2 Shrinking regions in a shrinking country: The geography of population decline in Lithuania 2001-2011

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Abstract

Shrinking populations have been gaining increasing attention, especially in postsocialist East and Central European countries. While most studies focus on specific cities and regions, much less is known about the spatial dimension of population decline on the national level and the local factors determining spatially uneven population change. This study uses Lithuanian census data from the years 2001 and 2011 to get insight into the geography of population change for the whole country. Lithuania has experienced one of the highest rates of population decline in the world in the last decades. The predictive models show that regional factors have a strong effect on the variation in population change throughout the country but also reveal that sociodemographic and economic area characteristics play a role in the process of decline. Our results give little hope to those who would like to reverse the ongoing trends of population change and emphasize the need for spatial planning to cope with the changes. This is an approach which currently does not exist in practice in Lithuania.

Keywords

Population decline; shrinking regions; postsocialist transition; suburbanization; Lithuania

§ 2.1 Introduction

Recently, there has been a wide interest in shrinking cities and regions[11] all over the world. Population decline has consequences for the economic base, labour market, housing market, and the social and technical infrastructures of regions. These consequences are especially severe in the postsocialist states of Central and Eastern Europe (CEE), which experienced some of the highest levels of population loss in the world during the last decades (Haase, Athanasopoulou, & Rink, 2016; Haase, Bernt, Grossmann, Mykhnenko, & Rink, 2016; Hospers, 2012; United Nations, 2015). This loss was conditioned by the profound political, economic and social transformations related to the demise of the Soviet Union at the end of the Nineteen Nineties. The deep economic recession, belated de-industrialization, decline in fertility rates, and massive (job-seeking) out-migration all resulted in a significant population loss in the CEE countries.

Lithuania is one of the leaders in terms of the population decline in the postsocialist region and in the world in general. According to census data, in the period between 1989 and 2011 the country has lost 17.2% of its residents, and the population drop was accelerating over time. The population of the country was just above 3 million in 2011. The broad tendencies of population change are already well known, but the specific drivers of change, and the regional variation within countries have not received much attention in the literature, which often focusses on specific cities or regions. Studies which take a national outlook (Cawley, 1994; Collantes, Pinilla, Sáez, & Silvestre, 2013; Haartsen & Venhorst, 2010; Kupiszewski, Durham, & Rees, 1998; Müller & Siedentop, 2004; Panagopoulos & Barreira, 2012; Wiechmann & Pallagst, 2012) usually limit analysis to particular aspects of decline and do not analyse a broader set of local factors determining spatially uneven population change. In this paper, we argue that uneven population change, with extreme population decline in some areas and a population increase in others, is the outcome of a certain combination of regional characteristics. Therefore, in order to explain the geography of population change, a national level perspective should be employed, which helps to understand the underlying processes and the spatial relationships between them.

The aim of this paper is to get more insight into the geography of population change in Lithuania and to increase our understanding of the regional factors, which contribute

11 In this paper we use term 'shrinkage' to indicate the process of a considerable and constant population loss. The term is also used to indicate employment decline or economic downturn (Hoekveld, 2012; Reckien & Martinez-Fernandez, 2011). We use terms 'shrinkage' and 'population decline' interchangeably in this paper.

to population change. More insight in regional differences in population change and their drivers will help to design coping strategies and policies to deal with especially high population decline. The case of Lithuania will also provide insights for other countries and regions dealing with the effects of population decline. This study uses Lithuanian census data from 2001 and 2011, aggregated in small regions (*seniūnija* corresponding to LAU2 statistical regions). Linear regression models were used to model population change of regions from a set of variables, including geographic, social, demographic, and economic characteristics.

§ 2.2 Literature review on population decline

Haase et al. (Haase, Bernt, et al., 2016) argue that 'the causes of shrinkage are as varied as they are numerous'. Population decline has proved to be a complex and multi-faceted phenomenon, which is highly dependent on political, economic, and social conditions, and therefore inconsistent and usually difficult to predict.

There are two main demographic trends associated with population decline: natural decline and negative net migration. These two trends are closely related and may even accelerate each other. Since spatial variations in births and deaths are generally only small (at least on the national level), most of the population change can be attributed primarily to net migration (Boyle, Halfacree, & Robinson, 1998, p. 45; Martí-Henneberg, 2005). A dominant approach towards understanding flows of people is based on neoclassical economic theory (Abreu, 2010; Arango, 2000; Lewis, 1954; Sjaastad, 1962; Stark & Bloom, 1985). This theory states that labour migration is the result of uneven geographical distribution of labour and capital, and that labour migration is mostly motivated by economic reasons measured by difference in wage levels. Therefore, people generally flow from high-unemployment to low-unemployment regions and from low-wage to high-wage regions. In the neoclassical view, labour migration should eventually lead to a new (spatial) equilibrium of wages (Sjaastad, 1962).

Despite the success of the neoclassical economic model, it has been questioned on a number of counts. It is being noted that economic motives and rational decisions are not the only concerns of migrants. As stated by Blau and Duncan (Blau & Duncan, 1967) 'Men do not flow from places of poor to places of good opportunity with the ease of water'. Institutional (political) constraints, personal characteristics, migration networks (prior links between countries or individuals), stage in the family life-

cycle and other factors are no less influential in determining mobility or immobility. Migration is therefore multi-layered and very complex in its nature. Different aspects of this complexity are being explained by deterministic, humanistic and biographical approaches (Ní Laoire, 2000). The alternative migration theories (e.g., the new economics of labour migration, dual labour market theory, world system theory) assert that migration usually reinforces inequality instead of leading to its reduction (Abreu, 2010; Arango, 2000). Therefore, the differentiation between the migration origin and destination regions (and countries) appears to result in the concentration of people and economic resources in some places and to a decline in other places. Similar mechanisms of increasing regional disparities are also highlighted by regional growth and local development theories (Capello, 2009).

One of the biggest sources of migrants in Western Europe in the last two decades is the postsocialist countries. The reforms in the 1990s opened the borders and lifted restrictions on mobility, causing a massive outflow of people from these countries. Since the movement of people was highly regulated during Soviet times, even within the national borders, the political reforms liberated residential mobility and enabled people to emigrate. The opening of the borders resulted in an increasing migration flows from the postsocialist countries, partly fuelled by an economic recession and high levels of unemployment in these countries. The emigration especially speeded up after the Eastern enlargements of the EU in 2004 and 2007 when many CEE countries became a legal part of the EU; and therefore residents could easily exploit better job opportunities in Western Europe (Kahanec, Zaiceva, & Zimmermann, 2010).

High levels of out-migration are often followed by side effects such as an ageing population and lower birth rates in the 'losing' regions. This is because mainly young people move away and the ageing population is left behind. The initial migrant stream may encourage a second stream, when first migrants are followed by family and friends: this process is called 'chain migration' facilitated by a migration network (Boyle et al., 1998, p. 36). Another side effect of out-migration is so-called 'brain drain', when higher educated people move away (Favell, 2008; Kazlauskienė & Rinkevičius, 2006; Kelo & Wächter, 2004). All of these effects are rather common in the CEE countries, and in many of these countries, the population decline is not limited to a decline in certain regions or cities but affects whole countries. The underlying process is one of 'cumulative causation' processes (first developed by Myrdal (Myrdal, 1957)), which means that once a negative development in an area has started, it is reinforced and thus leads to cumulative effects that make the situation even worse.

