20,000, while in Denmark and Sweden it is as low as 200 inhabitants. Sometimes additional parameters are included for clarification. Among the most commonly used are: the socioeconomic composition of the residents, population density and historically formed city status. Such diversity makes the implementation of comparative studies difficult and encourages the development of uniform methods to delineate cities and metropolitan regions. Although this falls under the scope of the Organisation for Economic Co-operation and Development (OECD), currently only 35 countries in the world belong to it, thus comparative studies remain limited.

In the Baltic States, the cities are being defined as the legal entities and no comparable statistics exist that would allow to analyse more meaningful and consistent physical or 'true-bounded cities' (Parr 2007, p. 382). This is a particular problem in case of large metropolitan cities, whose urban sprawl extends far beyond the administrative limits, but less of a problem for smaller cities. Although this is an important shortcoming, this paper relies on 'city proper' (administrative) data. The definitions of 'city' are similar in the Baltic States and may be regarded as a legacy of the Soviet period. In 2015, the smallest city in Lithuania had 239 inhabitants, in Latvia 526 and in Estonia 789.

Data and methods

The most common approach adopted by studies of city systems relies on Zipf's law (Gabaix & Ibragimov 2011; Gabaix & Ioannides 2004; Ioannides & Overman 2000; Nitsch 2005; Rosen & Resnick 1980; Soo 2005). This is a mathematical principle that implies remarkably stable regularity, defined by power-law probability distribution, which can be found in many types of data explored in the natural and social sciences. In the case of city analysis, this law predicts that the most populated city is twice as large as the second biggest, three times as large as the third, and so on (Giesen & Suedekum 2011; Zipf 1949). Zipf's law is typically used at the national level or for single regions, since it applies only to cities that are economically integrated. Although the validity of Zipf's law has been verified empirically in many countries, there is no consensus on

its universal applicability, and it has been questioned on a number of counts (e.g. BERRY & OKULICZ-KOZARYN 2012; FAZIO & MODICA 2012; PUMAIN et al. 2015). It is known that ZIPF's coefficient is sensitive to the definition of the city and the sample size (ROSEN & RESNICK 1980). It is also known that in many cases the power-law works for the upper tail, but often fails to predict the distribution of smaller cities. Therefore, the majority of existing studies analyse more populous countries and cities.

ZIPF's law can also serve as reference point to observe changes in time and differences between countries. In this paper, ZIPF's law is first used to explore and to compare the city-size distribution, as well as the regularity and stability of this distribution in the Baltic States. ZIPF's law provides us with the template model, which is used as an approximation to characterise the city-size distribution within the countries (ROSEN & RESNICK 1980). Linear regression is then employed to test the predictive power of some important factors that lead to city system change under market economy conditions. The regression models contain theory-guided variables, such as location, accessibility and urban functions. Unfortunately, it was not possible to include socioeconomic and demographic characteristics in this study, due to the limited access to equally detailed data in all three countries. Not all variables considered were reported in the final regression models because, in the preselection process, it was found that their influence was negligible. City-level variable summary statistics can be found in Table 2. All the variables were checked for multicollinearity and no risks were detected.

Tab. 2: Variable summary statistics

This study covers the period from 1989 to 2015 using population data provided by the National Statistical Offices in Estonia, Latvia and Lithuania. Aggregated city-level data of all officially recognised cities was used for 47 cities in Estonia, 76 in Latvia and 103 in Lithuania. The analyses were based on the constant number of cities found in 2015. Although the boundaries of some cities changed slightly during the period of analysis, the influence of this on the empirical results would have been negligible.

Results

Testing ZIPF's law on the Baltic cities

This section compares the city systems in the Baltic States and the trends in the changes. ZIPF's law is used as a reference point. Figure 4 illustrates the city-size distribution in 1989 and 2015. It plots the log for each city's rank against the log for each city's size, measured by the number of inhabitants. The general patterns of the city-size distribution are quite similar between the countries. However, it can be seen that in Lithuania the distribution in rank-size is flatter than in Estonia and Latvia, which means that the city system is more balanced. Another important feature is the exceptionally high role of Riga in the Latvian city system. The clearly visible trend in all three countries is a universal decrease in the cities' populations

between 1989 and 2015. However, to understand the underlying mechanisms leading to city system change, deeper empirical analysis is needed.

Fig. 4: Rank-size distribution of the Baltic cities, 1989 and 2015

Firstly, a goodness-of-fit test is used to check whether the empirical distribution of city size in the Baltic States between 1989 and 2015 followed the theoretical power-law distribution (see NITSCH 2005; TERRA 2009). In Table 3, significant values of this test show that the existing distribution of city size corresponds to the power-law distribution. It is interesting to note that in Lithuania the relationship between these distributions became significant after the Soviet period. Estonia, in contrast, demonstrates the opposite trend: the cities followed the power-law distribution up until 2011 and then suddenly ceased to apply. In Latvia, the ZIPFian distribution was not valid at all during the entire period; however, the *p* value does gradually increase. These results suggest that there are essential differences between the city systems and the trends in the changes. It is especially interesting to note the reverse development trajectories of the city systems of Lithuania and Estonia. This encourages the further exploration of the underlying factors determining these differences. Moreover, as has been suggested by NITSCH (2005, pp. 2), the ultimate goal should not be to reject or verify ZIPF's law, it is more important to empirically evaluate the fit as well as to understand the mechanisms behind it.

Tab. 3: Goodness-of-fit test (Kolmogorov-Smirnov)

We will better understand the processes of city system change if we compare the observed city-size distribution with the approximated Zipfian distribution. In Figure 5, the black lines represent the trend lines for the observed data and the red lines illustrate the power-law distribution (exponent equal to 1) and are used for the comparison. The Pareto value of the rank-size slope (coefficient α) is used for more accurate empirical evaluation. Our results show that in the Baltic States the rank-size slopes are considerably below 1 (Fig. 5 and Fig. 6). In contrast, cross-country studies usually find the exponents to lie between 0.8 and 1.2 for most countries (ROSEN & RESNICK 1980). According to PUMAIN et al. (2015), low values are common for FSU countries due to their relatively late industrialisation and more recent urban development.

Fig. 5: City-size distribution in the Baltic countries, 1989 and 2015

Figure 5 shows that virtually all of the points in the plots are below the comparison line (except for some in Lithuania). This indicates that the city size decreased more rapidly than implied by the rank-size rule. In other words, it shows that populations in the Baltic countries are less evenly distributed than this rule predicts. This is especially obvious in Estonia and Latvia, where the rank-size slope reaches values below

0.7. In these countries, the capital cities play highly dominant roles, accommodating as much as one-third of their total populations (Tab. 1). The common feature between the Baltic States is the obvious plateaus with many cities of similar size situated towards the lower ends of the curves. This adds to the explanation of the poor fit of the rank-size rule on the Baltic data. The patterns of the city-size distribution in the Baltic countries can be considered as an outcome of the socialist planning; similar patterns could also be found in other FSU countries.

