

LATVIJAS UNIVERSITĀTE

BIZNESA, VADĪBAS UN EKONOMIKAS FAKULTĀTE



ROLE OF THE SOCIOECONOMIC FACTORS AND REGIONAL POLICY  
IN THE DEMOGRAPHIC DEVELOPMENT OF LATVIA

SOCIĀLI EKONOMISKO FAKTORU UN REĢIONĀLĀS POLITIKAS LOMA  
LATVIJAS DEMOGRĀFISKAJĀ ATTĪSTĪBĀ

DOCTORAL THESIS

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- CBR – CRUDE BIRTH RATE
- CDR – CRUDE DEATH RATE
- CCC – CROSS-SECTORAL COORDINATION CENTRE
- CF – COHESION FUND
- CFCA – CENTRAL FINANCE AND CONTRACTING AGENCY
- CP – COHESION POLICY
- CSB – CENTRAL STATISTICAL BUREAU
- EAFRD – EUROPEAN AGRICULTURAL FUND FOR RURAL DEVELOPMENT
- EFF – EUROPEAN FISHERIES FUND
- EPRC – EUROPEAN POLICIES RESEARCH CENTRE
- ERDF – EUROPEAN REGIONAL DEVELOPMENT FUND
- ESF – EUROPEAN SOCIAL FUND
- ESIF – EU STRUCTURAL AND INVESTMENT FUNDING
- EU – EUROPEAN UNION
- FDI – FOREIGN DIRECT INVESTMENT
- GCI – GLOBAL CREATIVITY INDEX
- GDP – GROSS DOMESTIC PRODUCT
- GFR – GENERAL FERTILITY RATE
- GIS – GEOGRAPHIC INFORMATION SYSTEM
- GWR – GEOGRAPHICALLY WEIGHTED REGRESSION
- ITI – INTEGRATED TERRITORIAL INVESTMENT
- LAU – LOCAL ADMINISTRATIVE UNIT
- LBC – LATGALE BUSINESS CENTRE
- LISA – LOCAL INDICATORS OF SPATIAL AUTOCORRELATION
- LM – LINEAR REGRESSION MODEL
- MoEPRD – MINISTRY OF ENVIRONMENTAL PROTECTION AND REGIONAL DEVELOPMENT OF THE REPUBLIC OF LATVIA
- MoF – MINISTRY OF FINANCE OF THE REPUBLIC OF LATVIA
- MRP – RATE OF MISSING REGISTERED POPULATION
- NDP – NATIONAL DEVELOPMENT PLAN
- NUTS – CLASSIFICATION OF TERRITORIAL UNITS CREATED FOR THE PURPOSES OF EU STATISTICS

OCMA – OFFICE OF CITIZENSHIP AND MIGRATION AFFAIRS  
OECD – ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT  
OLS – ORDINARY LEAST SQUARES  
OP – OPERATIONAL PROGRAMME  
PR – PLANNING REGION  
R&D – RESEARCH AND DEVELOPMENT  
RDIM – REGIONAL DEVELOPMENT INDICATORS MODULE  
SDM – SPATIAL DURBIN MODEL  
SEM – SPATIAL ERROR MODEL  
SF – STRUCTURAL FUNDS  
SLM – SPATIALLY LAGGED MODEL  
SMR – STANDARDISED MORTALITY RATE  
SRDA – STATE REGIONAL DEVELOPMENT AGENCY  
SSO – SPECIAL SUPPORT OBJECTIVE

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## INTRODUCTION

### *Topicality*

Debate on the importance of the causal relations between regional demographic development and specific sets of socio-economic factors has been reappearing with noteworthy regularity over the last decades within both academic and political communities. While the local social and economic conditions have always been considered among core determinants of regional population change and included in most studies and surveys conducted in Latvia since 1936 (e.g. see Valsts statistiskā pārvalde, 1939), the overall attention to this topic has been notably growing throughout the European Union (EU) since the introduction of cohesion policy (CP) and the associated objectives of regional convergence among EU Member States.

The pressing need to better understand the relations between local socio-economic and demographic dynamics and account for it in the national and the EU-wide regional policy response was repeatedly underlined by many recent studies, including those carried out by Martin Ferry and Heidi Vironen (2010) at the European Policies Research Centre (EPRC) and Gabriella Fesus et al (2008) at the European Commission. Furthermore, new terms and disciplines like “Spatial Demography” were created, and lately - similar to the well-known and long-standing field of “Regional Economy”, some scholars have theorised the term “Regional Demography”. Irrespective of the name, most authors tend to agree that regional and spatial thinking, as well as spatial analysis perspectives have important roles to play in understanding the fundamental links between socio-economic conditions, policy response and demographic development, while helping to uncover new and previously unseen dimensions of existing regional development problems, as suggested by the renown American demographer and pioneering spatial analyst Paul R. Voss (2007), and supported by famous spatial sociologist John R. Logan and his colleagues at Brown University (2010).

The recent surge of interest in adding a regional perspective to the classical demographic studies is also driven by the increased availability of quantitative and qualitative data on the population dynamics, the associated socio-economic conditions and other underlying factors on the regional and local (sub-regional) territorial levels. This interest is fuelled even further by the ever-increasing availability of new methodologies for analysis and representation of such data including latest developments of the spatially adjusted econometric models and Geographic Information Systems (GIS).

In addition to the regional/spatial dimension, yet another plane of analysis may prove to be relevant for understanding the fundamental interactions of socio-economic environment, policy and population development, namely - time. American economist Elizabeth Brainerd (2010) argues that while most contemporary demographic problems in the Western European countries are a result of long-term social, economic and natural processes, the formerly socialist countries of Eastern Europe and the former Soviet Union are relatively new to these issues, as they have experienced a remarkable demographic transformation during just the past decades. In terms of population development, this is a relatively short period, which means that the underlying strengths and weaknesses of the national, regional and sub-regional demographic development in many new EU Member States, including Latvia, should be evaluated in not just spatial, but also temporal context.

While, adding such set of additional dimensions to the traditional demographic analysis may be considered a debateable and controversial issue, many recent studies look favourably at the possibilities provided by such approach, and agree that a wider spatial and temporal frame of population research significantly expands our understanding of the interactions occurring between the socio-economic and demographic processes. Arguments in favour of such approach have been presented by the team of researchers at the World Bank, including Mukesh Chawla (2007), as well as the American sociologists and demographers Stephen A. Matthews and Daniel M. Parker (2013).

These ideas may be challenged by the assumption that majority of the demographic parameters (age, sex, birth rate, mortality etc.) and the associated population processes are natural and genetically inherited factors influenced by the environmental conditions at best. However, the main question is – whether the socio-economic factors and policy actions being exogenous to the natural demographic processes can actually influence individuals' decisions on migration, family planning, choice of lifestyle and healthcare on the regional level, or even go beyond that – indirectly altering the pseudo-exogenous environmental conditions like the Psychosocial Distress.

Sebastian Klüsener and his fellow experts at the Max Planck Institute for Demographic Research (see Klusener et al, 2012) have comprehensively explained that although, in the scientific literature the demographic change, and other demographic processes are often viewed to as macro-phenomena influenced by localised events and the individual decisions of local actors, all evidence suggests that these decisions and events are in turn a direct product of the regional spatial and historical socioeconomic context in which these actors are embedded.

On the other hand, a sustainable demographic situation is recognised among the key preconditions for a successful regional and nationwide development, as the declining population dynamics and associated reduction of human capital unavoidably lead to grave socio-economic implications. On the other hand, evidence clearly shows, that degrading socio-economic environment can significantly impair the population development potential of the region, hence, forming an infinite loop of degrading returns, which can be broken exclusively by an exogenous intervention.

Keeping randomly occurring natural, geopolitical and economic occlusions aside, directed policy interventions and investments like those carried out under the framework of the Latvian regional and cohesion policy may be considered among the most significant exogenous interventions, which can successfully be planned, adjusted and controlled. This implies that links between policy actions and the resulting demographic responses on the regional level are not only relevant for the demographers, but also for policy-makers and the responsible public institutions.

Therefore, *the aim of the Thesis* is to determine the causalities and interactions between regional demographic development, socio-economic factors and regional policy interventions.

***The research object:*** Regional demographic development in Latvia.

***The research subject:*** Socio-economic determinants and consequences of the regional demographic development in Latvia.

***Research objectives:***

1. to describe possible ways how socioeconomic environment, spatial and historical preconditions and policy interventions may affect demographic processes and vice versa;
2. to analyse regional demographic development of Latvia on the scale of local municipalities;
3. to study the spatial autocorrelation of regional demographic processes and identify the unusual historical trends;
4. evaluate the role and significance of the “creative class” cohort within the population of Latvia and its neighbour Baltic States, project potential impact of these cohorts on the human capital capacity of the countries in question for middle and long term periods;

5. develop proposals for better targeted application of the available policy tools to tackle the identified regional demographic challenges.

***The following hypotheses*** are formulated to be defended in this dissertation:

1. Employment and personal income are the two key socio-economic determinants shaping regional demographic development in Latvia.
2. From the regional and cohesion policy instruments, the most significant positive demographic effects on the regional level are expected from the activities co-funded by the EU cohesion policy.

***These hypotheses are supported by several theses (arguments):***

1. Regional demographic development in Latvia is closely linked with the underlying socio-economic conditions (i.e., personal income, economic activity of the population or the social infrastructure development level) prevailing in the regions.
2. Spatial location of the municipality within the territory of a country plays a significant role in its population development processes due to the presence of significant spatial spillovers of the underlying socio-economic and environmental factors.
3. Territories currently showing similar population dynamics may have arrived to the present situation by divergent historical paths and have different underlying strengths and weaknesses, meaning that different long-term reactions to the exogenous interventions may be expected from the apparently similar contemporary regions.
4. Latvia has yet to benefit from the comparatively large cohort of young people born in the late 1980's reaching the estimated age of peak productiveness and creativity.
5. Using the geographically weighted regression models, one can better plan policy activities aimed at promoting regional demographic development, allowing decision-makers to identify those forms of policy instruments, which should be applied locally, and those, which may be used in a more centralised manner, expecting distributed effects.