There may be many factors resulting in a spatially uneven population change on the national level. Notwithstanding that studies which investigate population decline in all regions in the country are relatively rare, in most cases they only focus on specific

factors determining population change. For example, there are studies which mainly emphasize geographical factors. The relationship between population change and size of place (in terms of population) has been explored by Cawley (Cawley, 1994). It was found that high rates of population decline positively correlates with the small size of places. Other authors have found relationships between population change and population density (Kupiszewski et al., 1998). The impact of the distance to cities and selected urban centres on the spatial pattern of population change was analysed by Niedomysl and Amcoff (Niedomysl & Amcoff, 2011) and Westlund and Pichler (Westlund & Pichler, 2013). These studies showed that peripheral countryside areas had the biggest losses of the population, while metropolitan-adjacent areas experienced expansion. A series of studies pointed out that the surrounding areas of the major cities have the highest potential for population growth and in many countries, especially in CEE countries, these are the only areas gaining population nowadays (Borén & Gentile, 2007; Gentile, Tammaru, & van Kempen, 2012; Nuissl & Rink, 2005; Schmidt, 2011; Sýkora & Ouředníček, 2007; Ubarevičienė, Burneika, & Kriaučiūnas, 2011). Apart from the locational factors, many authors found a relationship between population change and various socioeconomic characteristics of regions and cities. Age structure of the population is one of the most widely discussed factors which influence uneven population change. The age structure reflects the potential of the labour market and the reproductive capabilities of the population. Selective migration of specific age groups often results in an aging rural population and intense population decline (Burholt & Dobbs, 2012; Walford & Kurek, 2008). Meanwhile, family-driven suburbanization directed towards the peripheral areas outside the main cities leads to a younger age structure in these areas (Kroll & Kabisch, 2012). Younger age groups are also more frequently found in inner city areas, which are more viable in terms of economic and cultural life. In line with the neoclassical economic model, many authors emphasize that job and educational opportunities are the most important drivers of migration (Ní Laoire, 2000; Stockdale, 2004). The other factors identified are average incomes, educational level of the population, size and structure of labour market, rate of unemployment, number of enterprises per capita, and level of foreign investments (Niedomysl, 2008; Schmidt, 2011; Tammaru & Sjöberg, 1999; Westlund & Pichler, 2013).

Population decline in postsocialist countries

The massive population decline in the Central and Eastern European (CEE) countries can only be understood within the historical contexts of these countries. From 1945/50 to 1989/91[12], CEE countries were under communist Soviet regime and subject to a command economy model, which was based on the principles of central planning. The countries were isolated from the rest of Europe, with the Iron Curtain as the symbol of the ideological conflict between communism and capitalism. The communist states had very limited relations with the outside world and for most people it was impossible to cross the Iron Curtain. Population movement was also regulated between the communist states and even within the national borders. The communist regime had a strong influence on the spatial distribution of human and economic resources. According to Gentile and colleagues (Gentile et al., 2012), there was an intention to 'annihilate social, economic and regional differences and inequalities, effectively pushing for complete social, economic and spatial homogenization over time'. The communist planning doctrine even extended to controlling the size and hierarchy of cities and aimed at a more even spread of population, without having a dominant city (Bertaud & Renaud, 1997). Even though spatial planning was quite successful, countervailing forces and the reality of the urbanization process did not allow urban planning to achieve this ultimate goal (Bater, 1980; Huzinec, 1978). Some cities were growing much faster than was expected and spatial as well as social disparities remained (Musil, 2005). Although there were variations between CEE countries in terms of the adaptation of communist ideologies, the communist period had a strong impact on the sociospatial organization of these countries and resulted in very different development paths compared to Western European countries.

The collapse of the communist regime in 1989/91 resulted in a new stage of sociospatial development in the region (Musil, 1993; Sailer-Fliege, 1999; Smith & Timár, 2010; Sýkora, 1999). The combined effects of major economic, social, demographic, and political transitions in the last two decades have resulted in large scale emigration and natural population decline, which caused the sociospatial landscape of CEE countries to change in a fast and dramatic way (Stryjakiewicz, Ciesiółka, & Jaroszewska, 2012). While emigration was fostered by the economic recession in the CEE countries and the new possibilities to search for better opportunities (job, education, quality of life, etc.) abroad, the natural decline was prompted not only by the reforms themselves but also by the sudden impact of the

12 The period of the socialism lasted differently in different CEE countries.

second demographic transition[13]. The population decline appeared to be so sudden that some demographers have named it the 'demographic shock' (Eberstadt, 1994; Rychtaříková, 1999; Sobotka, Zeman, & Kantorová, 2003; Steinführer & Haase, 2007). It is interesting that the population loss in most of the CEE countries was accelerating over time, and it was considerably higher in the second decade of the transition period than in the first one. In many countries it can be explained by an increase in (job-related) emigration, which was enhanced after the accession of many CEE countries to the EU (Kahanec et al., 2010). The abolition of political, economic, social, cultural, and psychological barriers and widening social networks abroad contributed to the increasing emigration over time. The fact that younger people are overrepresented among those who left will result in further natural population decline as the population ages while fertility drops.

Despite the general population decline in CEE countries, there is an increasing concentration of people in the major city-regions since 1990s (Borén & Gentile, 2007; Nuissl & Rink, 2005; Sýkora & Ouředníček, 2007), although inner cities themselves also face a declining population (Steinführer & Haase, 2007). Rural regions have seen the most extreme population decline because of the reduced importance of agriculture, which was prioritized under the communist regime (Enyedi, 1998; Leetmaa & Tammaru, 2007; Tammaru, 2001).

Postsocialist transition in Lithuania

Lithuania, Latvia and, Estonia were a legal part of the Soviet Union during 1940-1990/1991[14], were the Soviet principles of central planning were imposed consistently (Aberg, 2005; Borén & Gentile, 2007). The transition period was very sudden from being fully incorporated into the 'self-enclosing' communist system to full exposure to the global economy. Since the very beginning of the postsocialist period the Baltic States encountered major difficulties in reorienting their economies. This economic shift meant that the Baltic States changed their position from relatively affluent and prosperous region in the Soviet Union to the poor periphery of the European Union. The transition period was accompanied by a sharp population decline, which showed one of the highest rates of decline in the world between 1989 and 2011 (Berzins & Zvidrins, 2011).

13 The second demographic transition is mostly characterised by postponing marriage, increased proportion of adults living alone or cohabiting, increased fertility outside of marriage, and delaying or forgoing childbearing, which usually leads to rates of fertility below replacement levels and population ageing (Mayhew, 2015).

14 Lithuania, Latvia and Estonia were incorporated into the Soviet Union under the pact of the Molotov-Ribbentrop in 1940. Lithuania gained independence in 1990 and Latvia and Estonia in 1991.

The recent trends of sociospatial developments are similar between the three Baltic States, where decline of the rural areas and growth and spread of the metropolitan regions are the main features (Cirtautas, 2013; Krupickaitė, 2003; Vanagas, Krišjane, Noorkoiv, & Staniūnas, 2002). On the other hand, the transition period appeared to have different effects on the change of the sociospatial organization of Lithuania compared to the other Baltic States. This was due to the fact that during the Soviet period the unified settlement planning was implemented on a greater extent in Lithuania compared to the other Baltic States. This planning system was based on strengthening the development of regional centres and reducing the dominance of large cities, and it was done through housing and employment policy (people used to live and work in the places where they got assignments) (Bater, 1980; Šešelgis, 1996; Sýkora & Čermák, 1998). In Lithuania, this meant that part of the potential growth of the few larger cities was distributed to other regions of the country, and thereby a polycentric urban system was created. Meanwhile, the urban systems in Latvia and Estonia remained purely monocentric over the Soviet times and thereafter.