Fig. 6: Annual change of the rank-size slope in the Baltic countries, 1989-2015

Figure 5 also shows that in Estonia the rank-size slope decreased in 2015, which means that the gap between the observed and the typical rank-size distributions became greater and that the city system became more uneven. This most likely means that the concentration of people was growing at the upper end of the city hierarchy, while relatively fewer and fewer people remained in the smallest cities (this research does not include rural and suburban areas). In contrast, the rank-size slope slightly increased in Latvia, which may reflect the deconcentration trend in Riga. Interestingly, when the capital cities are excluded from the calculations, the city systems almost perfectly follow the Zipfian distribution and the changes over time are less pronounced in all three countries. This means that the capital cities are the main actors in the process of city system change.

Of all the Baltic States, the Lithuanian city system is closest to a typical system, with the rank-size slope 0.82 in 1989 and 0.78 in 2015. It is interesting that the second-rank Lithuanian cities are the only cities in the Baltic States that fit Zipf's law (they even exceed the average values). The changes in Lithuania are also the most visible. It is apparent that the second-rank cities changed their position with respect to the regression line. An important feature is the increased dominance of Vilnius. All of these changes are the response to previous constraints on migration, as discussed above.

To better understand the dynamics of the city system changes, the annual rank-size slopes are shown in Figure 6. The city system of Latvia experienced more rapid change in the first decade, but was very stable during the rest of the period. The city systems of Estonia and Lithuania show a constant and gradual decrease in the rank-size slopes. This indicates that the populations become more and more unevenly distributed within the countries. It is interesting that the trajectory of change is so pronounced in Estonia. It was expected that the Estonian city system would show only minor transformations. The trends in the changes for the Latvian and Lithuanian city systems were as predicted.

Table 4 shows the behaviour of the different city-size categories. The figures show that in Lithuania the greatest changes occurred in the upper end of the city system, suggesting an increasing weight of the capital city. The same trend can be seen in Estonia, while Latvia shows a slight change in the reverse direction, which again confirms the deconcentration trend in Riga. The rank-size slopes have very high values for the medium and small-sized cities in all the countries. This suggests that the city sizes decreased

much more slowly than the power-law predicts. This can be considered a result of the Soviet legacy, since regional planning policy was directed towards balanced territorial development and a network of regional centres was thus established. The weight of these cities declined in the post-Soviet period, although a slightly opposite trend can be found in Latvia. In summary, the upper-end and lower-end cities show different kinds of change. This reflects the ongoing trend towards metropolisation.

Tab. 4: The behaviour of different city-size categories in the Baltic countries, 1989 and 2015

Factors explaining the changing urban hierarchies

The results reported above reveal that the city systems of the Baltic countries followed different trajectories of change in the post-socialist period. This occurred because each city was affected differently by economic, demographic, geographical, political and other factors. Therefore, to understand the mechanisms behind city system change, we need to know what the effects of different factors were on those cities.

The recent study (UBAREVIČIENĖ et al. 2016) has shown that location is the most important factor when explaining the geography of population change in Lithuania. It can be expected that locational characteristics (e.g., distance from the capital city and from the Baltic Sea) also have a strong effect on the variations in population change in the Baltic cities. Other studies have found that the trajectories of population change can be predicted on the basis of a city's size, its past growth, accessibility (e.g. the presence of an airport) and urban functions (e.g. being a mono-city) (CAWLEY 1994; JUŠKEVIČIUS 2015; MURGANTE & ROTONDO 2013). All of the variables mentioned were included in the current study, although limited data availability does not allow to test the effects of many other important characteristics such as demographic structure or economic specialisation.

Table 5 shows four regression models: three countries and a "Baltic case". The results indicate the effects of different factors on population change in the Baltic cities between 1989 and 2015. They show that, firstly, the location of a city with respect to the capital was significant for all three countries: the greater the distance from the capital city, the greater the decrease in population and vice versa. It can be explained by the metropolisation process. Secondly, the effect of the distance from the Baltic Sea coast was significant for Estonia and Lithuania. However, in Estonia an increase in the distance is associated with a population increase, while in Lithuania it is associated with a population decline. This can be explained by the fact that Lithuania has only 100 km of coastline, and one of the major and most prosperous harbour cities is located on the coast, while Estonia has around 3,800 km of coastline, and thus many peripheral regions are adjacent to the Baltic Sea. Thirdly, the regional centres were more likely to decline less in population in Estonia and Lithuania, but the city status had no significant effect on the population change in the Latvian

cities. A variable measuring population change in the cities over a period of 1959-1989 was included to test how the current population dynamics were associated with trends during the Soviet planning period. The rationality of the relationship between two periods of growth might be found in path-dependency theory. The results show that the Lithuanian cities which grew more quickly in the period 1959-1989, were also more likely to grow more quickly (or decline less) in the post-Soviet period. However, no significant differences were found between the Estonian cities. Finally, between 1989 and 2015 mono-cities were more likely to lose more population in Estonia and Latvia, but the effect was reverse in Lithuania. The overall fit of the models is 32 percent in Estonia, 23 percent in Latvia and 33 percent in Lithuania. Although the models do not explain the major share of population change in the Baltic cities, this is a good result considering that the analysis was performed using relatively large and heterogeneous spatial units and did not include more detailed demographic and economic characteristics.

Tab. 5: Linear regression model of percentage population change in the Baltic cities, 1989-2015

Given the proximity and common macro-regional trajectory, we can look at the three Baltic States as to a single system and thus expect that the same factors will have similar effects. The results of the last model show that, in general, the predictive power of such model is lower (22 percent), even with additional variable included - the presence of an international airport. It means that the set of the variables used in this study explain the case of each individual country better. It also goes in line with the hypothesis that the city systems of the Baltic States experience different trajectories of change.

On the other hand, the key factors determining population dynamics are net migration rate and natural change. In Table 6, the results of the regression models with these two parameters included show that natural change has a stronger predictive power for population change than migration rate (except in Latvia, but possibly due to data limitations). It is also the case in the "Baltic case". This means that variations in population change between the Baltic cities are more likely to occur due to natural change than to migration processes. This is a surprising finding because, in post-socialist space, variations in population change are usually associated with migration processes. This might imply that the demographic structure is important, the foundation of which was formed in the Soviet period. However, it is very likely that if the metropolitan regions had been analysed rather than the cities in their administrative limits the results would have revealed the opposite.