***Following research questions are raised:***

- What are the main trends of regional demographic development in Latvia and how do these trends manifest in time and space?
- Which quantitative research tools are best suited for the analysis and modelling of regional demographic processes?

- What are the links and their theoretical foundations between socio-economic conditions, spatial and historical factors and regional demographic variables?
- What role does demographic development have in the Latvian national regional and cohesion policy?
- How regional and cohesion policy interventions can influence demographic processes on the regional level in Latvia?

*The theoretical framework* used for the elaboration of this Thesis consists of earlier research materials produced by Latvian authors on regional demographic and socio-economic issues, foreign theoretical sources and journal articles, publications by various public institutions, research centres and European Union bodies, as well as foreign and local statistical and policy reports.

Particular attention is devoted to the academic publications elaborated by the researchers representing University of Latvia and other major Latvian higher education institutions (e.g., Peteris Zvidrins, Parsla Eglite, Juris Krumins, Zaiga Krisjane, Baiba Rivza, Tatjana Muravska and others), which provided author with the necessary knowledge base on the demographic and socioeconomic development in Latvia over the previous decades.

Furthermore, in order to explore the contemporary schools of thought and innovative methodologies available for the regional demographic analysis, author relies on the research materials published by the researchers from the Max Plank Institute for Demographic Research (e.g., Eva Kibele and Sebastian Klusener).

Considering the wide use of spatial and geographically weighted quantitative tools, author has consulted extensively the available studies and methodological publications developed by the world's leading experts in the field of spatial analysis, including the major works published by Luc Anselin, Patrick P. A. Moran and Paul R. Voss.

The author also relies on his practical experience and knowledge acquired from attending numerous local and international conferences, seminars and workshops on demographic, regional development and cohesion policy topics.

The following key *research methods* are used in the thesis:

- Extensive review of the available literature, previous studies and reports on regional demography, spatial demography, regional development, as well as regional and cohesion policy in Latvia.
- Qualitative methods, including:

- case studies and comparative studies focusing on the specific conditions existing in the selected local municipalities, or the effects of the selected policy interventions;
  - content analysis of the national planning documents and written proceeding of the Latvian Parliament;
  - interview with representatives of the Ministry of Environmental Protection and Regional Development of the Republic of Latvia.
- Quantitative methods, including:
    - statistical analysis and standardisation of the regional demographic indicators;
    - exploratory spatial analysis of the demographic data on the municipal level in Latvia;
    - time-series clustering of the historical population trends in the local municipalities;
    - classical and geographically-weighted regression models.

Graphical data representations, including quantile maps, graphs, charts and other convenient forms of data visualisation.

### ***Data sources***

Considering the scope of the research included in this thesis, it relies on two major sets of data. First set contains regional population data and demographic indicators provided by the Central Statistics Bureau of Latvia (CSB) and the Office of Citizenship and Migration Affairs of the Ministry of Interior of the Republic of Latvia (OCMA). During the elaboration this thesis, the complete results of the 2011 Population and housing census of Latvia have become available to the public, which have been used extensively by the author.

Second principal set of data sources includes data on regional socio-economic conditions, regional policy interventions and other forms of regional investment obtained primarily from the reports and publications of the State Regional Development Agency, as well as other state agencies and ministries involved in the planning and implementation of national regional and cohesion policy. At the later stages of this research, some of the aforementioned data were acquired using the new Regional Development Indicator Module (RDIM) of the national Territorial Development and Planning Information System, which accumulates the most up-to-date statistical information produced by the related ministries and government agencies. In all cases, the CSB estimates of the total actual population have been used for producing the per capita values of the derived indicators.

In addition, the Global Creativity Index data published by the Martin Prosperity Institute were utilised in conjunction with the Eurostat population projections for producing human capital development forecasts included in the last Chapter of this Thesis.

Further empirical data concerning the practical aspects of regional and cohesion policy in Latvia were collected by the author within the framework of the project “The Objective of Economic and Social Cohesion in the Economic Policies of EU Member States” carried out by the Centre for Transition and European Studies at the University of Latvia in cooperation with University of Strathclyde.

Section 3 and 4 of the thesis use recalculated and georeferenced historical population data produced within the framework of the European Commission’s DG REGIO 2012 project “Population Data Collection for European Local Administrative Units from 1960 Onwards” undertaken by the Netherlands-based research centre “Spatial Foresight” in collaboration with University of Latvia. Author actively participated in the realisation of this project and contributed to the elaboration of data collection and recalculation methodology. Spatial data (generally – in form of ArcGis shapefiles), employed for the elaboration of spatial weights matrices and estimation of the spatially adjusted models, was obtained by the author from various open-source spatial data libraries available on-line.

### ***Scientific novelty***

The Thesis contributes to the existing literature and methodological frameworks by explaining and applying several innovative aspects of the regional demographic research.

#### *Methodological novelty:*

- Author outlines a methodology and discusses main results of the recalculation of Latvian historical regional population data (starting with 1959) in accordance with the contemporary territorial boundaries, while providing both spatial exploratory and cluster analysis of the obtained historical trends of regional population development. The methodology developed and employed by the author for this recalculation has been verified and published by Eurostat within the framework of the project “Population Data Collection for European Local Administrative Units from 1960 Onwards”.
- Author expands the existing methodological framework by advocating for and practically demonstrating the application of spatial exploratory analysis tools for the regional demographic research. Based upon the results of such analysis, author proceeds further by developing and adapting a series of geographically weighted regression (GWR) models (along with the necessary spatial weights), which previously had never been used

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for regional demographic studies, in order to analyse direct and spatially-distributed effects of socio-economic factors and policy interventions.

*Practical novelty:*

- Thesis complements the accumulated knowledge base concerning the regional demographic development in Latvia by uncovering, describing and quantifying the theoretical and empirical causal links between socio-economic conditions, regional policy interventions and population dynamics at the regional level.
- This Thesis provides options for better planning of the future regional investment / aid priorities aimed at improving the local demographic situation, allowing to identify those forms of investment instruments needed to be applied locally and those, which may be used in a more centralised manner in order to achieve higher efficiency, desirable level of impact and better spatial coverage.
- For the first time since the restoration of independence, this study offers a detailed computation and subsequent analysis of the standardised mortality rates in Latvia on the scale of local municipalities, by using the 2011 population and housing census data.
- Thesis also incorporates results of the first comprehensive content analysis study focusing on the demographic issues, involving major national planning documents and the transcripts of the national parliament (Saeima) debates.

***Research limitations***

If not stated otherwise, in this thesis author analyses data on the scale of Latvian local municipalities (*novadi*). Logic dictates that before conducting any quantitative study it is necessary to identify the available data and understand the associated limitations. As it will be explained further in the Thesis, the administrative-territorial reform of 1999-2009 has resulted in the completely new single-level system of the LAUs in Latvia. Unfortunately, due to dramatic changes in territorial planning caused by this reform, not all of the necessary socio-economic data is available on the LAU level prior to 2009, what limits the temporal scope of the primary quantitative analysis components used in this study to the 2009-2016 period.

The historical data on the regional population numbers, employed for the secondary analysis in this thesis, covers the period starting with 1959 population census, as this was the first such survey carried out within the boundaries of the modern Latvia on the regional and sub-regional scale, providing sufficient information for the data recalculation in line with the contemporary territorial boundaries.

Considering the limitations and assumptions on the population data, in case of Latvia, particular problems are posed by the unregistered migration represented in part by the Difference between CSB and OCMA data. In order to ensure data comparability across regions, many indicators had to be recalculated per capita. However, official publications often differ in the chosen approach – using either the estimated CSB population count or the registered OCMA data. As a result, author had to recalculate many such indicators using the estimated official CSB population data only.

Further, following the generally accepted principles, with the purpose of capturing the dynamics of the observed population changes, many indicators had to be recalculated and represented as change rates or change indexes (using year 2011 as base – 100). All these transformations have caused the unavoidable distortions of the original data sets. Finally, the number of possible impact variables used in the econometric models is limited by the amount of data available on the municipal level.

### ***Scope and structure of the Thesis***

First two chapters represent theoretical and methodological framework of the thesis.

In **Chapter 1**, author conducts extensive literature review on the links between different aspects of population development and socio-economic conditions, while also discussing current and future demographic implications of relevant policy interventions.

**Chapter 2** reviews major demographic problems and related development challenges that have been observed in Latvia over the last decades, along the available regional and social policy tools and their potential application effects. Special emphasis is placed on the phenomenon of missing registered population that was revealed after population census results of 2011.

**Chapter 3** sets fourth data and methodologies necessary for the thorough quantitative assessment of processes under study with the assistance of key selected indicators, while overcoming various methodological challenges, derived from somewhat unique shifts in territorial boundaries within Latvian territory. Author recalculates historical population data that would fit single frame of reference for the analysis of population dynamics and develops standardised mortality rate in Latvian municipalities.

**Chapter 4** presents main study outcomes and subsequent interpretation of the applied quantitative analysis methods. Author provides results of spatial auto-correlation analysis of major regional demographic indicators in Latvia and highlights specifics of spatial

demographic development in the country, including spillover effects. The chapter also highlights implications of long-term responses to the various policy instruments and regional aid measures on behalf of the territories displaying similar demographic dynamics at present that have, however, arrived to the present state through divergent historical courses.

### ***Approbation***

The results of the research have been presented and discussed in 15 conferences (11 international and four local), as well as three seminars (one international and two local); five peer-reviewed and four other publications have been produced within the framework of this Thesis. The author has participated in three research projects directly related to the scope of this Thesis.