The transition to a market led neoliberal economy resulted in a new stage of sociospatial development in Lithuania. Many regions whose growth has been stimulated during the Soviet period became unable to provide sufficient level of employment and standards of living under the new competitive economic conditions. Moreover, after the 1990s the distribution of the population was no longer regulated, and, as a result, the residential patterns started to change. Personal and economic motives of individuals have replaced the communist planning doctrine and became the most important factors influencing population change. Population started to concentrate into the major city-regions, especially in Vilnius. The urban system of Lithuania is evolving into a model where the capital city is dominating, which is typical for the other Baltic States as well.

Under the communist regime without market competition, and in a society with no significant economic and social differences, the Soviet-made territorial organization of Lithuania performed relatively well and was perceived as an achievement of Soviet urban planners (Vanagas et al., 2002). However, the transition to a market led neoliberal economy, strengthening domestic and international competition, processes of globalization, social segregation, and other effects raised a lot of challenges for the inherited territorial organization in Lithuania. This is confirmed by very high rates of international and internal migration, shrinkage of urban and rural areas, intense suburbanization of major cities, and by other urban processes. However, even under such circumstances, the growth oriented development paradigms are still dominant in Lithuania, and planning for decline seldom appears on the agendas of planners and politicians. There is no strategy on how to cope with population change and no dialog exists between politics, planners, and researchers to discuss possible

scenarios for the future. This paper could serve as a starting point for such discussions, describing and explaining the present pattern of population change and evaluating the importance of regional factors in uneven regional development.

§ 2.3 Data and methods

This study uses aggregated data on the low spatial level of *seniūnija* (corresponding to LAU2 statistical regions) from 2001 and 2011 Lithuanian censuses. There were 546[15] spatial units covering Lithuania: 82 of them are classified as urban areas, and the rest are classified as rural areas. The average size of rural *seniūnija* is 135 km^2, with approximately 2820 inhabitants in 2001 and 2470 inhabitants in 2011. The average size of the urban *seniūnija* is 17.4 km^2, with 26,300 inhabitants in 2001 and 20,360 inhabitants in 2011. Since not all of the required data are provided by the censuses, we also used data from Statistics Lithuania, which were only available at the level of the 60 Lithuanian municipalities.

In the descriptive part of the results, we discussed the spatial pattern of population change between 2001 and 2011 in Lithuania. Next, we used linear regression to model population change and to explore the relationship between the rate of the population change (dependent variable) and various territorial characteristics (independent variables). By using linear regression, we were able to test the predictive power of a set of variables and to assess the relative contribution of each variable on the process of population change (Pallant, 2011). Based on a simple regression model with only locational characteristics, we constructed further models in order to find out the underlying explanations for the geographical pattern of population change[16]. The following models contain theory guided variables measuring sociodemographic and socioeconomic characteristics of regions. We used data from 2001 as baseline characteristics. Not all variables considered were reported in the main regression models, because in the preselection process it was found that their influence was negligible. The variables we used can be categorised into locational, sociodemographic

15 In Fact, there were 549 of such administrative-statistical units in 2011. Because over time the spatial borders of some *seniūnija* changed and because we wanted to clearly distinguish urban and rural areas, we had to make some adjustments by combining and separating some units.

16 All the variables were checked for multicollinearity, and there were no risk of that. The models were also checked for collinearity statistics (tolerance, VIF) and there were no violations detected.

and socioeconomic characteristics. We used this distinction in our models. We presented the results of the regression models in tables as well as in maps in which we show the unstandardized predictive values (values that the regression model predicts for the dependent variable when a certain set of independent variables is included) and residuals (the actual value of the dependent variable minus the value predicted by the regression model).

It has to be mentioned that due to the data limitations we could not make the distinction between population change caused by natural change and by net migration. More detailed information would have provided a better understanding of the drivers of change and the role of various local factors. On the other hand, the analysis on the municipal level showed that population change has a high correlation (r=.88) with net migration ratio; thus we can assume that most of the variations in the population change are caused by migration (both internal and outward).

The locational characteristics require some additional explanation. We started using a simple urban-rural distinction to replicate the existing spatial pattern of population change. By using this variable, we aimed to examine how well spatial variation in population change can be explained by an urban-rural distinction. Using dummies we coded all the spatial units into one of the following categories: (1) three largest cities; (2) area within 15 km distance from one of the three largest cities; (3) other cities; (4) area within 15 km distance from a medium city (county capital); (5) area within 15 km distance from a smaller city (municipal capital); reference category – the remaining areas or areas further than 15 km from the cities. During the initial analysis of the data, we observed that the medium and smaller cities had the same rates of population change (decline), and, to limit the number of variables included, we grouped them into the same category. The regions around medium and smaller cities, however, varied in terms of population change. Detailed variable summary statistics for all included variables can be found in Table 2.1.

	MINIMUM	MAXIMUM	MEAN	STD. DEVIATION
Percentage population change, 2001-2011	-41.70	90.90	-14.047	14.041
Urban – rural distinction[a]				
3 largest cities[b]	0	1	0.06	0.235
Areas within 15 km from 3 largest cities	0	1	0.10	0.306
Other cities	0	1	0.09	0.289
Areas within 15 km from medium cities	0	1	0.09	0.281
Areas within 15 km from smaller cities	0	1	0.32	0.466
Seniūnija-level variables				
Mean age in years, 2001	28.37	52.69	39.209	3.168
Percentage working-age (15-64) population, 2001	47.47	79.18	61.78	4.953
Percentage households with children, 2001	13.79	54.56	36.291	6.850
Percentage Lithuanian ethnic group, 2001	2.29	99.92	87.206	23.715
Percentage university education, 2001	8.71	44.18	20.419	6.714
Percentage of employed, 2001[c]	23.22	74.52	47.472	8.441
Percentage joblessness, 2001[c]	2.96	36.47	14.298	5.706
Percentage of employment in 2001 in:[d]				
• Primary sector	0.99	80.82	35.226	20.037
• Industry and construction sector	1.22	49.14	17.921	9.663
• Traditional service sector	3.86	39.46	14.414	6.434
• Business service sector	1.88	42.86	9.297	4.323
• Public administration	5.24	53.42	20.348	6.790
Percentage of high-ranking occupation[e], 2001[d]	4.87	50.26	15.822	6.913
Percentage of receiving social benefits, 2001[c]	2.36	15.78	7.566	2.497
Municipal-level variables				
Average wage, 2001 EUR	195.78	488.30	239.413	50.324
Foreign invest. per capita (EURm), sum 2001-2011	0.01	126.56	9.3022	23.082
Number of economic entities[f] per 1000 person, 2001	7.60	67.50	15.227	4.751
Number of social dwellings per 1000 person, 2003	0.17	35.62	2.1328	1.8753

[a] *Reference = rural areas further than 15 km from the cities.*
[b] *In three largest cities, there are 32 research areas.*
[c] *From the working-age population.*
[d] *From the employed population.*
[e] *The high-ranking occupation group includes managers and professionals (according to the International Standard Classification of Occupations).*
[f] *An economic entity can be any organization or unit in society including state-owned companies, municipal enterprises, private and public companies, associations, and charity organizations.*

TABLE 2.1 Variable summary statistics – 2001 and 2011
Source: Lithuanian census data and Statistics Lithuania (N = 546)