Tab. 6: Linear regression model of percentage population change in the Baltic cities, 1989-2015

Conclusion and discussion

This study explored how the city systems changed in the Baltic States in the post-Soviet period, prompted by the specific historical-geographical context of these countries. In this regard, firstly, the Baltic States

experienced a radical shift from Soviet-type communism and centrally planned economies to a capitalist system with market-led economies. Secondly, during this period of transition, they showed very high rates of population decline. Thirdly, different types of city systems formed in these countries during the Soviet period: polycentric in Lithuania, monocentric in Latvia and partly monocentric in Estonia. Despite these specific factors, comparative urban studies on the Baltic States are scarce. This paper addressed this lack by answering the following research questions: Did the systemic changes affect the different city systems in the same way and to the same extent? What is the impact of the factors analysed (location, past growth, etc.) on changing urban hierarchies under the conditions of a market-led economy?

The hypothesis was that the city systems of the Baltic States experienced different trajectories of change after market forces took over, but eventually these city systems should become similar. The results of the research largely confirmed this hypothesis, demonstrating that since the 1990s the city systems in the Baltic States experienced tangible changes, but they varied between the countries. The Lithuanian city system has experienced the greatest transformation. This can be explained by unified settlement planning, which was implemented in Lithuania to a great extent during the Soviet period. As a result of such planning policy, part of the potential growth of the capital city was distributed to other regions of Lithuania. In the post-Soviet period, after a market-led economy was introduced, the population and economic activities started to increasingly concentrate in Vilnius, and the Lithuanian city system thus began transforming from an explicitly polycentric to a monocentric form. In contrast, the Latvian and Estonian city systems, which were already highly monocentric in the Soviet period, retained their monocentricity. In Estonia, the population concentrated in the upper end of the city hierarchy (particularly in Tallinn, but not only). In Latvia, it was interesting to observe a trend of deconcentration from Riga. This is most likely explained by suburbanisation, where large flows of people move from central parts of a city to the surrounding city region. While in the Soviet times the absence of a real estate market and the absence of private property conditioned that suburbs did not exist, now people can express different preferences. The attractiveness of suburban locations, in terms of natural environment and metropolitan potential (associated with jobs and facilities), drew growing numbers of people to the suburbs. Although suburbanization is more intense in Riga (it can be seen in Fig. 2), this is a common feature for all larger metropolitan regions in the Baltic States.

In contrast to the Soviet period, the current development paths of the city systems are little regulated by state regional policies. Since the 1990s, spatial development in all three countries has been highly influenced by the forces of the market economy. This study revealed that location, the status of the regional centre and the growth rate in the past had the greatest influence on population change in the cities in the post-Soviet period. Location with respect to the capital city was of particular importance. This illustrates metropolisation and spatial polarisation trends, a pattern that is consistent with that found in many Central and Eastern Europe countries (BORÉN & GENTILE 2007; LANG et al. 2015). This can be explained

by agglomeration economies that lead to the associated employment opportunities as well as to service provision, especially under the conditions of population decline. This study also showed that the capital cities are the main actors in the process of city system change. The current development trajectories contradict earlier expectations that the city systems would develop in different ways in the Baltic countries (VANAGAS et al. 2002). The prospect of similar spatial organisation should encourage greater cooperation between the countries in creating common regional policies, in particular those related to shrinking cities and regions.

The Soviet legacy still has a significant influence on the current paths of spatial development in the Baltic States. Moreover, it is particularly evident in Lithuania. Those cities which, according to the results of this study, have more favourable positions have a greater chance of maintaining their population in the future. The fact that location is very important also means that it would be difficult to reverse the existing trends, even if they were subject to certain political or economic measures. Thus, the current trends will continue until a certain level of spatial optimisation is reached. A better picture of change could be gained by analysing cities as metropolitan regions. It is most likely that this would reveal an even more pronounced metropolisation trend in the Baltic States. The results of this paper have strengthened the assumption that population redistribution has been greater in the Baltic States than any other FSU or CEE country, although it has not been empirically tested. For further investigation, a comparative study including more case studies should be done.

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References

AMBINAKUDIGE, S. and D. PARISI (2015): A Spatiotemporal Analysis of Inter-County Migration Patterns in the United States. In: Applied Spatial Analysis and Policy, pp. 1-17.

BATER, J. H. (1980): The Soviet City. London.

BERRY, B. J. L. and A. OKULICZ-KOZARYN (2012): The city size distribution debate: Resolution for US urban regions and megalopolitan areas. In: Cities 29, suppl. issue 1, pp. S17-S23.

BERTAUD, A. and B. RENAUD (1997): Socialist Cities without Land Markets. In: Journal of Urban Economics 41, 1, pp. 137-151.

BERZINS, A. and P. ZVIDRINS (2011): Depopulation in the Baltic States. In: Lithuanian Journal of Statistics 50, 1, pp. 39-48.

BORÉN, T. and M. GENTILE (2007): Metropolitan processes in post-communist states: An introduction. In: Geografiska Annaler, Series B Human Geography 89, 2, pp. 95-110.

BUCKLEY, C. (1995). The myth of managed migration: Migration control and market in the Soviet period. In: Slavic Review 54, 4, pp. 896-916.

CAWLEY, M. E. (1994): Desertification: measuring population decline in rural Ireland. In: Journal of Rural Studies 10, 4, pp. 395-407.

CHRISTALLER, W. (1933): Central places in Southern Germany. London.

CINIS, A., M. DRĖMAITĖ and M. KALM (2008): Perfect presentations of Soviet planned space. Mono-industrial towns in the Soviet Baltic Republics in the 1950s-1980s. In: Scandinavian Jurnal of History iFirst Art, pp. 1-21.

CLAYTON, E. and T. RICHARDSON (1989): Soviet Control of City Size. In: Economic Development and Cultural Change 38, 1, pp. 155-165.

COFFEY, W. J. (1998): Urban Systems Research: Past, Present and Future. An Overview. In: Canadian Journal of Regional Science 21, 3, pp. 327-364.

DEMKO, G. J. and J. REGULSKA (1987): Socialism and its impact on urban processes and the city. In: Urban Geography 8, 4, pp. 289-292.

DIJKSTRA, L. and H. POELMAN (2014): A harmonised definition of cities and rural areas: the new degree of urbanisation. In: Regional and Urban Policy. Working paper 1.

EHRLICH, K., A. KRISZAN and T. LANG (2012): Urban Development in Central and Eastern Europe – Between Peripheralization and Centralization? In: disP − The Planning Review 48, 2, pp. 77-92.

EUROSTAT (2016): Migration and citizenship data. European Commission. Retrieved from http://ec.europa.eu/eurostat/web/population-demography-migration-projections/migration-and-citizenship-data/database [16 November 2017].

FAZIO, G. and M. MODICA (2012): Pareto or log-normal? A recursive-truncation approach to the distribution of (all) cities. Retrieved from http://www.gla.ac.uk/media/media_238147_en.pdf [4 October 2017].

GABAIX, X. and R. IBRAGIMOV (2011): Rank - 1/2: a simple way to improve the OLS estimation of tail exponents. In: Journal of Business and Economic Statistics 29, 1, pp. 24-39.