### ***Presentations at the international conferences and seminars:***

- Poster presentation “East – West Health Divide Crossing the Territory of Latvia: Divergence or Convergence?” (with J. Krumins), MPIDR 4th Human Mortality Database Symposium: Similarities and peculiarities on the way to longer life in human populations (22-23 May, Berlin, Germany).
- “Demographic Implications of the Recent Regional and Cohesion Policy Developments In Latvia” (with J. Krumins, T. Muravska and A. Berzins), International conference “New Challenges of Economic and Business Development – 2017” (Riga, Latvia, 19 May 2017).
- “Demographic Determinants of Creativity” (with V. Rojenko), Riga Technical University 57<sup>th</sup> annual international conference “Scientific Conference on Economic and Entrepreneurship 2016” (Riga, Latvia, 30 September 2016).
- “Socioeconomic Determinants of Regional Mortality in Latvia”, international conference “European Population Conference 2016” (Mainz, Germany, 31 August – 3 September 2016).
- “Regional demographic development in Latvia – does policy matter?”, international conference “New challenges of Economic and Business Development 2016” (Riga, Latvia, 12 – 14 May 2016).
- “Measuring demographic impact of the EU cohesion policy actions: example of Latvia”, international conference within the framework of the European Commission’s “Open Days of Regional Policy” (Brussels, Belgium, 12 – 14 October 2015).

- “Measuring Demographic Impact of the 2007-2013 Regional and cohesion policy Actions in Latvia”, conference “Challenges for the New cohesion policy 2014-2020: Academic and Policy Debate” (Riga, Latvia, 5 February 2015). Best paper award.
- “Long-term Spatial Population Data Analysis in Latvia: Challenges Posed by the Administrative-Territorial Reforms” (poster presentation), International conference “European Population Conference 2014” (Budapest, Hungary, 25 – 28 June 2014).
- “Historical Regional Demographic Divergence in Latvia: Lessons of the Common Past with EaP Countries”, international conference “EU Eastern Partnership – from Capacities to Excellence: Strengthening Research, Regional and Innovation Policies in the Context of Horizon 2020” (Riga, Latvia, 11 June 2014).
- “Measuring the Impact of Spatial Factors in Regional Demographic Development of Latvia”, international conference “New Challenges of Economic and Business Development - 2014” (Riga, Latvia, 10 May 2014).
- “A spatial approach to regional demographic research and policy making: Example of Latvia”, ESPON: ENECON project conference (Aalborg, Denmark, 28 March 2014).
- “Regions versus the Capital in Latvia”, European Union Permanent Representation in Latvia seminar „Capital Cities: Embracing the Change and Tapping into Opportunities” (Riga, Latvia, 13 October 2013).

*Presentations at the local conferences and seminars:*

- “Reģionālās statistikas jautājumi demogrāfiskajos pētījumos”, Latvijas Statistiku Asociācijas (LSA) lasījumi, seminar (Riga, Latvia, 26 September 2016).
- “Iedzīvotāju mirstības teritoriālā diferenciacija Baltijas valstīs”, Latvian geographic society annual conference: “V Latvijas Ģeogrāfijas kongress” (Riga, Latvia, 18 March 2016).
- “Latvijas iedzīvotāju mirstības reģionālo atšķirību sociāli ekonomiskie faktori”, University of Latvia 74<sup>th</sup> annual conference, section “Depopulācijas riski un izaicinājumi” (Riga, Latvia, 25 February 2016).
- “Reģionālās un kohēzijas politikas instrumentu demogrāfiskā ietekme Latvijā”, University of Latvia 73<sup>rd</sup> annual conference, section “Demogrāfijas loma valsts un tās reģionu ilgtspējīgai attīstībai” (Riga, Latvia, 27 February 2015).
- “Latvijas demogrāfiskās attīstības ekonometriskā analīze”, Doctoral School „Baltijas jūras reģiona valstu integrācija ES nozīmīgākās sadarbības dimensijās” seminar (20 May 2014).

- “Latvijas novadu demogrāfiskās attīstības telpiskā ekonometriskā analīze”, University of Latvia 72<sup>nd</sup> annual conference, section “Ekonomikas un biznesa analītiķi: pārmaiņu aģenti” (Riga, Latvia, 6 February 2014).

Peer-reviewed publications:

- Dahs, A., 2017. Measuring the Impact of Spatial Factors in Regional Demographic Development of Latvia. *Economic and Management Research*, 4(5), 15-28. [Indexed in Web of Knowledge database]
- Rojenko, V., Dahs A., 2017. Demographic Determinants of Creativity: the Analysis of Creative Potential Development and Forecast for the Baltic States. *Economics and Business*, 30(1). Available at: <https://doi.org/10.1515/eb-2017-0007> [Indexed in EBSCO, CSA/ProQuest and other databases].
- Dahs, A., 2016. Demographic Implications of the 2007-2013 Regional and cohesion policy Actions in Latvia. In: Bachtler J., Berkowitz P., Hardy S. & Muravska T., (eds.) EU cohesion policy: Reassessing performance and direction. Regions and Cities book series. Routledge: London, 101-114. [Indexed in SCOPUS, Web of Science and other databases].
- Muravska, T., Aprāns, J., Dahs, A., 2016. cohesion policy in the sparsely populated countries. In: Piattoni S. and Polverari L., (eds.) E. Elgar Handbook of cohesion policy. Edward Elgar: London, 285-301. [Indexed in SCOPUS and other databases].
- Dahs, A., 2016. Regional demographic development in Latvia – does policy matter? *New Challenges of Economic and Business Development – 2016: Society, Innovations and Collaborative Economy: Conference Proceedings*, 147-157. [Indexed in EBSCO database].
- Dahs, A., 2014. Historical Regional Demographic Divergence in Latvia: Lessons of the Common Past with Eastern Partnership Countries. *Baltic Journal of European Studies*, 4(2), 119-133. [Indexed in EBSCO, SCOPUS and other databases].

Other publications and proceedings:

- Dahs, A., 2016. Iedzīvotāju mirstības teritoriālā diferenciācija Baltijas valstīs. *Ģeogrāfiskie raksti "Folia Geographica"*, 16(1), 93-97.

- Dahs, A., 2016. Socioeconomic Determinants of Regional Mortality in Latvia. On-line proceedings of the European Population Conference 2016. Mainz, 31 August – 3 September 2016. Available at: <http://epc2016.princeton.edu/uploads/160451>.
- Dahs, A., 2014. Long-term Spatial Population Data Analysis in Latvia: Challenges Posed by the Administrative-territorial Reforms. On-line proceedings of the European Population Conference 2014. Budapest, 25 – 28 June 2014. Available at: <http://epc2014.princeton.edu/papers/140605>.

Participation in research projects:

- Population Data Collection for European Local Administrative Units from 1960 Onwards (2012-2013). Project lead: Spatial Foresight GmbH (Luxembourg). Tender by: EC DG REGIO (No. 2012/S 152-253426). Role – researcher, national expert. University of Latvia proj. No. 2851.
- The Objective of Economic Cohesion in the Economic Policies of EU Member States –annual EoRPA reports “Policy Reform under Challenging Conditions”, “Regional policy in times of austerity” & “Rethinking Regional Policy at National and European Levels” (2013-2016). Project lead: European Policies Research Centre (EPRC) at the Strathclyde University (UK). Role – researcher, national expert.
- Renewal of society through reducing the risk of depopulation, through demographic development and strengthening links with the diaspora for the transformation of the Latvian economy (2014-2017). Project 5.2.4. of the National Research Programme 5.2. EKOSOC-LV. Role – researcher.

# 1 THEORETICAL AND METHODOLOGICAL BACKGROUND OF THE REGIONAL DEMOGRAPHY

Over the last few decades, one may observe a growing interest in research concerning the complex regional socio-economic processes, and the regional demographic change is no exception to this trend. One may notice an increased number of both national and EU-level policy documents, reports, studies and other publications addressing the issues of population development, as well as its associated factors, policies and the future implications. These materials vary greatly in scope and methodology, but universally, point out the importance of regional demographic development in shaping the social, economic and even political landscape of the future EU and its member states.

Considering the above, one may safely state that the issue of regional demography is gaining recognition among the European policy makers and contemporary scholars working in the related study fields. Literature review also indicates, that in the sparsely populated countries of the Eastern Europe, and particularly – in the Baltic States, facing the most pressing demographic challenges, historically diverse studies and views touching upon the subject of regional population development are frequently drawn into the comparatively new and vaguely defined interdisciplinary scientific framework of “Regional demography”.

With the aim to understand better the whole concept of regional demography, its origins and relations with other social sciences and research dimensions, this Chapter is dedicated to the review of previous studies concerning regional demographic development and associated processes; particularly focusing on the nature of the term “Regional demography” and the practises it describes.

## 1.1 The concept of regional demography

Sustainable demographic situation is recognised among the key preconditions for a successful regional and nationwide development, as the declining population dynamics and associated reduction of human capital unavoidably lead to serious socio-economic implications. On the other hand, evidence clearly shows that degrading socio-economic environment can significantly impair the population development potential of the region, hence, forming an infinite loop of degrading returns, which can be broken exclusively by an exogenous intervention.

In order to understand and manipulate such spiralling progression, one has to start by defining and testing several fundamental principles:

- First is the question about presence of causal links between the various aspects of population change in the region and the specific set of measurable socio-economic factors.
- Second is the assumption that through a targeted application of the specific tools aimed at tackling the aforementioned socio-economic factors, either willingly or inadvertently, one can manipulate the dynamics of regional demographic development.