§ 2.4 Results

Descriptive results of population decline in Lithuania

According to the censuses, in the period between 1989 and 2011, Lithuania lost 17.2% of its population. The actual loss could be even higher, because a lot of emigrants do not declare when they leave the country (Civinskas, Genys, Kuzmickaitė, & Tretjakova, 2011). The population decline was almost three times more intense during the second decade of the postsocialist transition period compared to the first one which can be seen as a sign of the delayed consequences of the transition. The spatial pattern of population change between 2001 and 2011 is illustrated in Figure 2.1. The map shows that the range of the population change varies a lot across Lithuania, with some areas almost doubling their population (+91%), while other areas lost close to half of their population (-41%) during the same period[17]. The map clearly shows that the population decreased almost everywhere, except in the areas around the largest cities, where metropolitan growth through suburbanization is taking place since the early 1990s. The sharpest decline in population can be observed in rural areas located further from the cities. 41% of the country's area (in km^2) lost more than 20% of the population during the last decade and only 6% of the country's area did not experience a drop in population. The main reason of population decline in Lithuania was emigration, which accounted for 80-90% of the population loss (Civinskas et al., 2011; Statistics Lithuania, 2012). On the other hand, natural decrease was also high and the total fertility rate in Lithuania was among the lowest in Europe, reaching 1.29 in 2001, although it soon started to increase and converged to the average of the EU in 2012 (1.6) (Eurostat, 2016).

17 In reality, the contrast in the spatial pattern of the population change is higher, because people do not always report the change of the residence. Taking into account the dominant destinations of inner migrations, the residents in the rural areas are more often overrepresented, while residents in the metropolitan areas are under-represented.

If we want to understand the population change as we see it in the map in Figure 2.1, we need to look at the underlying factors. The geographical pattern of population change suggests that certain regional characteristics have a strong effect on the variation in population change throughout the country. Based on the map, we expect that locational factors, which we summarise in an urban-rural classification, will be one of the most important factors in explaining population change, even after controlling for other area characteristics. The distance from major cities also seems to play an important role: areas near larger cities experience population growth and areas further away from cities generally experience a strong decrease in population. Underlying the spatial pattern are also sociodemographic and economic characteristics. Population decline is likely to be highest in those regions with a low percentage of working-age population, a low percentage of households with children, and high levels of unemployment. The spatial pattern of population decline can also be expected to be influenced by the educational level of the population and structure of the labour market. Population is likely to increase in areas with higher share of higher educated people and in areas with increasing employment in the service sector but will decrease in areas with a high percentage of employment in the primary sector (agriculture). In addition, we expect that those areas which receive the highest levels of foreign investments will show a lower decrease in a population.

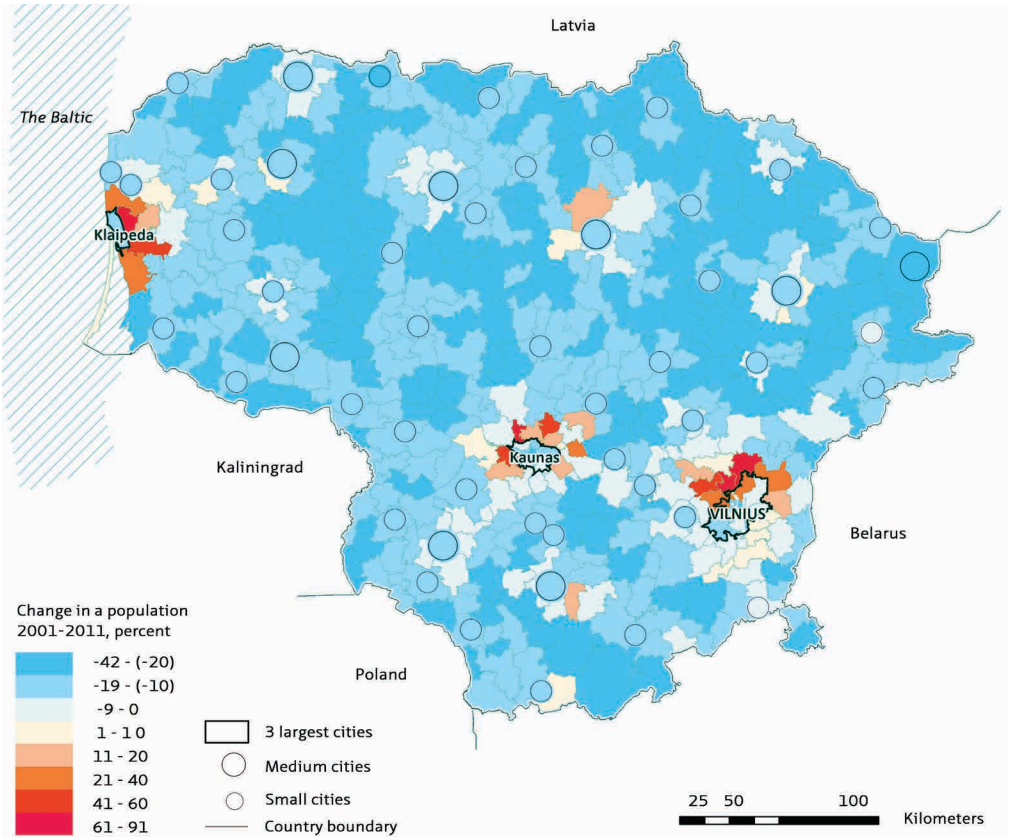

FIGURE 2.1 Population change in *seniūnija* in 2001-2011
Source: own calculations based on the 2001 and 2011 Lithuanian census

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Modelling population change in Lithuania

In order to better understand the causes of the existing spatial pattern of population change, we employed linear regression to model the effect of different territorial characteristics on population change at the level of *seniūnija*. Table 2.2 shows the results of five models of population change. In model 1, we only included an urban-rural classification, with rural areas as the reference category. This simple model already explains 43% of all variation. The results show that the territories around the largest cities are the only areas gaining population. Although the three largest cities themselves are actually losing population, the average rate of this decline is slower than in the other places. The areas around medium-sized cities stand out by the smaller population drop compared to the cities they surround, while the areas around smaller cities show a higher level of population decline. The predicted values of model 1 are mapped in Figure 2.2. Comparison of this map with the map in Figure 2.1 shows how well the model performs. The modelled spatial pattern shows that the urban-rural distinction, city size, and distance to cities are major explanatory factors of population decline.

	MODEL 1	
	B	*BETA*
Locational characteristics (ref = rural areas)		
3 largest cities	13.540	0.227***
Areas within 15 km from 3 largest cities	31.404	0.685***
Other cities	5.999	0.123***
Areas within 15 km from medium cities	9.479	0.190***
Areas within 15 km from smaller cities	3.885	0.129***
Sociodemographic characteristics		
Percentage of working-age population, 2001		
Percentage of households with children, 2001		
Socioeconomic characteristics		
Percentage of university education, 2001		
Change in the percentage of university education, 2001-2011		
Percentage of employed, 2001		
Percentage of employment in business services, 2001		
Change in the percentage of employment in business services, 2001-2011		
Percentage of high-ranking occupation, 2001		
Constant	-20.715	
R^2	0.432	
F(df), significance	540(5), 0.000	
Residual sum of squares (total 107 440)	61 004	
* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.		