GABAIX, X. and Y. M. IOANNIDES (2004): The Evolution of City Size Distributions. In: Handbook of Regional and Urban Economics 4, 4, pp. 2341-2378.

GENTILE, M., T. TAMMARU and R. van KEMPEN (2012): Heteropolitanization: Social and spatial change in Central and East European Cities. In: Cities 29, 5, pp. 291-299.

GIESEN, K. and J. SÜDEKUM (2011): Zipf's law for cities in the regions and the country. In: Journal of Economic Geography 11, 4, pp. 667-686.

GRAVA, S. (1993): The Urban Heritage of the Soviet Regime - the Case of Riga, Latvia. In: Journal of the American Planning Association 59, 1, pp. 9-30.

HAASE, A., M. BERNT, K. GROSSMANN, V. MYKHNENKO and D. RINK (2016): Varieties of shrinkage in European cities. In: European Urban and Regional Studies, 23, 1, pp. 86-102.

IOANNIDES, Y. M. and H. G. OVERMAN (2000): Zipf's law for cities: an empirical examination. In: Journal of Economic Literature 33, pp. 1-12.

JUŠKEVIČIUS, P. (2015): Lietuvos miestų sistemos raida ir jos ateities perspektyvos [The evolution and future prospects of the Lithuanian urban system]. In: Acta Academiae Artium Vilensis 76, pp. 11-34.

KRUPICKAITĖ, D. (2003): Naujos Lietuvos ir kitų Baltijos šalių miestų sistemų raidos tendencijos [New tendencies of town system development in Lithuania and other Baltic States]. In: Geografija 39, 2, pp. 38-44.

LANG, T., S. HENN, W. SGIBNEV and K. EHRLICH (2015): Understanding Geographies of Polarization and Peripheralization: Perspectives from Central and Eastern Europe and Beyond. London.

LEETMAA, K. and T. TAMMARU (2007): Suburbanization in countries in transition: Destinations of suburbanizers in the Tallinn metropolitan area. In: Geografiska Annaler, Series B Human Geography 89, 2, pp. 127-146.

LÖSCH, A. (1940): The economics of location. New Haven, Connecticut.

MÄGI, K., K. LEETMAA, T. TAMMARU and M. VAN HAM (2016): Types of spatial mobility and the ethnic context of destination neighbourhoods in Estonia. In: Demographic Research 34, pp. 1161-1192.

MARTINEZ-FERNANDEZ, C., I. AUDIRAC, S. FOL and E. CUNNINGHAM-SABOT (2012): Shrinking Cities: Urban Challenges of Globalization. In: International Journal of Urban and Regional Research 36, 2, pp. 213-225.

MURGANTE, B. and F. ROTONDO (2013): A Geostatistical Approach to Measure Shrinking Cities: The Case of Taranto. In: Montrone, S. and P. Perchinunno (eds.): Statistical Methods for Spatial Planning and Monitoring. Milano, pp. 119-142.

MUSIL, J. (2005): City development in Central and Eastern Europe before 1990: Historical context and socialist legacies. In: Hamilton F. E. I., K. D. Andrews and N. Pichler-Milanovic (eds.): Transformation of Cities in Central and Eastern Europe – Towards Globalization. Tokyo, pp. 22-43.

NITSCH, V. (2005): Zipf zipped. In: Journal of Urban Economics 57, 1, pp. 86-100.

PARR, J. (2007): Spatial definitions of the city: Four perspectives. In: Urban Studies 44, 2, pp. 381-392.

PUMAIN, D., E. SWERTS, C. COTTINEAU, C. VACCHIANI-MARCUZZO, A. IGNAZZI, A. BRETAGNOLLE, S. BAFFI (2015): Multilevel comparison of large urban systems. Retrieved from: https://journals.openedition.org/cybergeo/26730 [12 August 2016].

ROSEN, K. T. and M. RESNICK (1980): The size distribution of cities: An examination of the Pareto law and primacy. In: Journal of Urban Economics 8, 2, pp. 165-186.

SCOTT, A. J. and M. STORPER (2007): Regions, Globalization, Development. In: Regional Studies, 41, suppl. issue 1, pp. S191-S205.

ŠEŠELGIS, K. (1996): Teritorijų planavimo raida Lietuvoje [Development of regional planning in Lithuania]. In: Urbanistika Ir Architektūra 21, 1, pp. 4-19.

SOO, K. T. (2005): Zipf's Law for cities: A cross-country investigation. In: Regional Science and Urban Economics 35, 3, pp. 239-263.

STANILOV, K. (2007): The Post-Socialist City: Urban Form and Space Transformations in Central and Eastern Europe after Socialism. Dordrecht.

SÝKORA, L. and Z. ČERMÁK (1998): City growth and migration patterns in the context of 'communist' and 'transitory' periods in Prague's urban development. In: Espace, Populations, Sociétés 16, 3, pp. 405-416.

TAMMARU, T. (2000): Differential urbanisation and primate city growth in soviet and post-soviet Estonia. In: Tijdschrift Voor Economische En Sociale Geografie 91, 1, pp. 20-30.

TERRA, S. (2009). Zipf's Law for cities: On a new testing procedure. Retrieved from http://publi.cerdi.org/ed/2009/2009.20.pdf [9 July 2016]

UBAREVIČIENĖ, R. (2016): Lietuvos gyventojų vidaus migracijų teritoriniai ypatumai 21 a. [Territorial features of internal migration of Lithuanian population in the 21st century]. In: Lietuvos Socialinė Raida: Teritorinis Aspektas 5, pp. 9-24.

UBAREVIČIENĖ, R., M. VAN HAM and D. BURNEIKA (2016): Shrinking Regions in a Shrinking Country: The Geography of Population Decline in Lithuania 2001-2011. In: Urban Studies Research, pp. 1-18.

UNITED NATIONS (2015): World Population Prospects: The 2015 Revision. United Nations, Department of Economic and Social Affairs, Population Division.

VANAGAS, J., Z. KRIŠJANE, R. NOORKOIV and E. STANIŪNAS (2002): Planning urban systems in Soviet times and in the era of transition: The case of Estonia, Latvia and Lithuania. In: Geographia Polonica 75, 2, pp. 75-100.

ZIPF, G. K. (1949). Human Behavior and the Principle of Least Effort: An Introduction to Human Ecology. Cambridge.