The strive to either confirm or deny these assumptions (which coincide with the two primary hypotheses of this Thesis) unavoidably leads scholars into the interdisciplinary and many-faceted research field (involving not only demography, but also geography, history, economics, regional policy and a variety of other social science topics), which can be referred to as “Regional demography”. This determines the expansion of the analytical and methodological inventory used for demographic research. In the report on training and support for population scientists, a group of American demographers and social scientists including Jane Menken, Ann C. Blanc, and Cynthia Lloyd (2002), stated that “*the broadening of the traditional demographic research field has necessitated the acquisition of additional skills and familiarity with the concepts and tools of related disciplines*”.

Let us begin by learning how regional demography can help one understand and test the first assumption concerning the existence of specific factors capable of influencing the population change on the local level.

Although, the demographic change, as well as the associated population development processes are often referred to as macro-phenomena influenced and driven by localised events and the individual decisions of local actors, all evidence suggests that these decisions and events are in turn a direct product of the social and economic context in which these actors are embedded (see Klusener et al, 2012). These ideas may be challenged by the assumption that majority of the demographic parameters (age, sex, birth rate, mortality etc.) and the associated population processes are natural and genetically inherited factors influenced by the environmental conditions at best.

However, the main question of regional demography in this context is – whether the socio-economic factors being exogenous to the natural demographic processes can actually influence individuals’ decisions on migration, family planning, choice of lifestyle and healthcare on the regional level, or even go beyond that – altering the pseudo-exogenous environmental conditions like the Psychosocial stress, frequently considered as a contributing

factor in higher mortality in former socialist countries by an American sociologist William C. Cockerham (1999) or German demographer Reiner H. Dinkel (1999).

Contemporary literature sources dealing with this question are somewhat limited and divergent in terms of scope and methodologies, which is not surprising, as each country or region has its own particular demographic problems and the associated set of related influencing factors or corrective policy measures. However, some common principles and research sub-dimensions can be deduced from the accumulated population studies in Latvia and other countries around the globe.

First, it is important to mention that multiple interpretations of the term “regional demography”, which is quite often used by Latvian scholars, exist in the literature. One way of looking at the regional demography is by placing it in between the spatial population statistics and population geography, connecting and enriching both disciplines by adding the theory-based interpretations and region-specific information to the spatial / geographical data (e.g. see Voss et al, 2006).

Another possible interpretation describes the regional demography as a process of adding the concept of place (and often – time) to the traditional population statistics, which is, basically, a new look at the century old techniques of building demographic trends and population data analysis within the framework of regional development processes. Famous American demographer Donald J. Bogue has once labeled such studies as “micro demography” (see Bogue, 1957).

Third and the most popular explanation of the term (which does not necessarily exclude the first two) sees Regional demography as any demographic / population research with the limited geographical scope (i.e. urban, rural, local, national or even international, but not global), depending on the existence of the wider framework under which the particular study is carried out. Several studies, carried out at the University of Latvia by a renown Latvian demographer Peteris Zvidrins and his colleagues, can serve as a fine example (e.g. see Zvidrins, 2009).

With this in mind, one might prematurely conclude that regional demography is just another name for the well-known discipline of “Spatial demography”. For example, Voss (2007) explains, that most of the traditional demographic research is, in fact, a direct product of spatial demography, with few exceptions involving the pioneering works of anthropologists, statisticians and mathematical demographers who have elaborated general theories and causalities of population development, free from the empirical factors like time and space. Classic examples of such approach can be found in studies published by Croatian-

American mathematician William Feller (1941), American mathematician and statistician Alfred J. Lotka (1938), or American statistician Louis I. Dublin (see Dublin & Lotka, 1925).

While finding this statement true, and after reviewing the available previous regional demographic studies conducted by Zvidrins (2009) or Latvian statistician Zigrīda Gosa (2008), author would like to argue that the concept of regional demography goes beyond the framework of spatial demography, by adding the regional development context and the regional impact factor analysis (as well as a whole set of other methods and disciplines) to the spatial population data. Such perception considerably broadens the research field, as the processes and implications of social, economic, historical and even political regional development have to be analysed along with the population dynamics and the traditionally associated factors like the environment or socio-economic conditions.

Now that we have established the theoretical scope of “Regional demography” and seen how it can help us in identifying the socio-economic factors capable of fostering or disrupting the regional demographic development, let us concentrate on the opportunities presented by the regional demographic research in determining tools and methods capable of applying sufficient external influence necessary to alter the regional demographic processes.

Practice shows, that the regional demographic research may incorporate a wide range of scientific techniques, which will be described in detail further in this Thesis. However, on the purely theoretical level, it is necessary to remember, that regional demography is a multidisciplinary framework capable of bringing together and systemically analysing demographic, environmental and socioeconomic processes, while providing further opportunity to add any number of other external factors in to the analytical mix. Therefore, in such a study, one has to apply simple logic and consider – what are these exogenous tools worthy of such an analysis?

Several dominant groups of such influencing exogenous factors are identified in the available literature. For example – geopolitical change shifting the established socioeconomic and demographic balance, or even causing the sudden onset of a demographic transition (as suggested in the works of German demographer Eva Kibele at the Max Planck Institute for Demographic Research (see Kibele, 2012)), or the whole range of environmental factors capable of changing the demographic characteristics of the entire populations or specific cohorts as demonstrated by an American demographer Anne R. Pebley (1998)). However, keeping randomly or uncontrollably occurring natural, geopolitical and environmental occlusions aside, one can safely say that directed policy interventions and investments should be considered among the most significant exogenous interventions, which can be successfully

planned, adjusted and controlled. This implies that regional demographic analysis involving the possible bonds between policy actions and the resulting demographic responses on the regional level is not only relevant for the demographers, but for policy-makers and the responsible public institutions as well.

This concludes the brief theoretical review aimed at defining the concept of “Regional demography” in a wider scientific framework. Author concludes that it is both practical and scientifically correct to use the regional demographic research and the existing academic work in this area as a basis for achieving the aim of this Thesis, as well as for testing both principle hypotheses. Next sub-section of this Chapter describes the methodological scope of the regional demographic studies.

## **1.2 Principal directions and methods of regional demographic research**

As the majority of interdisciplinary studies, regional demography does not concentrate on just one or few specific issues. Rather, it presents researchers with the freedom to choose from a variety of available techniques, depending on the type and characteristics of the regional demographic processes under study, geographical and temporal scope, data availability and the required precision level. Going into more detail, several key research directions can be identified within the accumulated literature connected with the topic of regional demography.

Majority of the studies tend to analyse the differences of demographic development between various territorial units, but only few follow the complex, multifactorial approach. These papers attempt to determine relations between the complex regional demographic processes and whole sets of the possible impact factors. For example, in his paper “*Iedzīvotāju veselība, mirstība un mūža ilgums Latvijā: tendences, faktori, perspektīvas*” Juris Krumins (2006) conducted an extensive study analysing the whole range of factors (including social conditions and healthcare) influencing regional population health, life expectancy and mortality processes in Latvia. While many of such studies use some form of statistical analysis as the basic analysis tool, it is important to note that there is a substantial number of advanced methods and models suitable for such type of research. American spatial scientist Guangqing Chi and statistician Jun Zhu have explained, that such techniques range from basic linear regression estimations to the advanced geographically weighted regression (GWR) models described further in this Thesis (see Chi & Zhu, 2008).

More common are the studies on / about variances in specific demographic factors among regions of the same country or populated by the same ethnic groups. For example, in

Latvia, as well as other European countries, there is a significant amount of research available concerning regional variance of birth rate or mortality (e.g. Gosa, 2008 or Kruminis et al, 2009). A particularly good example of this type of study is the monography “*Regional mortality differences in Germany*” (Kibele, 2012), which presents the detailed analysis of the regional mortality differentiation in different parts of Germany, focusing particularly on to the East-West dichotomy. Again, statistical analysis tools are most common in these forms of research, but some authors, Including E. Kibele do use some of the more advanced quantitative tools to support their research findings. Besides the aforementioned linear and GWR models, other types of econometric tools like multi-level modelling or cluster analysis appear in these studies.

Another rather small group of studies evaluate the onset, progress and consequences of the demographic transitions at the specific territorial level (usually, countries or macro-regions). For instance, Norwegian economists Kjetil Bjorvatn and his German colleague Mohammad Farzanegan in their study “Demographic transition in resource rich countries: a blessing or a curse?” (2013) focus on the onset and socio-economic effects of the various stages of demographic transition in the multiple regions of the Middle East and North African countries. Interestingly, authors conclude, that that the increasingly young populations in these territories appear to constitute a force of social and political unrest rather than economic progress, and the specifics of regional economy (including local labour markets) have to be considered in the demographic studies concerning these regions. Some further examples of such studies are provided by a Hungarian demographer Paul Demeny (2011).

In some rare cases, the historical specifics of the territories in question are also placed under review. In his work “*Долговременные исторические тренды как фактор экономического прогнозирования: транспорт, экономика, демография*”, Russian statistician Gregory Golc (2004) has proven that the long-term historical demographic trends have a measurable influence on the contemporary and future demographic developments of the particular territorial unit. Other researchers have followed these conclusions and factored in these historical dependencies in their regional demographic studies (e.g. see Brainerd 2010).

From the sources listed above, one can see, that many authors attempt to analyse the underlying social, economic or environmental factors preceding the regional demographic change, but only a handful of studies focus specifically on the demographic effects of the national or regional policies (intentional or unintentional). Such studies are normally limited to the specific countries or regions, where there are known population development issues,

which are / have to be addressed by the corrective policy measures. Examples of this case include works by Klusener et al (2013), American economist Luis G. Pol and health scientist Richard K. Thomas (2013), or famous Latvian economist and demographer Parsla Eglite (e.g. see Eglite et al, 2004). Particularly interesting and innovative example of such study is presented by a group of Australian geographers Peter Smailes, Trevor Griffin, and Neil Argent in their 2014 paper “*Demographic Change, Differential Ageing, and Public Policy in Rural and Regional Australia: A Three-State Case Study*”, which addresses the actual and potential effects of public policy on to the key regional demographic processes in Australia.