TABLE 2.2 Linear regression model of percentage population change at the *seniūnija* level ($N = 546$)

	MODEL 2		MODEL 3		MODEL 4		MODEL 5	
	B	*BETA*	*B*	*BETA*	*B*	*BETA*	*B*	*BETA*
	5.739	0.096**	10.440	0.175***	-1.297	-0.022	-10.784	-0.181***
	26.807	0.584***	26.632	0.581***	17.243	0.376***	13.675	0.298***
	0.301	0.006	1.186	0.024	-4.416	-0.091	-2.133	-0.044
	7.394	0.148***	7.365	0.147***	4.588	0.092***	3.27	0.065**
	2.865	0.095**	2.419	0.080	1.639	0.054	1.342	0.044
	0.631	0.222***	0.129	0.045	-0.354	-0.125	-0.216	-0.076
			0.431	0.210***	0.709	0.346***	0.726	0.354***
					0.517	0.247***	0.436	0.209***
					1.791	0.351***	1.322	0.259***
							0.207	0.125***
							1.596	0.491***
							5.773	0.491***
							-0.269	-0.133**
	-57.705		-42.546		-40.451		-56.005	
	0.453		0.475		0.576		0.633	
	539(6), 0.000		538(7), 0.000		536(9), 0.000		532(13), 0.000	
	58 747		56 390		45 508		39 389	

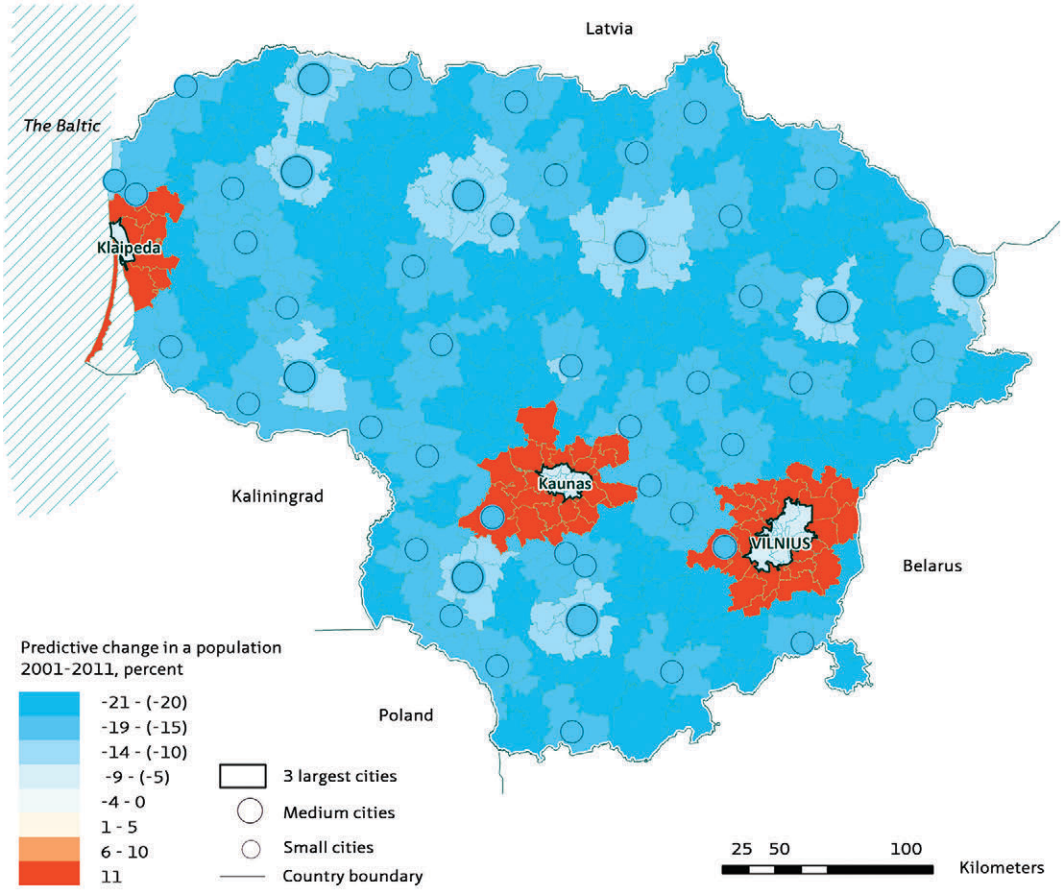

FIGURE 2.2 Predictive population change according to geographical location factor in *seniūnija* in 2001-2011 (based on the outcome of model 1)
Source: own calculations based on the 2001 and 2011 Lithuanian census

In the subsequent models, we sought to examine whether the geography of population decline can be explained by other factors: what are the underlying explanations of the geographical pattern? In model 2, a sociodemographic variable measuring the percentage of working-age population (people aged between 15 and 65) is included. This age group has the highest impact on the population change compared to the other groups (the under-15- and over-65-year-old, results not shown). The higher the percentage of working-age population, the higher the increase in population. Part of this effect is caused by the fact that a large proportion of the working-age population is also in the family formation stage. After controlling for the working-age population, the effect of the three largest cities decreases significantly. This means that the relatively favourable population trajectory of these cities is caused by their favourable age

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composition. According to census data from 2001, in the three largest cities, 64% of the population was of working-age, compared with 59.5% in Lithuania as a whole and 52.7% in rural areas (Statistics Lithuania, 2002). Because of the inclusion of the age composition variable, the effect of the other cities, compared to the reference category of rural areas, diminishes and becomes insignificant in model 2. Thus, when controlling for the age composition, other cities are not statistically different in population change from the rural areas. The effect of suburban areas reduced only slightly after the age composition was included, which suggests that the geographical location of suburban areas is more important than their demographic composition.

Model 3 also includes the percentage of households with children. The higher the percentage of the households with children, the higher the increase in population (or the lower the decrease). This variable partly overlaps with the working-age population (the correlation is 0.625, so multicollinearity is no big issue); therefore the effect of the working-age population decreases when the percentage of households with children is included.

In model 4, we added a variable indicating the percentage of people with university education and a variable measuring the change in the percentage of university educated people between 2001 and 2011. The results show that the higher the share of university educated residents, the higher the population increase in an area. The results also show that an increase in the percentage of university educated residents is associated with an increase in population. This model explains 57.6% of all variation in population change between the areas. After controlling for education, the effect of the largest three cities lost its significance. Therefore, the initial positive effect of the largest cities, in addition to their favourable age structure, can be explained by the higher average levels of education of their population.

An interesting and unexpected finding is that the level of unemployment has no significant effect on the population change in an area (results not shown in Table 2.2, but can be found in the Appendix, Table 2.4). The correlation between population change and unemployment rate was also insignificant in our dataset. An underlying cause might be that unemployment is poorly registered. Many people in Lithuania register themselves as unemployed in order to receive social benefits, while at the same time they might be working informally or have temporarily emigrated abroad. According to many studies, unemployment is a relevant factor determining out-migration and population decline (Ní Laoire, 2000; Panagopoulos & Barreira, 2012; Stockdale, 2004). However, other research has shown that unemployment does not necessarily associate with population decrease (Elshof, van Wissen, & Mulder, 2014; Etzo, 2008; Tervo, 2000).

Finally, model 5 includes some variables measuring labour market characteristics. The results show that the higher the share of employed persons (as a percentage of the working-age population), the lower the population decline. When including employment by economic sector (controlling for all other characteristics), we only found employment in the business service sector to have a significant impact on population change. The higher the percentage of employment in this sector, the higher the population increase in an area. The results also show that an increase in the percentage of employment in business services is associated with an increase in population. In addition, the higher the share of population having a high-ranking occupation (managers and professionals), the higher the increase in population. After controlling for the last set of (labour market) characteristics, the effect of the largest cities and the effect of their suburban areas decreased. It means that those areas have more capacity to hold on and attract population due to a better structure of the labour market. Meantime, the effect of the other cities and the suburban areas (no matter what is the size of the city they surround) did not change much. This result implies that the labour market had little impact on the population change in these areas or that the structure of the labour market is already unfavourable here.