Dr. Rūta Ubarevičienė

Institute of Human Geography and Demography

Lithuanian Social Research Centre

Goštauto 9

LT-01108 Vilnius

Lithuania

Delft University of Technology

Faculty of Architecture and the Built Environment

OTB – Research for the Built Environment

PO Box 5030

NL-2628 BL Delft

The Netherlands

R.Ubareviciene@tudelft.nl

Резюме

Рута Убаревичене

Городские Системы Балтийских Стран: Советское Наследие и Современные Траектории Развития
В статье анализируется развитие городских систем стран Балтии (Эстонии, Латвии и Литвы). Развитие городских систем в данных странах представляет собой особый научный интерес, так как, с одной стороны, в определенный исторический момент оно происходило в условиях централизованного планирования СССР, а с другой стороны, современное пространственное развитие данных стран осуществляется в условиях либеральной экономики ЕС. Цель статьи - проанализировать в какой степени переход от централизованной плановой экономики к рыночной экономике повлиял на развитие (изменение) городских систем стран Балтии. Эмпирической базой исследования являются годовые данные численности населения в городах анализируемых стран за период с 1989 по 2015 годы. В рамках данной статьи закон Ципфа принят в качестве отправной точки для изучения распределения размеров городов внутри данных стран, для сопоставления результатов между странами, а также для анализа регулярности и стабильности данного распределения (распределение Ципфа) внутри стран анализируемого региона. Линейная регрессия использовалась для определения влияния факторов, способствующих трансформации городских систем в условиях рыночной экономики. Результаты исследования показали, что, несмотря на то, что современные траектории развития городских систем стран Балтии различны, тем не менее, они демонстрируют сходные тенденции к метрополизации и поляризации пространства. На основании полученных результатов, можно предположить, что пространственно-неравномерное развитие в странах Балтии будет продолжаться, в связи с чем политика регионального развития должна принимать во внимание текущие тенденции. Результаты исследования также позволяют говорить о необходимости более тесного сотрудничества между странами Балтии при формировании политики регионального развития, и в частности, тех ее аспектах, которые связаны с городами и регионами теряющими население.

Балтийские государства; постсоветское развитие; городские системы; депопуляция

Résumé

RUTA UBAREVICIENE

Systèmes de Villes dans les États baltes: l'héritage soviétique et les voies de changement actuelles

Cet article analyse l'évolution des systèmes de villes dans les États baltes (Estonie, Lettonie et Lituanie). Ces pays ont connu une transition entre le royaume de l'Union Soviétique, relativement isolé, et l'Union Européenne, l'une des économies les plus libérales du monde. Cet article a pour objectif d'analyser comment la transition entre une économie centralement planifiée et une économie déterminée par le marché de consommation a influencé la façon

dont les systèmes de villes ont changé. L'étude fait appel aux données annuelles sur la dynamique démographique des villes entre 1989 et 2015. La Loi de Zipf sert de point de référence pour explorer et comparer la répartition des tailles des villes, de même que la régularité et la stabilité de cette répartition dans les États baltes. Une régression linéaire est utilisée pour déterminer l'impact de facteurs pertinents conduisant au changement dans les systèmes de villes, dans des conditions d'économie de marché. Les résultats montrent que, bien que les voies d'évolution actuelles soient différentes dans les États baltes, les pays font montre de tendances similaires pour la métropolisation et la polarisation spatiale. Les résultats de cette étude laissent à penser qu'une évolution spatialement irrégulière se poursuivra dans les États baltes, et que les politiques de développement régionales devront s'aligner sur les tendances persistantes. Les constats auxquels l'étude est parvenue parlent en faveur du développement d'une plus grande coopération entre les États baltes, en créant des politiques régionales, notamment celles relatives à leurs villes et régions en déclin.