The entirely different form of regional demographic studies concerning the impact of the current regional demographic processes on to the future socio-economic conditions and regional development in general is gaining popularity with such supranational institutions as the European Commission and European Parliament voicing concerns about the sustainability of the regional economic growth in the face of the forecasted demographic perils. As a result, these issues have received a substantial political and academic attention. Numerous detailed reports and forecasts were produced recently, including such major works as “*Dealing with demographic change: Regional policy responses*” (Ferry and Vironen, 2010), “*Regions 2020: Demographic challenges for European regions*” published by European Commission (Fesus et al, 2008), or “*The impact of European demographic trends on regional and urban development*”, developed by a Hungarian economist Eva Gerohazi and her team in 2011 within the framework of the Hungarian presidency of the Council of the European Union.

All these documents underline the risks posed by the current demographic dynamics of the EU and its member states, while focusing on the spatial distribution of the most demographically challenged regions and the associated implications for regional growth, equity and sustainability. The EPRC paper also provides a noteworthy set of proposals for adjusting the EU regional policy response for tackling the aforementioned issues. These and many similar studies underline the important role that the EU cohesion policy funding might have in alleviating the negative socio-economic consequences of the population change throughout the EU regions, but only few authors suggest using the same cohesion policy investment in an attempt to influence the demographic processes themselves. This is surprising, as one recent study “*How can regional and cohesion policies tackle demographic challenges?*” carried out on behalf of the European Commission by Italian researchers Manuela Lodovici & Monica Patrizio (2013), has clearly indicated that “*the regional and local dimensions are crucial in addressing demographic change and that cohesion policy is among the main tools to support regions in adapting to demographic change, especially*

*thanks to the focus on regional socio-economic development and labour markets and the multi-year integrated programming approach.”*

In terms of the methodology, regional demographic studies tend to be very diverse and encompass all the available tools presented by the scientific disciplines associated with it – statistics, geography, economy, etc. However, the increased availability of quantitative and qualitative data on the population dynamics, the associated socio-economic conditions and other underlying factors on the regional and local territorial levels, has recently sparked a surge of interest in adding both, spatial and econometric analysis perspectives to the classical demographic studies.

Particularly interesting methodological case is presented by the combination of spatial and econometric tools. In such studies, exploratory spatial analysis is applied first with the purpose of finding regional trends, clusters or other patterns in the spatial demographic data. Then, the uncovered patterns are analysed with the tailored application of the specialised econometric models (particularly – GWR), yielding much more probable and informative results in comparison with the traditional statistical and model-based analysis (Matthews & Parker 2013).

In order to achieve the aim of this Thesis, author relies on the accumulated research experience presented above and, to some extent, tackles all of the aforementioned regional demographic research dimensions.

### **1.3 Spatio-temporal dimensions in regional demographic development**

No country, state, region or municipality exists in the perfectly isolated socio-economic environment. This is not because of the lack of trying – in the world history, there are numerous examples of the isolationist regimes attempting to cut all ties with the outer world and set their own truly independent development course, but arguably – none has succeeded as of yet. Any geographical entity is inevitably linked with its neighbours and the greater world by an uncountable number of factors ranging from the political influence to the environmental pollution.

Same statement is true for the demographic development – demographic processes of one region do not end abruptly at the border of another. People tend to communicate, commute, change their place of residence and gain or spend their income in other territorial units. Even on two sides of the strictest border regime between two countries there will still be people sharing social habits, ethnic roots of family ties. This also implies, that the potential impact factors cannot be viewed as a purely local thing, as financial flows, ecology,

knowledge, public investment and other influences tend to spill across borders no matter what (e.g. see Alvarez et al, 2006, Autant-Bernard, 2009, or van Ham et al, 2001). As it has been well underpinned by Voss et al (2006) in their work “*Explorations in spatial demography*”, idea that “spatial is special” is a notion that has begun only slowly to enter the awareness of demographers. As the author has shown in the previous sub-section, this notion has a good support from the methodological perspective as well.

Returning to the previously quoted conclusion regarding the reliance of the macro-level demographics on the individual-level decisions, offered by Klusener et al (2012), it is impossible to deny that these individual decisions are not absolutely free of the spatial context into which these characters are embedded – spatial context has a role in many demographically important decisions, including but not limited to: household formation, children and household size, engagement in risk-prone activities etc.

In addition to the regional/spatial dimension, yet another plane of analysis may prove to be relevant for understanding the fundamental interactions of socio-economic environment, policy and population development, namely - Time.

While spatial aspect of the regional demographic research is still gaining its recognition among scholars, the fact that demographic change most surely has a temporal dimension was known and recognised among the demographers long before the elaboration of the “Demographic transition theory”, described in detail by an American economist and demographer Ronald D. Lee (2003), which has brought new light to this dimension of the demographic research. Neither regions, nor people appear at the particular spatial coordinates overnight. Both, territories and their inhabitants gain their current characteristics over centuries and even millennia of social, economic and political development. For example, research elaborated by Golc (2004) or an American demographer James W. Vaupel and his Danish colleague James Vaupel (2002) demonstrate that many social and demographic processes take a long time to develop, and often overlap the short-term socio-economic turbulences with little notice.

Furthermore, Klusener et al (2012) argue that in the context of regional demographic research, a particular advantage presented by the temporal analysis of the population development is that demographic data are usually available for medium or even long periods of time, which makes it possible to study indirectly the associated regional non-demographic factors and processes for which there is little or no data available. The traditionally high quality and good availability of demographic data helps researchers in developing better long-

term studies concerning the aforementioned spatial dimension of regional demography (e.g. see Goldstein and Klüsener 2010).

Although, introducing the additional dimensions to the traditional demographic analysis may be considered unnecessary for many general-purpose demographic studies, many authors support the conclusions presented by Klüsener et al (2012) and look favourably at the regional demographic analysis possibilities provided by such approach. General agreement is that a wider spatial and temporal frame of population research may significantly expand one's understanding of the links and interactions occurring between the socio-economic and demographic processes on the local and regional level (e.g. see Matthews and Parker et al, 2007 or Matthews and Parker, 2013).

It is the opinion of the author that analysis and understanding of these time and space dimensions of the regional demographic development is crucial for the accurate and thorough analysis of the links between the regional demographic processes, socioeconomic factors and policy interventions in Latvia. Previous studies and official reports (e.g. SRDA, 2012 or SRDA, 2013) indicate that on the level of local municipalities or former districts, Latvia, as well as many other European countries, present significant spatial divergence in terms of social, economic and demographic development.

In the working paper "*The Demographic Transformation of Post-socialist Countries*" Brainerd (2010) explains that the seemingly identical problems of the current Western European and former Socialist Block countries stem from the principally different roots. Brainerd argues that while current demographic problems in the Western European countries are the result of long-term natural and social processes, former socialist countries of Eastern Europe are relatively new to these issues, as they have undergone a remarkable demographic transformation, in just the past twenty-five years. This is particularly important, when considered in conjunction with the demographic implications of the Soviet occupation period (see Zvidrins, 2008, or Eglite, 2010).

In their article "*Jobs, careers, and becoming a parent under state socialist and market conditions: Evidence from Estonia 1971-2006*", Swedish demographer Sunnee Billingsley with her Estonian colleagues Allan Puur and Luule Sakkeus (2014) have provided an extensive evidence of the demographic implications arising from the political and socio-economic transition witnessed by populations of Estonia, as well as its neighbour Baltic States and many other post-socialist countries.

In further support of this argument, one should mention that in the book "*From Red to Grey: The "Third Transition" of Aging Populations in Eastern Europe and the Former Soviet*

*Union*”, Chawla et al (2007) have discussed in detail that the Eastern European countries, have not just undergone a political, social and economic transition, but also have fast-tracked through the demographic transition, which was different from the one being experienced by the wealthier aging countries of Western Europe. This in turn raises concerns, that the impact of aging populations will undermine the long-term success, of the socio-economic transitions by putting at risk economic growth and social sustainability. The experience of 2008-2010 economic crisis in Latvia shows, that such threat is even more evident on the regional level, where rapidly reduced population potential and changing population age structure are unable to accommodate the demands of modern economy.

Data needs and methodologies implied by the spatio-temporal approach in regional demographic research are discussed in Chapter 3 of this Thesis.

#### **1.4 Human capital and the role of demographic processes in the sustainable economic development.**

Findings on the demographic determinants of human capital productivity and creativity discussed in this sub-section and further in this Thesis were produced by the author in collaboration with Vladimirs Rojenko at the University of Latvia (for further information see Rojenko & Dahs, 2017)

While it is very important to understand what socio-economic tools can do for the demography, it is imperative to realise, how demography can in turn affect region’s economic capacity. In the very first sub-section of this Chapter author has argued that the Sustainable demographic situation is recognised among the key preconditions for a successful regional and nationwide development. In the modern innovation-driven economy, human capital has become the foremost production factor in almost every economic sector (e.g. see Dakhli & DeClercq 2003). It has also been identified as the primary driver for the truly sustainable nationwide and regional economic growth (see Sabadie 2014). With this in mind, it is both practical and necessary to expand the regional demographic study by evaluating the return effects of the demographic situation and structure on to the innovation and growth capacity of the territory under study.

From the economic perspective, nowadays, a fundamental transformation from resource-based economy to modern knowledge-based economy is underway. Thus, modern and future competitive advantages arise from the ability of nation, country or region to develop its own trends and innovations, using creative potential of its human capital in most effective way. Creative dimension of the human capital becomes a new source of sustainable

and innovative development, as suggested by authors of the “Blue Ocean Strategy”, American management scientists W. Chan Kim and Renee Mauborgne (2005).