It has to be mentioned that we did not include the ethnic composition of the population in the main models because of the specific geographical composition of ethnic minorities in Lithuania. Due to historical reasons, most of them are concentrated in the Vilnius region (Ubarevičienė, Burneika, & van Ham, 2015), where population is increasing because of the suburbanization process.

Model 5 explains 63.3% of all variation in the data, with a limited set of regional characteristics. This is a good result, especially since the size of the spatial units is relatively large and there is little homogeneity within them. Other studies, which used linear regression to model similar social processes, found similar levels of prediction (van Ham & Clark, 2009). When we map the predicted values of model 5 (see Figure 2.3), we see that the model performs really well and replicates the pattern of real population change as observed in Figure 2.1. The model which only included locational factors already explained 43% of all variation between the areas, while a model which only included a set of sociodemographic and economic characteristics explains 53.3% of all variation (see Table 2.3 in the Appendix). When we map the predicted values without locational characteristics (Figure 2.4 in the Appendix), we do see the effects of cities and the surrounding areas, but such model fails to identify smaller population decline in the more distant suburban areas of the larger cities. This indicates that these suburban areas have a certain 'locational advantage' over other places with regard to how attractive they are to live in. So, geography, and mainly distance to the three main cities, plays a role on top of sociodemographic and economic area characteristics. This relates back to the ongoing transformations of the urban network (mainly metropolitan growth) as discussed in the theoretical part of this paper.

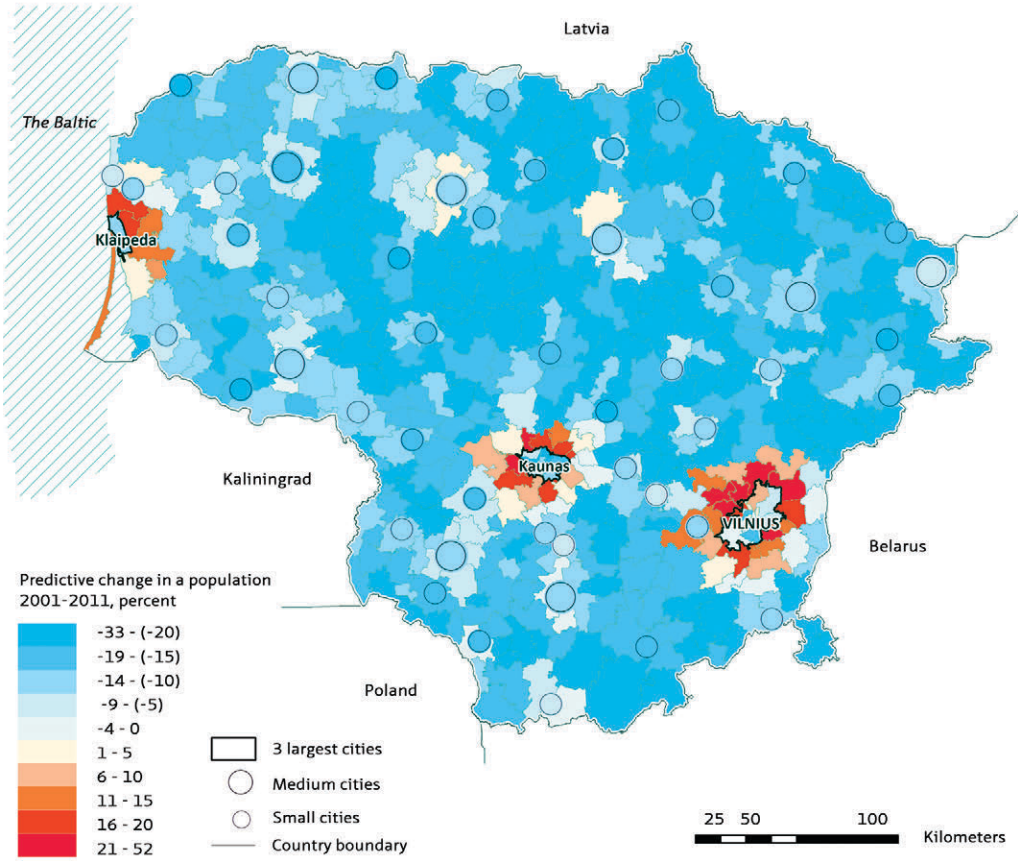

FIGURE 2.3 Predictive population change according to geographical location and socioeconomic factors in *seniūnija* in 2001-2011 (based on the outcome of model 5)
Source: own calculations based on the 2001 and 2011 Lithuanian census

The results of the cartographical analysis showed that all predictive models are less accurate in the areas, where the actual population change was the most extreme. How well the models performed can be illustrated by mapping the residual values of each model (see Figure 2.5 in the Appendix). The mapped residuals show that the models performed less well in the suburban areas around the largest cities (and even the smaller cities), which experienced population increase. The model with only locational characteristics mostly overestimates population change in the suburban areas, while the model which includes only social and economic factors mostly underestimates them. Although the final model (Model 5) performs the best, the highest residual values remain to be found in the suburban areas. This finding suggests that there might be more factors influencing population change in the suburbs, which we could not include in our models, or that these areas are less homogenous than others, and therefore less predictable.

Many other variables were included in the preliminary analysis, but they were excluded from the final models as presented, since they did not improve the predictive power of the models. We have tested models with more detailed information on unemployment levels, the use of social benefits, average wages, foreign investments, the number of economic entities, and social housing (the last four variables were only available at the municipal level due to limited access to the lower level data). However, none of these variables were significant in the models. The extended model, including all characteristics, can be found in Table 2.4 in the Appendix.

§ 2.5 Conclusions and discussion

Lithuania is losing population at increasing rates since the political reforms of the early Nineteen Nineties, and it is now among the fastest shrinking countries in the world. Our analyses showed that the population decline is unevenly distributed throughout the country. The highest rates of depopulation were recorded for the rural and peripheral areas of Lithuania; meanwhile, population increases could be observed in the regions directly surrounding the major cities. Although all CEE countries experienced similar trends of spatial development, the urban structure developed during the Soviet times makes the spatial variations in population change more profound in Lithuania compared to the other countries. The main reason was that the largest cities in Lithuania were relatively underdeveloped as they lagged behind in their 'natural' growth.

The main aim of this paper was to get more insight into the geography of population change in Lithuania and to increase our understanding of the factors which contribute to population change. A novelty of the study was that we investigated shrinkage for a whole country, using data at a very low spatial level (*seniūnija*), where most other studies use much larger municipalities. Moreover, this is one of the first studies to use the 2011 Lithuanian census. In our linear regression models, we included two types of area characteristics: a detailed urban-rural classification and a range of sociodemographic and economic characteristics. Our main hypothesis was that the urban-rural distinction would be the most important predictor of variation in population change between regions.