États baltes; développement post-soviétique; systèmes de villes; déclin

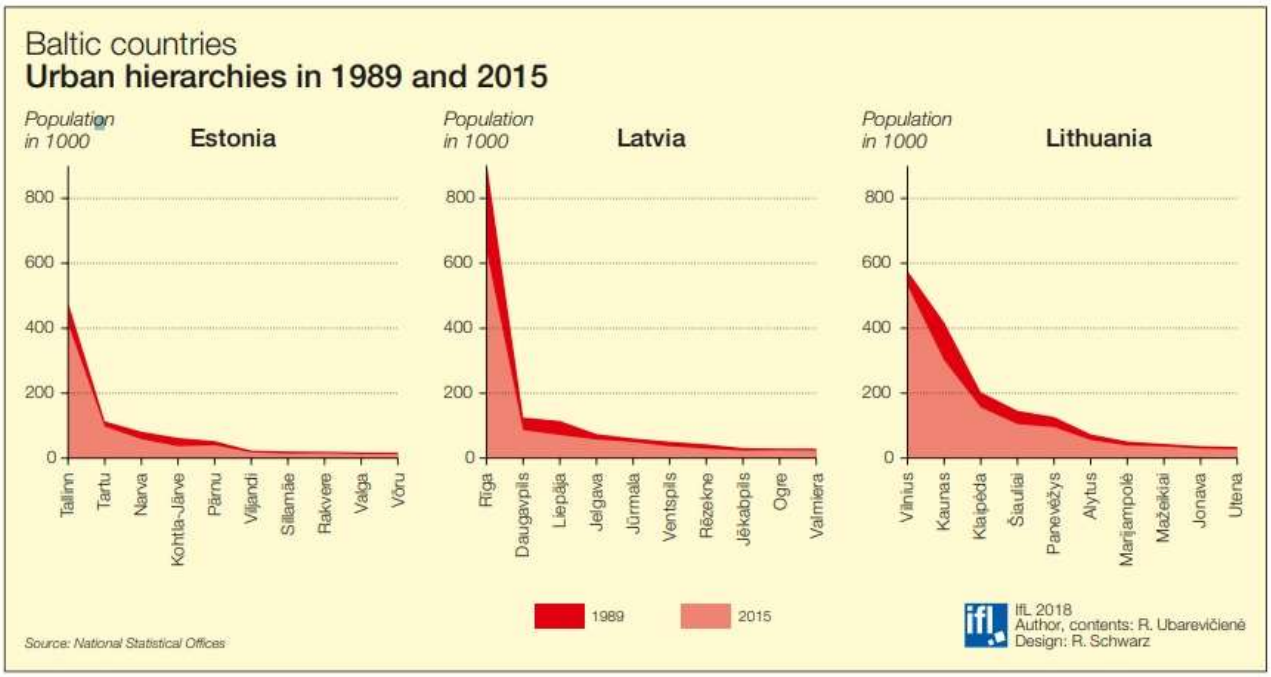


Fig. 1

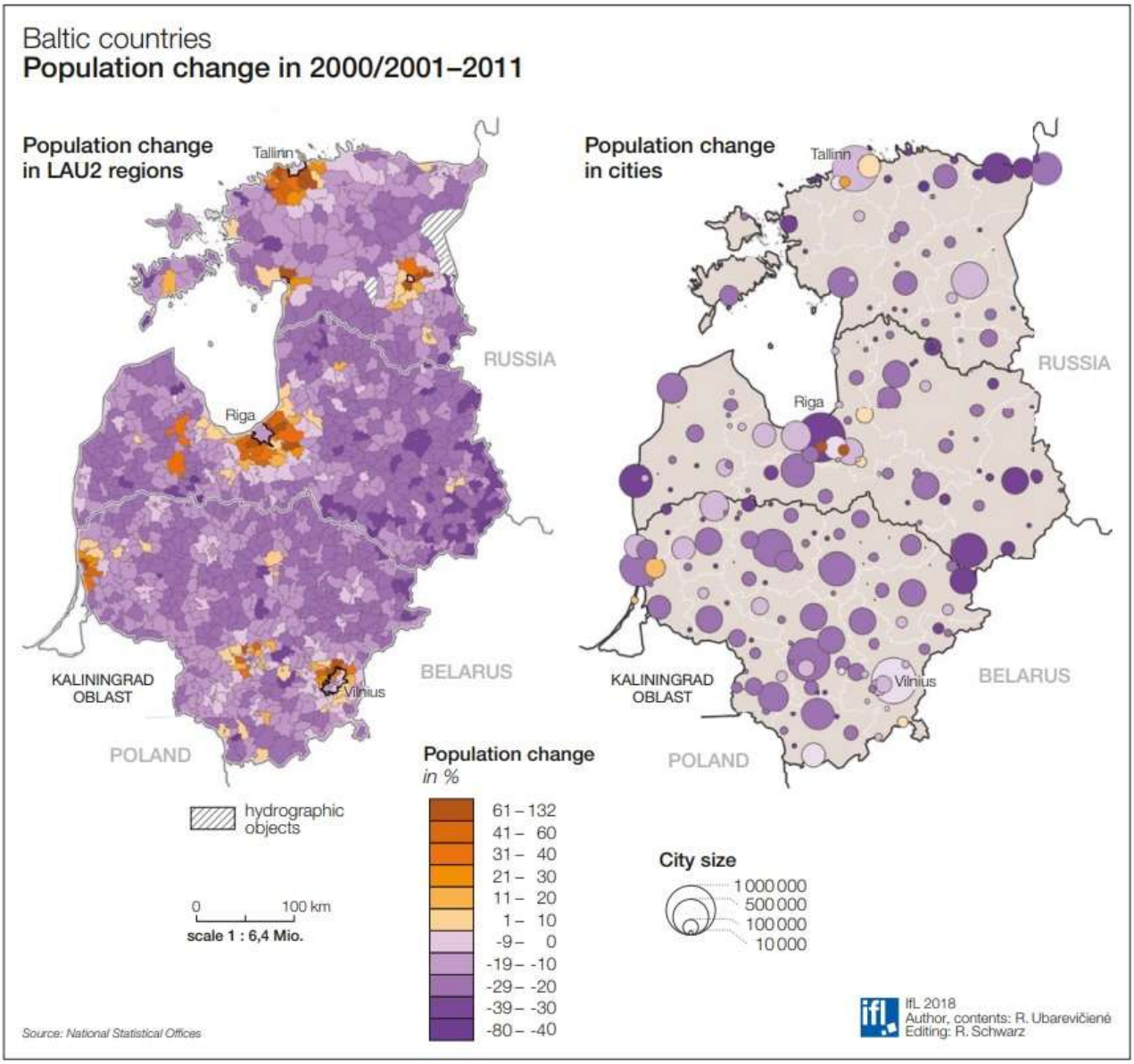


Fig. 2

Comparison of the Baltic countries, 1989 and 2015

Country	Total population			Population of capital city [% from total]			Primacy index		Urbanisation rate	
	1989	2015	Change [%]	1989	2015	Change [%]	1989	2015	1989	2015
Estonia	1,565,662	1,313,271	-16.1	478,974 (30.6)	413,782 (31.5)	-13.6	4.22	4.25	69.8	66.9
Latvia	2,665,770	1,986,096	-25.5	910,445 (34.2)	641,007 (32.3)	-29.6	7.29	7.42	70.0	67.9
Lithuania	3,674,802	2,921,262	-20.5	576,747 (15.7)	531,910 (18.2)	-7.8	1.38	1.77	67.3	67.2