The overall human capital development and appropriate opportunities for the countries or regions are determined generally by the age distribution of population and education attainment. These demographic factors directly affect the human capital and its creative potential development opportunities: human mind productivity and appropriateness for certain creative work and employment. The impact of age structure on the business environment has been extensively reviewed by a group of British economists Werner Bonte, Oliver Falck and Stephan Heblich (2007). Furthermore, according to the renowned American economist and urban studies theorist Richard Florida (2010), the main driver of modern economy is a special group of inhabitants sharing specific age and education criteria – “Creative Class”. Analysing the differences in the development of countries, R. Florida has determined that the regions with a higher proportion of “Creative Class” representatives are more successful and able to develop successfully and realize their inherent competitive advantage.

In order to ensure the opportunity of sustainable development and welfare of its citizens the EU is strengthening its global competitiveness by removing barriers to innovation and making it easier for the public and private sectors to work together and cooperate in the field of delivering, implementing and developing innovations. These days there is a growing consensus that the EU and its member states must do more to develop human capital that will determine their future economic prosperity, to create an economy where innovations forms a core part of daily economic life of every country and region (e.g. see. Schleicher, 2006). The EU innovation and economic development policy is based on the innovation, human capital and creativity, which increase opportunities for individuals and tackle social exclusion (e.g. see Arvanitopoulos 2010).

Latvia and its neighbouring Baltic States, which have simultaneously joined the EU back in 2004, nowadays hold different positions in innovative development. According to the 2015 EU innovation scoreboard, positions of the Baltic States are still lower than the EU average. Compared with Latvia and Lithuania, which for many years are among the moderate innovators, Estonia is more successful in the field of innovation growth (European Commission 2016).

Mentioned tendencies in the field of innovative development, and relatively high positions of the Baltic States (positions from 16-23 in the overall world rankings) in the Human capital index, developed by the World Economic Forum, indicate existing problems connected with human capital stagnation due to underinvestment in education and training,

depopulation, population aging and other social and demographic challenges (World Economic Forum 2015). Considering the core role of the creative potential of the human capital in development of new competitive ideas and innovations which have the ability to revive the socio-economic development of country or region, it is up to the regional demography to identify the links and relationships between the creative potential of human capital and local demographic processes. Furthermore, using the mix of aforementioned factors and the identified relations it is also possible to forecast the future development trends.

Let us begin by establishing the function and importance of human capital and its creative potential in the modern innovation-driven economy. Nowadays a fundamental transformation from resource-based economy to modern knowledge-based economy is underway all around the world. The economic landscape is rapidly changing, affecting the ways of life, structure of national economies and habits of private and corporate consumption (Florida 2010). Changes occurring in the external and internal environment of the globalized economics affect the way in which economic developers foster the environment, which encourages growth of existing businesses and promote the establishment of new forms of business and uncontested market spaces. Ordinary goods and services are no longer sufficient for private and corporate customers, who nowadays are seeking new experiences – memorable events that engage them in an inherently personal ways (see Gilmore & Pine, 2007).

The most successful and profitable products presented at all kinds of markets are innovative, unique and highly qualitative goods and services that give customers an opportunity to gain new, previously unknown experiences. Nowadays market leaders are successful only when they are meeting expectations of modern customers and create new and innovative market niches. Therefore, human capital and its creative dimension becomes a new source of sustainable innovative development, resulting in the appearance of unique innovation trends and new, uncontested market spaces that makes competition less relevant and ensure the opportunity of sustainable development in the future (Mauborgne & Kim, 2005).

According to Richard Florida the main driver of modern economy is a special cohort within the general human capital pool – “Creative Class”. They are the people for whom creating and developing new, innovative ideas is a daily routine. Analysing the differences in the development of countries R. Florida has determined that the regions with a higher proportion of “Creative Class” representatives are more successful and able to develop successfully and realize their inherent competitive advantage (Florida 2010). In order to

compare the development of creative dimension of the human capital in different countries a Global Creativity Index (further – GCI) was developed. The GCI is measured using three core dimensions of creativity – Technology, Tolerance and Talent. The Technology dimension of GCI includes the share of GDP devoted to R&D activity and number of the applied patents per capita, Talent dimension mainly includes the share of the workforce in the “creative class” cohort and the share of adults with higher education, in its turn Tolerance dimension covers the share of people who are tolerant to racial minorities, people with other political or religious views etc. (Martin Prosperity Institute 2015).

R. Florida and the researchers from Martin Prosperity Institute (a part of the Rotman School of Management at the University of Toronto) point out that there is a strong correlation between region’s creativity and competitiveness, which underlines a significant role of human capital’s creative potential in the development of modern competitive economies (The Martin Prosperity Institute, 2015).

On the wider scale, studies on regional development features, conducted by the series of researchers during the last decades, show that human capital development factors, and especially - its creative dimension, not only play an important role in spurring regional development, but are also strongly connected with regional development tendencies and are determined by the individual characteristics of the region under study (e.g. see Lee et al, 2010). As it may be observed from the structures of the GCI or Human capital index, the overall human capital development opportunities of the specific countries or regions are generally determined by various demographic factors. Most important of them are age distribution, education attainment and population change indicators that directly affect human capital and its creative potential development opportunities: human mind productivity and appropriateness for certain creative work and employment.

Furthermore, considering that the stock of human capital also changes with age, it is clear that each particular person will be better suited for different types of employment at different intervals of the lifecycle (Bonte, Falck, Heblich, 2007). Traditionally, young people are more creative, brave and risky; in their turn, elder people usually have wide and long-range experience and are able to realize it in new creative ideas. Level of education and training of people in appropriate age categories are usually seen as the most important investments in human capital (Florida et al, 2008).

Summarising the ideas presented above, it is possible to claim that strengthening the creative dimension of the country or region provides an opportunity to achieve an economical breakthrough and strengthen modern competitive advantages. Smart management of the

regional development policy and consideration of the appropriate demographical factors provide an opportunity to accelerate and/or better control the development of the human capital creative dimension.

*In this Chapter author has shown that contemporary literature sources dealing with the concept of “Regional demography” are rather divergent in terms of scope and methodologies. This emerging discipline is often placed within the scope of such wider scientific fields as population statistics, population geography or spatial demography. However, evaluation of the more recent studies show that the concept of “regional demography” actually goes beyond the aforementioned study fields, by addressing a whole set of other region-oriented interdisciplinary issues associated with the population development and bringing new and unconventional research methodologies to the traditional population data analysis.*

*By reviewing the relevant literature, one can observe that many authors attempt to analyse the underlying social, economic or environmental factors preceding the regional demographic change, but only a handful of studies focus specifically on the intentional or unintentional demographic effects of the policy interventions or other attempts to control the regional population change. The limited amount of the relevant EU-level studies underline the risks implied by the current demographic dynamics of the EU Member States and their regions.*

*The unique historical and territorial situation of Latvia and many other post-Soviet countries present an interesting case for detailed spatio-temporal analysis as territories currently showing similar population dynamics may have arrived to the present situation by the divergent historical trends. Adding the additional time and space dimensions to the classic regional demographic research methodology can help one uncover new, previously unseen issues of regional demographic development, and indirectly observe the associated regional non-demographic processes for which there is little or no data available.*

*Creativity nowadays becomes a principal source of sustainable competitive advantages, economic welfare and success for the nations, states and regions. Human capital and its demographic determinants, like the existence and characteristics of the “Creative” cohort, have undeniable and important role in shaping the local creativity potential; and therefore, must be considered in relevant studies or policy planning.*

## 2 KEY DETERMINANTS OF THE REGIONAL DEMOGRAPHIC DEVELOPMENT IN LATVIA

Now that we have established what “Regional demography” is, and seen what research directions and methodologies it entails, it is logical to proceed with determining the factual scope of the study. Keeping in mind the two primary hypotheses introduced in the beginning of this Thesis and recalling the results of theoretical review presented above it is logical to focus further analysis on several principal questions concerning the demographic and socio-economic regional development in Latvia.

First is the question regarding indicators and trends of the regional socio-economic and demographic development - it is important to determine the main present issues of regional demographic development and the implications they pose for the sustainable nationwide and regional development. Besides explaining the actual situation in the regions, this information will help author in defining scope of the further quantitative analysis and establishing primary data requirements.

Next, considering the previously mentioned role of the public policy in facilitating socioeconomic and possibly – even demographic change, one has to address the level of attention devoted to the regional demographic development by national policy makers and responsible institutions capable of influencing the socio-economic factors and conditions in the country and its regions. In other words, author has to establish the existence of “political will” and legal capacity to bring some changes in the area of regional demographic development.

Third, it is logical to evaluate the tools and methods already available and applied for bringing the socioeconomic and structural improvements in the regions, namely – activities of the national regional and cohesion policy. It is then necessary to understand, whether some of the identified policy instruments are capable of exhibiting some actual or potential influence on the local socio-economic and demographic processes, and whether they coincide with the aforementioned political will.

Finally, one has to appraise the spatio-temporal specifics of the regions in questions, which should be addressed in the further quantitative analysis.

## **2.1 Contemporary regional demographic challenges in Latvia and the associated socioeconomic factors**

Through the review of existing regional demographic studies, we have established that local population development within the specific country or territory is neither static nor homogenous process. Therefore, in order to capture main problems and trends of the regional demographic development in Latvia, it is necessary to explore thoroughly the existing statistical data, while focusing on the differences between various regions of the country, as well as the temporal dynamics of the demographic processes in question.

For centuries, the nationwide population census remains to be the principal method for obtaining detailed and comprehensive data on residents, their families and households at the smallest possible level of territorial division in the country (see Baffour et al, 2013). It was in early 2011 when the latest national population census has been carried out in Latvia, commissioned and implemented by the Central Statistical Bureau of the Republic of Latvia (CSB). The previous census in Latvia took place more than 10 years earlier - in 2000, and it was first one since the restoration of country's independence in 1991. Comparison of the key results of just these two sequential surveys clearly depicts not only the substantial pre-existing regional demographic disparities, but also indicate an alarming progressive divergence of the population development trends throughout the country.