Our results show that the geographical pattern of population decline is highly structured and that city size and distance to cities are important factors in explaining this pattern. The model with only the locational factors included already explained

43% of all variation in population change between regions. Thus, the hypothesis that the geographical location is an important predictor of the population change can be supported. In line with the literature, we found that the age structure and the household structure (percentage of households with children) of the population are important sociodemographic characteristics playing a role in the process of decline. The higher the percentage of working-age population and households with children, the lower the population decline. Moreover, the higher the share of university educated residents, the higher the population increase in an area. An interesting and unexpected finding is that the percentage of joblessness has no significant impact on population change; however, an underlying cause might be poorly registered unemployment. Our results also showed that the higher the percentage of employment in the business service sector and the higher the share of the residents with high-ranking occupations, the higher the population increase. We did not find a significant relationship between jobs in other sectors of the economy (agriculture, industry, traditional services, and public administration) and population change, when controlling for other characteristics. Moreover, the analysis showed that the level of foreign investments is not an important factor predicting population change. Our final regression model explained 63.3% of all variation in the data. Our analysis of predicted values and associated residuals showed that our models performed less well in the suburban areas directly surrounding the largest cities. This suggests that there are processes at play that could not be captured using the variables we included.

To conclude, the geographical pattern of population change clearly shows that the areas directly surrounding larger cities are increasing in population, while rural and peripheral areas are experiencing extreme population decline. Our results give little hope to those who would like to develop policies to stop this decline outside metropolitan regions. Geography seems to be very important factor explaining population change. Lithuania can be seen as a large experiment of urban development and population redistribution. Under Soviet rule and a centrally planned economy, policies were aimed at actively redistributing population away from the largest cities and towards regional cities and rural areas. This policy was more explicit in Lithuania than in other CEE countries and was aimed at reducing the dominance of the capital city of Vilnius. However, after the early 1990s and the fall of the Soviet regime, market economic forces took over and despite large scale emigration from Lithuania, the three largest urban regions started to grow. Most population growth was experienced in the suburban rings of these cities. This indicates that the preferences of households developed in the direction of the suburbs, a process which could be observed decades before in Western European cities. Based on our results, we believe that the process of decline will not stop soon in Lithuania. We now observe that the population is concentrating in the metropolitan regions; this process is fuelled at the expense of the rest of the country. However, the capacity of the regions, in terms of human recourses,

is decreasing; thus the migration towards the metropolitan areas will drop, and the population in these regions will stop growing or even may start to decline as well (if no major changes in international migration occur).

Although the attention to population decline is increasing in Lithuania, most of the regional planning is still growth oriented. Local politicians and planners do not seem to accept that population decline might be an unavoidable process, common to many European regions, but manifesting strongly in Lithuania. There are no well-developed plans or strategies to adapt to the shrinkage. As the population of the whole country is declining, attracting new residents to one declining area would mean more decline in other areas. As in other (Western) European countries, the current investments into declining regions (e.g., in transport infrastructure and school renovation) are costly and ineffective. It is interesting that although the population decline in Lithuania is quite extreme, the economy of the country is still growing. This can be explained by the increasing productivity of the labour force and the positive role of internal migration with young people moving to cities. On the other hand, the growing economy is one of the excuses for the government not to take any steps in managing the structural process of population. Depopulation will inevitably lead to negative consequences, especially in peripheral regions, which are rapidly losing their human capital. Without any strategy to cope with shrinkage, population decline might even pose a threat to the stability of the economy and the society of Lithuania, especially when regional levels of inequality are rising and people in declining areas feel left behind by the national government.

We believe that spatial planning policies – which are currently lacking – could play a major role in dealing with decline, but the challenge is how to keep a good balance between the needs of the residents and financial capacities of the state. One of the areas that need urgent attention is the network of public amenities. This network was designed for a population of 4 million people and was fairly evenly distributed across the country, while the current population is 3 million and more and more concentrated in cities. Although the reorganization of infrastructure and services has already started, it lacks consistency, rationality, and efficiency. To cope with the population decline, regional centres must be formed with concentrations of a variety of high quality services, accessible by (public) transport for all residents. This is a strategy used by many Western countries. At the same time, it is important to develop financial instruments to improve employment and housing opportunities for young people and families to encourage them to stay in the provinces or at least in the country.

The development of alternative economic activities, especially those requiring a lotof space or a natural environment (e.g., alternative energy and tourism) or activities focussed on the 'silver economy'[18] of population aging, could create new jobs. Economically, it might make most sense to plan for further population concentration in Lithuanian cities, as this is the most cost-efficient in terms of services and infrastructure. In declining areas, the most efficient strategy would be to accept decline and concentrate services in accessible regional centres.

Acknowledgments

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18 The silver economy is a concept that has emerged in response to ageing demographics (European Commission, 2015).

Appendix

	MODEL 1	
	B	*BETA*
Sociodemographic characteristics		
Percentage of working-age population, 2001	1.192	0.420***
Percentage of households with children, 2001		
Socioeconomic characteristics		
Percentage of university education, 2001		
Change in the percentage of university education, 2001-2011		
Percentage of employed, 2001		
Percentage of employment in business services, 2001		
Change in the percentage of employment in business services, 2001-2011		
Percentage high-ranking occupation, 2001		
Constant	-87.676	
R^2	0.177	
F(df), significance	544(1), 0.000	
Residual sum of squares (total 107 440)	88 449	
* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.		

TABLE 2.3 Linear regression model of percentage population change at the *seniūnija* level (*N* = 546)

	MODEL 2		MODEL 3		MODEL 4	
	B	*BETA*	*B*	*BETA*	*B*	*BETA*
	0.748	0.264***	-0.224	-0.079	-0.314	-0.111*
	0.513	0.250***	0.879	0.429***	0.979	0.478***
			0.246	0.118*	0.291	0.139*
			2.661	0.521***	2.031	0.398***
					0.116	0.07*
					1.475	0.454***
					5.448	0.464***
					-0.346	-0.17***
	-78.899		-51.620		-52.557	
	0.215		0.461		0.533	
	543(2),0.000		541(4), 0.000		537(8), 0.000	
	84 339		57 961		50 125	

	MODEL 1	
	B	*BETA*
Geographical characteristics (ref = rural areas)		
3 largest cities	13.540	0.227***
Areas within 15 km from 3 largest cities	31.404	0.685***
Other cities	5.999	0.123***
Areas within 15 km from medium cities	9.479	0.190***
Areas within 15 km from smaller cities	3.885	0.129***
Sociodemographic characteristics		
Percentage of working-age population, 2001		
Percentage of households with children, 2001		
Socioeconomic characteristics		
Percentage of university education, 2001		
Change in the percentage of university education, 2001-2011		
Percentage of employed, 2001		
Percentage of employment in business services, 2001		
Change in the percentage of employment in business services, 2001-2011		
Percentage of high-ranking occupation, 2001		
Percentage of joblessness, 2001		
Percentage of employment in industry and construction sector, 2001		
Percentage of employment in traditional service sector, 2001		
Percentage of employment in public administration, 2001		
Percentage of receiving social benefits, 2001		
Municipal-level variables		
Average wage, 2001		
Foreign investments per capita 2001-2011		
Number of economic entities per 1000 person, 2001		
Number of social dwellings per person, 2003		
Constant	-20.715	
R^2	0.432	
F(df), significance	540(5), 0.000	
Residual sum of squares (total 107 440)	61 004	
* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.		