Source: National Statistical Offices

Tab. 1

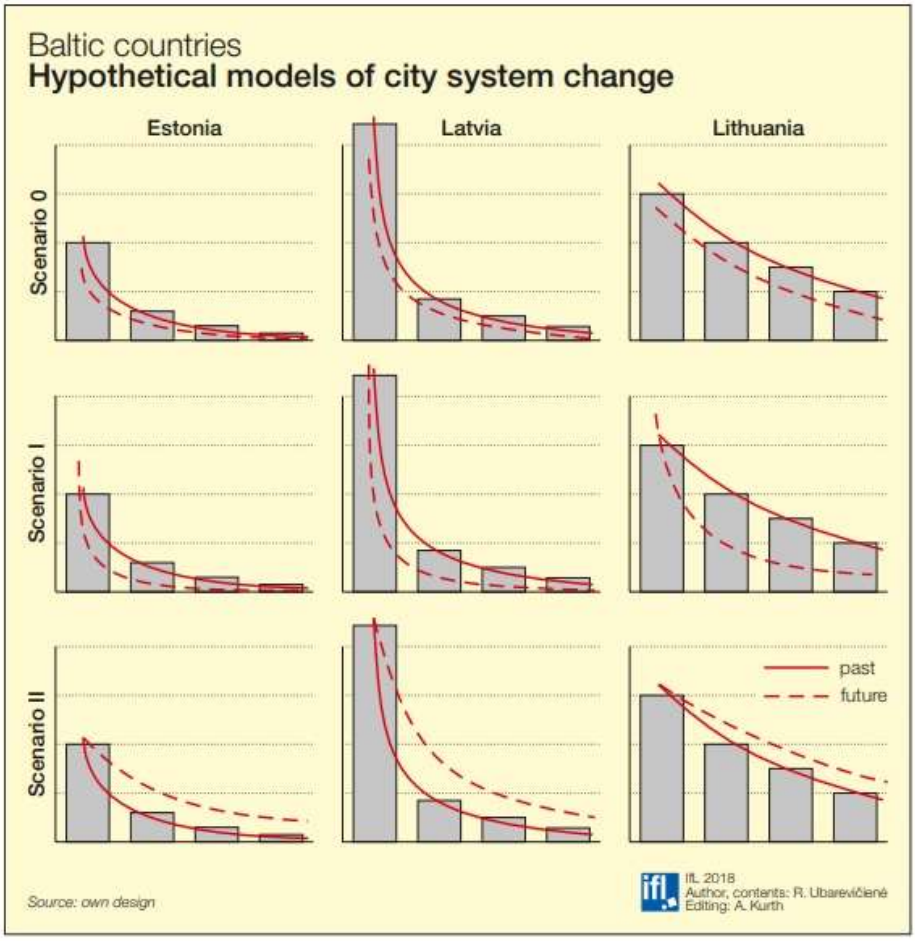


Fig. 3

Variable summary statistics

	Minimum			Maximum			Mean			Standard deviation		
	Est	Lv	Lt	Est	Lv	Lt	Est	Lv	Lt	Est	Lv	Lt
Population change, 1989–2015 *[%]*	-61	-60	-50	28	89	16	-27	-23	-25	14.3	21.1	11.4
Distance from the capital city *[km]*	0	0	0	222	254	299	125	118	143	58.3	61.1	75.6
Distance from the Baltic Sea coast *[km]*	0	0	0	152	247	336	45	81	180	47.3	69.0	89.2
Past growth, 1959–1989 *[%]*	-38	-	-55	528	-	780	74	-	119	97.7	-	143.1
Regional centre	0	0	0	1	1	1	0.4	0.1	0.5	0.5	0.3	0.5
Mono-city*	0	0	0	1	1	1	0.2	0.2	0.2	0.4	0.4	0.4
Airport city**	0	0	0	1	1	1	0.04	0.01	0.03	0.2	0.1	0.2
Average net migration rate, 2001–2015 *[per 1000 inhabitants]*	-36	-14	-27	7	-3	15	-7	-9	-9	7.0	3.6	5.4
Average natural change 1989-2015 *[per 1000 inhabitants]*	-1.5	-0.6	-2.0	0.5	-0.2	0.2	-0.5	-0.4	-0.6	0.4	0.1	0.5

** The status of 'mono-city' was assigned according to expert opinion on each of the Baltic countries. These are cities with a predominant industrial or recreational function. They were developed in the Soviet period and to a large extent they have kept their mono-functional structure to date. There are 10 mono-cities in Estonia, 14 in Latvia and 20 in Lithuania in the dataset of this research.*
*** Only the international airports are included: Tallinn, Tartu, Riga, Vilnius, Kaunas and Palanga.*

Source: National Statistical Offices; author's compilation

Est Estonia Lv Latvia Lt Lithuania

Tab. 2

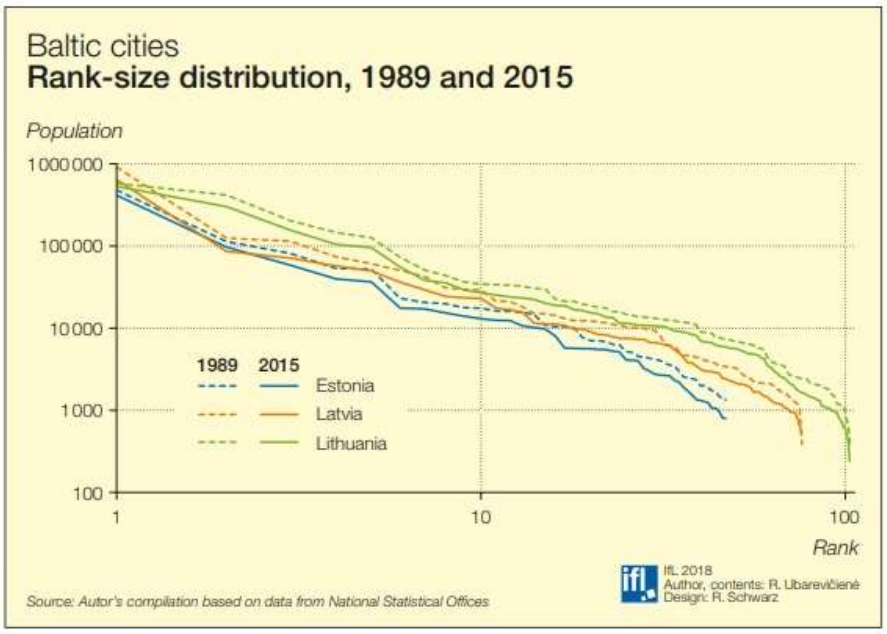


Fig. 4

Goodness-of-fit test (Kolmogorov-Smirnov)
p-values

	Estonia	Latvia	Lithuania
1989	.200*	.009	.087
1999	-	.004	.200*
2000	.200*	.004	.200*
2001	.190*	.004	.175*
2002	.097	.005	.182*
2003	.200*	.017	.187*
2004	.200*	.016	.190*
2005	.195*	.018	.200*
2006	.200*	.023	.200*
2007	.200*	.033	.200*
2008	.200*	.039	.200*
2009	.200*	.047	.200*
2010	.200*	.053	.200*
2011	.200*	.058	.200*
2012	.054	.065	.200*
2013	.045	.084	.200*
2014	.030	.062	.200*
2015	.037	.063	.200*

** A lower boundary of true significance. The sudden changes in the p-values are probably related to administrative changes.*