According to the CSB, during the census of 2011, data on the actual population numbers in Latvia and its municipalities were obtained using three distinct methods:

- residents were invited to complete census questionnaires online;
- CSB personnel visited people at their places of residence;
- conclusions regarding the other residents not polled individually were drawn using the information available in the State information systems and administrative registers.

Results of the 2011 census, have shown that as of March 1, 2011 the actual number of population in Latvia was 2 070 371. Such number was rather alarming, especially when considered in comparison with the previously available population figures of January 1, 2011: 2 236 910, derived from the official data of the Population Register, maintained by the Office of Citizenship and Migration Affairs (OCMA), revealing that the actual number of Latvian population was in fact lower by over 166 500.

Such gap has been previously predicted in several academic studies (e.g. see Hazans and Philips 2010), explaining that these differences in population figures are caused by the fact that a large portion of work-migrants, moving to another country for temporary

employment, do not notify the competent authorities about the change of their residence data. In this regard, 2011 census results have only confirmed the scientific estimations, considering that during the census residents provided information on their actual place of residence, rather than the declared or recorded address stated in the Population Register.

The general comparison of the 2011 and 2000 census results show the overall decrease of country's population by more than 309 500 (13%) residents over just one decade. Using the combination of the CSB and OCMA data it is easy to observe, that the dramatic population decrease can be attributed to both the negative natural population growth (with number of deceased in most municipalities exceeding the number of new-borns) and the intensive international migration. Death rate in the entire period since the 2000 census has exceeded the birth rate, resulting in a population reduction of 119 000, whereas the population decrease attributed to the registered and unregistered emigration may be estimated to be around 190 000 persons or roughly 9% (CSB, 2016 and OCMA 2016).

Before proceeding any further with the review of the census results and population trends on the regional level, it is necessary to touch upon the basic principles, specifics and hierarchical structure of the country's administrative division.

At the national level, there are five planning regions in Latvia: Riga, Kurzeme, Zemgale, Vidzeme and Latgale, which is in slight contradiction with the NUTS 3 classification, which defines six statistical regions (MoEPRD 2016 & CSB 2015a). The NUTS 3 regions of Riga and Pieriga merge into a single Riga planning region and are viewed as one in most political and planning documents. The available statistical information, however, is available mostly for the NUTS 3 division. For the purpose of the study carried out in this Thesis, the author, subject to the particular issue under discussion, uses both regional classifications. On the municipal level, two types of Local Administrative Units (LAU) exist in Latvia – Cities under state jurisdiction and local municipalities (*novadi*). The administrative-territorial structure of Latvia will be discussed in detail further in this Thesis.

Riga planning region undoubtedly deserves a special attention from the demographic perspective, as, according to the latest census data, it is now home for more than 50% of total population of Latvia (with 32% of total country's population residing within the Riga city limits). Such situation places Latvia amongst the short list of unique countries with extremely prominent centre-periphery population distribution structure.



**Figure 2.1 Planning regions, Statistical (NUTS 3) regions and Cities under state jurisdiction in Latvia as of 2016**

*Latvijas Plānošanas reģioni, Statistiskie (NUTS 3) reģioni un Republikas pilsētas 2016. gadā*

Source: MoEPRD 2016, CSB 2015a

On the level of the planning regions, most significant losses in population count in 2011, as compared with 2000, may be observed in the Latgale region (21% reduction), where both the negative natural population growth and the intensive emigration (have caused the most alarming demographic conditions. Population losses were slightly less pronounced in Vidzeme (17.4%) and Kurzeme regions (16.0%), while Zemgale (13.2%) and Riga planning regions (8.4%) demonstrate some marginally better results.

According to the annual reviews developed by the State Regional Development Agency (SRDA), largest cities generally follow the overall population decline tendency of their respective regions. Between the two latest censuses, population count has most rapidly declined in Daugavpils (19.1%) and Rezekne (17.7%), both located in the Latgale region. On the other hand, the lowest rate of depopulation was in Jelgava (6.6%) followed by Jurmala (9.0%), Valmiera (9.5%), Jekabpils (11.7%) and Ventspils (12.0%). Population of the Riga city has dropped by about 14 percent over the decade (SRDA 2012).

On the lowest – municipal level, during the 2000-2011 period actual population growth has been registered in just 17 out of 110 local municipalities. All of the municipalities showing positive population trends are situated in the direct vicinity of the Riga city and fall within the so-called “Riga city area of influence” which will be addressed later in this thesis. The remaining 93 municipalities have demonstrated population decrease, with the most noticeable drop (30%) registered in Baltinava and Viļaka municipalities, closely followed by Alsunga (29%), Cībla and Aglona municipalities (28%), as well as Kārsava and Rundāle municipalities (27%). Other LAUs show less severe, but still troubling reductions.

As it was already mentioned, there is a noticeable difference between the actual number of residents (as displayed clearly by the 2011 census) and the official records data on

registered population. Keeping in mind that after the 2011 census results were published, CSB have adjusted their population estimation methodologies in order to capture the actual amount of residents at the given time, it is now both possible and useful to compare the (1 January 2016) difference between these indicators on the various levels of territorial division (CSB, 2012a).

By subtracting the actual population numbers from the official registered figures, and later, calculating the proportion of the registered population missing from the region, one can produce a simple yet effective indicator for capturing the scale of population displacement (e.g. those who have temporary left their places of residence for other regions or other countries in search for employment or due to other factors). Hereafter, in the following Chapters of the thesis, author will be referring this indicator (ratio) as Missing Registered Population (MRP).

$$MRP = \frac{\text{Registered population} - \text{Factual population}}{\text{Registered population}} \quad (2.1)$$

Table 2.1 shows the differences between the estimated actual number of residents and the registered population as of January 1, 2016 in all five planning regions, as well as aggregated results for the cities under state jurisdiction and local municipalities. Figures for the two local municipalities with the highest positive and negative shares of MRP are also shown.

As one may see from the table, the actual population of Latvia was 8.2 % smaller than according to the OCMA data on registered residents. The adjusted actual population data produced by the CSB indicate a significantly smaller population figures in all planning regions. In comparison with the Population register data, the largest differences are evident in Latgale (9.5%) and Kurzeme regions (9.1%), while the Riga planning region (7.7%) shows comparatively smallest divergence.

Looking at a smaller, municipal level it is possible to observe that there is also a significant disparity in the overall number of residents among the LAUs – as of 1 January 2016, the smallest municipalities in Latvia in terms of actual population are Baltinavas novads (1 062), Alsungas novads (1 380) and Mersraga novads (1 554). On the other hand, the largest local municipalities in terms of population include Ogres novads (34 028), Talsu novads (28 947) and Tukuma novads (28 726), which even outnumber majority of the Cities under state jurisdiction. Among the cities, Riga has by far the largest population estimated at

638 784, whereas the population of the smallest city under state jurisdiction - Jekabpils is only 22 722 residents.

Table 2.1

**Difference between the actual and registered population count in Latvia and its regions as of 1 January 2016**

*Starpība starp faktisko un reģistrēto iedzīvotāju skaitu Latvijā un tās reģionos uz 2016.gada 1.janvāri*

Planning region or municipality	Population count		Difference	MRP (%)
	Registered	Actual		
Riga region	1091469	1006943	84526	7,7%
Vidzeme region	213438	195799	17639	8,3%
Kurzeme region	276024	250897	25127	9,1%
Zemgale region	258901	239335	19566	7,6%
Latgale region	304931	275983	28948	9,5%
Local municipalities ( <i>Novadi</i> )	1033313	957427	75886	7,3%
Cities under state jurisdiction	1111450	1011530	99920	9,0%
Highest negative MRP ( <i>Burtnieku novads</i> )	7977	8059	-82	-1,0%
Highest positive MRP ( <i>Jurmala city</i> )	57371	49305	8066	14,1%
<b>Latvia</b>	<b>2144763</b>	<b>1968957</b>	<b>175806</b>	<b>8,2%</b>

Source: Author's elaboration based on the SRDA and CSB data.

Recent official report of the State Regional Development Agency (SRDA) points out that although, according to the national Law "On Administrative Territories and Populated Areas" the minimum statutory criterion for municipalities is set at 4 000 residents and for cities – 25 000. This means, that approximately one-third of the local municipalities and one city (Jekabpils) do not meet the criterion according to the actual population data. (SRDA 2013).

Returning to the Table 1.1, comparing the actual municipal population figures with the registered data, one may observe, that in 2016 actual population of the cities has been smaller by an average of 9.0%, and population of local municipalities by 7.3%. It is also possible to observe some ongoing divergence of the actual and official data in the few recent years, for instance – the MRP percentage for cities and local municipalities in 2011 has been 7.2% for the cities and 7.9% for municipalities. However, by 2016, the average MRP figures for cities and *novadi* have become reversed, as cities now show noticeably higher percentage than the municipalities.

In addition, in 2011 there were eight local municipalities (all located in the vicinity of Riga city) showing the small surplus of actual population (negative MRP values) in relation to the register data. Whereas five years later, in 2016, only one such LAU - *Burtnieku novads* demonstrates the negative MRP rate (surplus population). Throughout the country, MRP differs greatly, ranging from -1.0% in *Burtnieku novads* up to as much as 14.1% in *Jurmala city* or 13.1% in *Auces novads*. The fact that these two particular LAUs have scored highest in terms of MRP presents an extremely interesting and illustrative case. This is because *Jurmala* (high-income resort city within the Riga planning region) and *Auce* (rural municipality near the border with Lithuania) obviously have different underlying causes for the high MRP rates, and, consequently – receive different economic outcomes from their situation. The explanation for this unusual divergence can be found in the spatial and socioeconomic specifics of the two municipalities under question, as well as (surprisingly) in the peculiarities of the Latvian national tax system.