TABLE 2.4 Linear regression model of percentage population change at the *seniūnija* level (*N* = 546)

	MODEL 2		MODEL 3		MODEL 4	
	B	*BETA*	*B*	*BETA*	*B*	*BETA*
	-10.784	-0.181***	-12.568	-0.21***	-12.429	-0.208***
	13.675	0.298***	12.011	0.262***	12.084	0.263***
	-2.133	-0.044	-3.938	-0.081*	-3.917	-0.081*
	3.27	0.065**	2.681	0.054*	2.497	0.05*
	1.342	0.044	1.054	0.035	1.129	0.037
	-0.216	-0.076	-0.313	-0.11*	-0.32	-0.113*
	0.726	0.354***	0.727	0.355***	0.706	0.345***
	0.436	0.209***	0.353	0.169**	0.39	0.186**
	1.322	0.259***	1.21	0.237***	1.225	0.24***
	0.207	0.125***	0.225	0.135***	0.218	0.131***
	1.596	0.491***	1.551	0.478***	1.536	0.473***
	5.773	0.491***	5.664	0.482***	5.592	0.476***
	-0.269	-0.133**	-0.218	-0.107	-0.24	-0.118*
			0.041	0.017	0.04	0.016
			0.027	0.019	0.025	0.017
			0.178	0.082*	0.173	0.079*
			-0.034	-0.016	-0.03	-0.015
			-0.259	-0.046	-0.286	-0.051
					-0.01	-0.035
					0.033	0.055
					-0.105	-0.035
					0.163	0.022
	-56.005		-49.523		-44.980	
	0.633		0.638		0.640	
	532(13), 0.000		527(18), 0.000		523(22), 0.000	
	39 389		38 855		38 673	

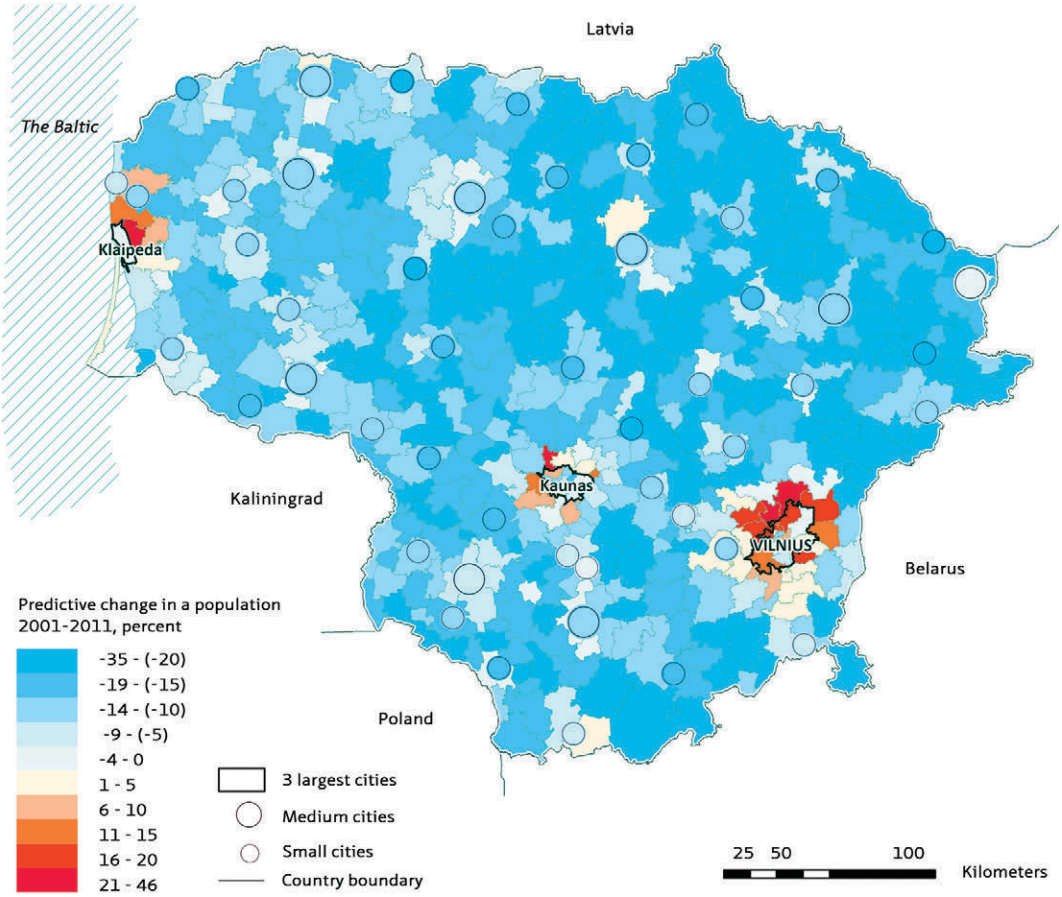

FIGURE 2.4 Predictive population change in *seniūnija* in 2001-2011 (based on model 4 in Table 2.3)
Source: own calculations based on the 2001 and 2011 Lithuanian census.

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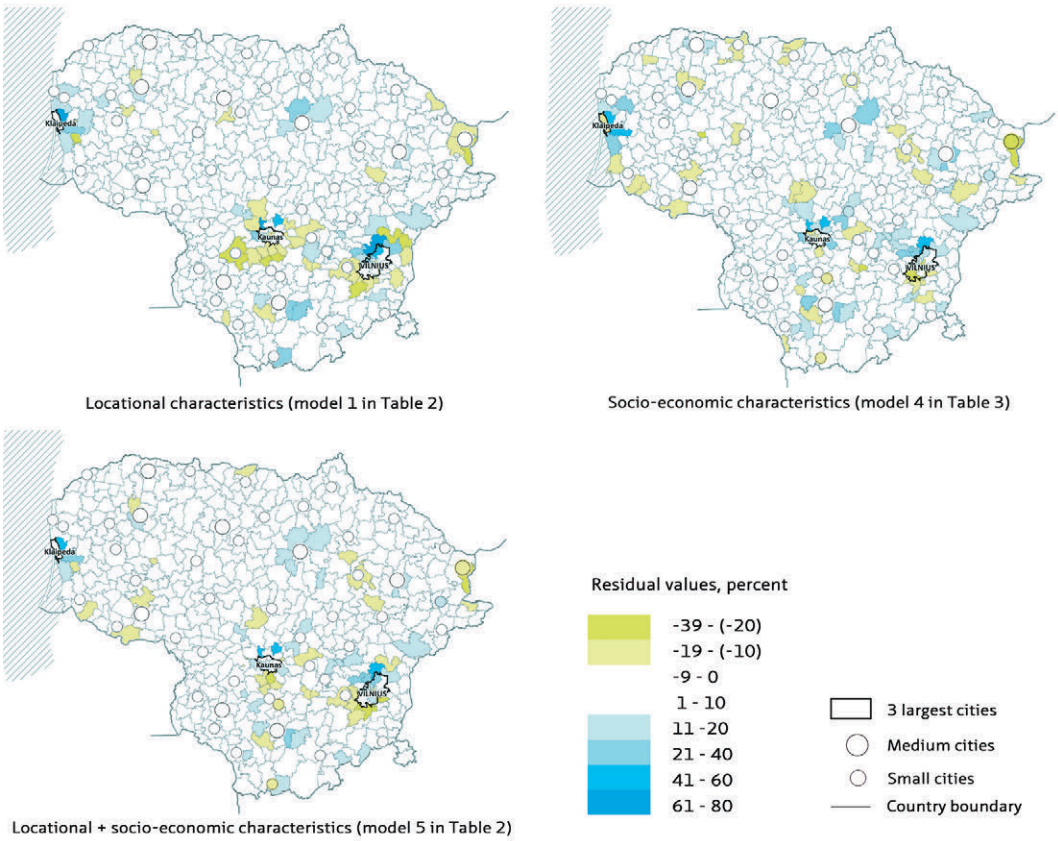

FIGURE 2.5 Residuals of various models
Source: own calculations based on the 2001 and 2011 Lithuanian census

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