Source: Author's compilation based on data from the National Statistical Offices

Tab. 3

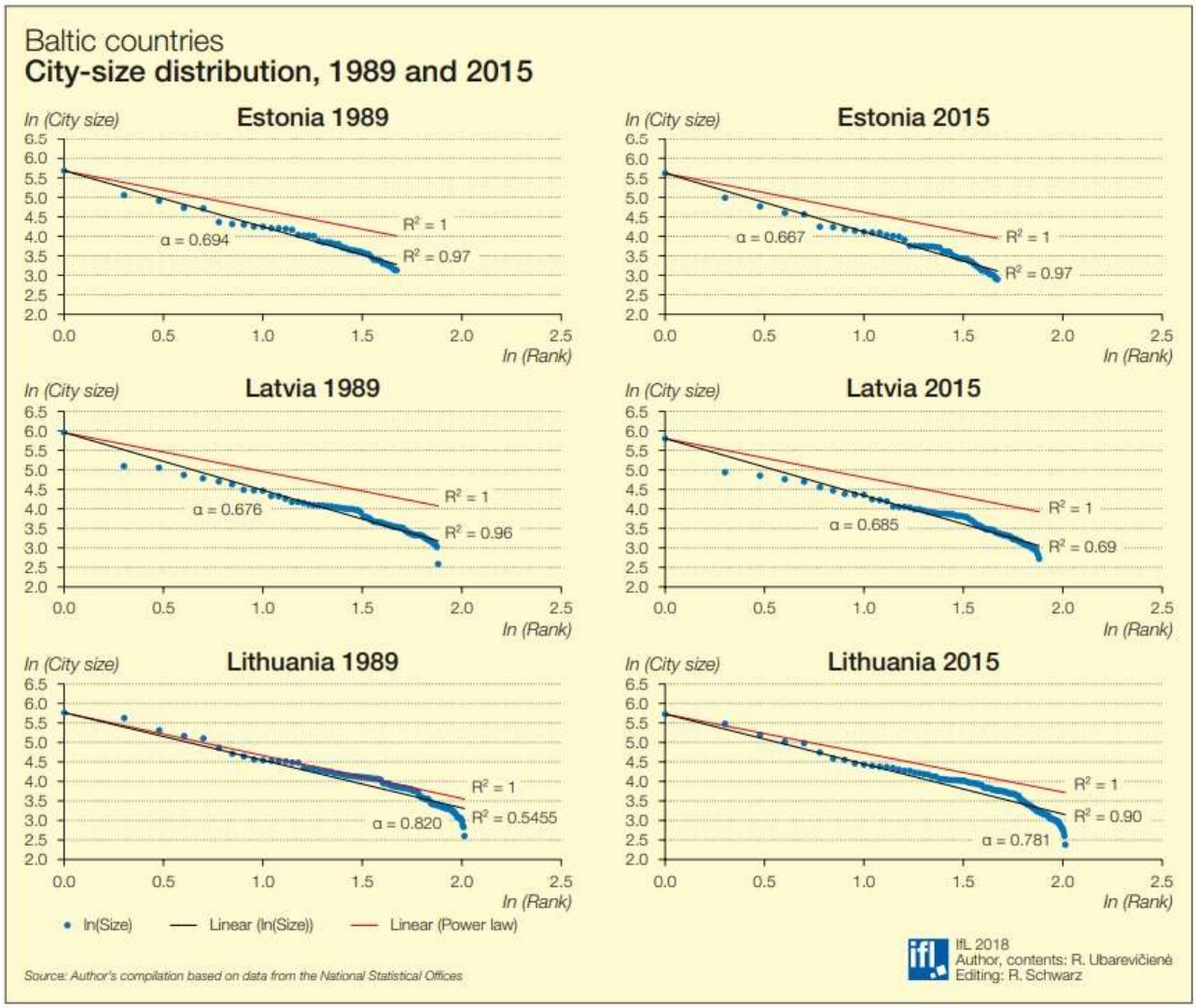

Baltic countries
City-size distribution, 1989 and 2015
Estonia 1989
Estonia 2015
Latvia 1989
Latvia 2015
Lithuania 1989
Lithuania 2015
ln (City size)
ln (Rank)
α = 0.694
α = 0.667
α = 0.676
α = 0.685
α = 0.820
α = 0.781
R² = 1
R² = 0.97
R² = 0.96
R² = 0.69
R² = 0.5455
R² = 0.90
ln(Size)
Linear (ln(Size))
Linear (Power law)
Source: Author's compilation based on data from the National Statistical Offices
IfL 2018
Author, contents: R. Ubarevičienė
Editing: R. Schwarz

Fig. 5

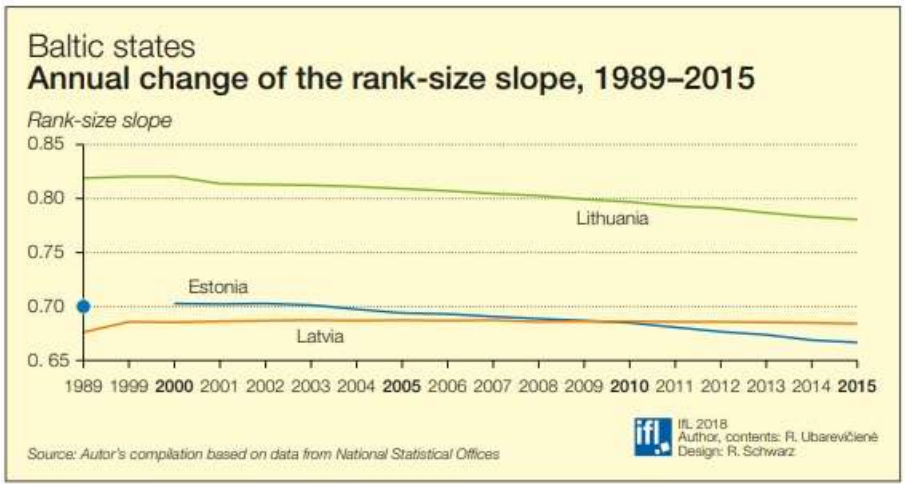

Baltic states
Annual change of the rank-size slope, 1989–2015
Rank-size slope
Lithuania
Estonia
Latvia
1989 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Source: Autor's compilation based on data from National Statistical Offices
IfL 2018
Author, contents: R. Ubarevičienė
Design: R. Schwarz

Fig. 6

Baltic states
The behaviour of different city-size categories 1989 and 2015

City-size catergories *[Inhabitants]*	ESTONIA		LATVIA		LITHUANIA	
	1989	2015	1989	2015	1989	2015
More than 50 thousand	0.649	0.602	0.564	0.573	0.933	0.829
10–50 thousand	3.861	3.436	2.141	2.331	2.809	2.681
Less than 10 thousand	2.725	2.551	2.288	2.309	2.688	2.475

Source: Author's compilation based on data from the National Statistical Offices

Tab. 4

Baltic cities
Linear regression model of percentage population change 1989–2015
according to geographical location and other factors

	Estonia (N = 47)		Latvia (N = 76)		Lithuania (N = 103)		Baltic case (N=226)	
	B	β	B	β	B	β	B	β
Distance from the capital city	-0.097	-0.461***	-0.184	-0.533***	-0.072	-0.473**	-0.021	-0.132**
Distance from the Baltic Sea coast	0.081	0.323**	0.009	0.029	-0.045	-0.350**	0.001	0.009
Regional centre	7.160	0.294**	0.598	0.009	4.832	0.212**	3.639	0.161**
Past growth, 1959–1989[a]	0.018	0.149	-	-	0.026	0.328***	0.032	0.368***
Mono-city	-7.007	-0.237*	-11.337	-0.210*	4.928	0.165*	0.756	0.027
City with international airport[b]	-	-	-	-	-	-	7.854	0.133**
Constant	-22.402		0.102		-13.287		-28.921	
R^2	0.328		0.229		0.331		0.254	
df; significance	44 (5); 0.007		75 (4); 0.001		100 (5); 0.000		158 (6); 0.000	

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

[a] *Data was available for only nine cities under state jurisdiction in Latvia, thus this variable was not included.*
[b] *Data for each country is not included due to a small number of international airports.*

Source: Author's compilation based on data from the National Statistical Offices

Tab. 5

Baltic cities
Linear regression model of percentage population change 1989–2015
according to net migration rate and natural change

	Estonia (N = 47)		Latvia[a] (N = 9)		Lithuania (N = 103)		Baltic case (N=226)	
	B	β	B	β	B	β	B	β
Average net migration rate, 2001–2015 *(per 1000 inhabitants)*[b]	5.333	0.441***	7.610	-0.752**	8.043	0.647***	6.384	0.528***
Average natural increase 1989–2015 *(per 1000 inhabitants)*[b]	8.385	0.527***	-0.295	-0.015	8.626	0.813***	7.906	0.653***
Constant	-29.002		-26.417		-23.905		-25.912	
R^2	0.588		0.554		0.777		0.643	
df; significance	2; 0.000		2; 0.089		2; 0.000		2; 0.000	

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

[a] *Data was available for only nine cities under state jurisdiction in Latvia.*
[b] *A standardised z scores are used.*

Source: Author's compilation based on data from the National Statistical Offices

Tab. 6