Available spatial and socioeconomic data (RDIM 2016), as well as the information published by the *Jurmala* municipality (NRA, 2013) leads to the conclusion that Residents of *Jurmala* prefer to register (declare) their place of residence and procure real estate property in this city in order to gain additional socioeconomic benefits, while actually residing and working in Riga. The short commuting time between *Jurmala* and *Riga* city is also an important factor allowing people to switch their place of residence frequently or seasonally.

On the other hand, *Auce* municipality does not have the benefit of being located next to a big city, nor has it so many attractive socioeconomic benefits to offer its residents. Almost a 1 000 of its 7 586 registered population chose to look for temporary residence in other LAUs or even outside the country due to the degrading socioeconomic conditions, poor access to jobs and underdeveloped transport infrastructure. So why is *Jurmala* still a winner in this situation?

According to the Ministry of Finance of the Republic of Latvia (MoF), Latvian national tax system foresees the partition of all tax income between the State budget and municipalities, subject to the type of the tax and proportions predefined by the legislation. As of 2016, Personal income tax is distributed as follows:

- 80 % of the tax income is received by the municipality in which the particular person is registered as a permanent resident
- 20 % of tax income goes to the state budget.

Furthermore, 100 % of the Real estate tax collected in the particular municipality remains in the local municipal budget (MoF, 2016a).

As a result, *Jurmala* city receives high levels of tax income from its registered residents, who actually live, gain income and use public infrastructure of the country's capital - *Riga*. On the other hand, *Auce* municipality is losing its human capital through the unregistered migration process, only gaining some (usually limited) returns in the form of the Personal income tax. Considering the case explained above, it is clear that yet another task of the regional demography is – to distinguish such cases of apparently similar regions with different underlying conditions, and present policy-makers with the tailored solutions for each particular territory.

The availability of the actual data on population age structure produced by the 2011 census provides an opportunity to analyse one of the most important indicators directly linking the realms of demography and economy - demographic pressure or dependency ratio (i.e. the number of persons outside working age per 1000 persons of working age) (e.g. see Zvidrins 2003).

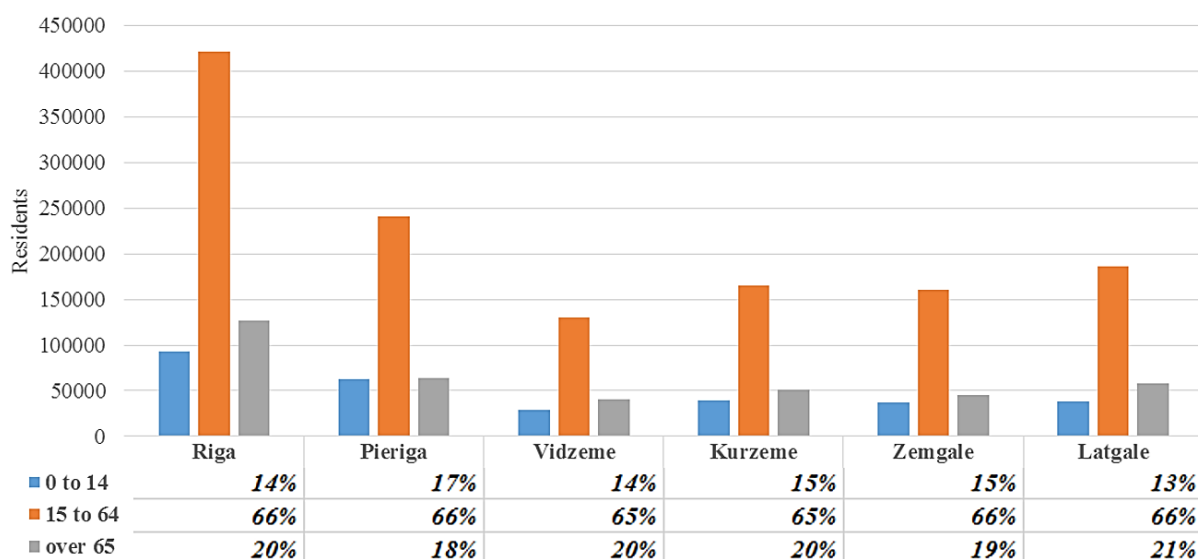
Demographic pressure is used for measuring the proportional distribution between the different age-specific groups of residents, and specifically – those who are of their working age and are (or could be) capable of economic activity and the rest of population (children, seniors) supported by the economically active inhabitants. The type-specific dependency ratios are also often employed for the more detailed socio-economic analysis, e.g. - old age dependency ratio.

According to the CSB reports, since 1993, share of seniors within the demographic pressure have exceeded that of minors, meaning, that in the following years there will be less and less residents of working age and the overall demographic pressure level will keep growing (CSB, 2013). Latest census results confirm the alarming trend of population ageing – share of seniors in the population structure is gradually growing due to low fertility and intense outmigration of youth and economically active population.

CSB data (CSB, 2013) show that in the period between the 2000 and 2011 population censuses, the total number of minor population (below 15 years of age) in Latvia has receded by 31.6% (roughly 136 thousand) and working age population number (15-61 years of age) has dropped by 12.2% (185 thousand), while the number of senior residents (62 and older) grew by 3.2% (14 thousand). During the 2011 census, on the NUTS3 level, highest shares of minors (0-14 years) in the population structure have been recorded in the Pierīga (16%) and Kurzeme (15.2%). On the other hand, lowest shares of minors were in Rīga (13%) and Latgale (13.2%). In terms of actual working-age population, Rīga and Zemgale NUTS3 regions were the leaders with 64.8% and 64.3% respectively. Largest share of senior residents

among the local population was observed in Latgale (22.9%), while the lowest such ratio was registered in Pierīga (19.9%), making it the most successful NUTS3 region in terms of demographic pressure in the census year.

The more recent CSB estimations for 2015 show no noticeable improvements, with the average population age being 42.5 years (39.2 for men and 45.3 for women). In average, the youngest (judging by the mean age) inhabitants reside in the Pierīga NUTS 3 region (40.9 years average), while the oldest (44 years average) – in Latgale regions (CSB, 2015b). For more detail, Figure 2.2 below shows the estimated population distribution by age groups of “0 to 14”, “15 to 64” and “over 65” in all six Latvia’s NUTS 3 regions.



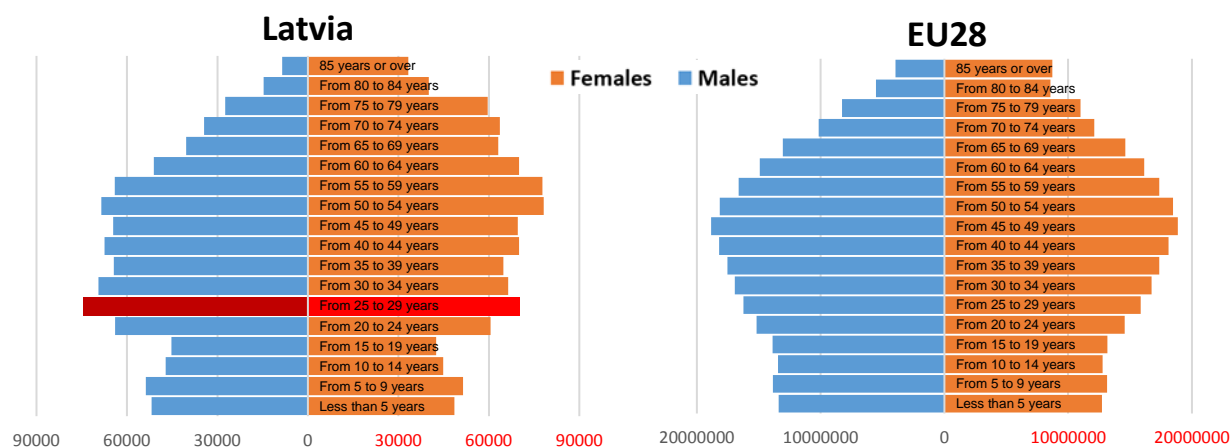
**Figure 2.2 Population in Latvia’s NUTS 3 regions by age groups as of 1 January 2015**

*Latvijas NUTS 3 reģionu iedzīvotāju sadalījums pa vecuma grupām uz 2015.gada 1.janvāri*

Source: Author’s elaboration based on CSB data

From the chart presented above, one can see that the share of population in the “15 to 64” cohort is nearly the same in all regions, while the number of minor population in the “0 to 14” age group is subject to the highest dispersion: from 13% in Latgale to 17% in Pierīga.

After studying the regional population ageing trends, it is useful to see, how these project on to the wider picture of nationwide demographic stability. The simple population pyramids (see Figure 2.3) can best represent the overall situation in the country, in terms of gender and age structure. When compared to the EU28 average, Latvia generally follows the EU-wide trend of imminent population ageing and raising old-age dependency, with the widest population cohorts located between the age of 50 and 59 in Latvia, and 45 to 54 in the EU28. Both pyramids show clear sustainability issues, with an obvious shortage of population in the 0 to 19 age groups.



**Figure 2.3 Population pyramids of Latvia and EU28 as of 1 January 2015**

*Latvijas un ES28 iedzīvotāju piramīdas 2015. gada 1. janvāri*

Source: Author's elaboration based on Eurostat data

After closer examination, one may notice, that Latvia, as well as some other post-Soviet states, has a rather unique feature in its population age and gender structure. Unlike the majority of the 28 EU Member States, Latvia has experienced a noteworthy but temporary increase in birth rate during the late 1980's and early 1990's (highlighted in red in the Figure 2.3), which is often referred to as the late Soviet "baby-boom" (see Lutz et al, 2002). This period of relatively high birth-rate was followed by a rapid decrease in fertility causing speculations over the long-term perspectives and sustainability of the human capital in Latvia and other post-Soviet countries. This interesting issue will be analysed separately in the further Chapters of this Thesis.

The aforementioned demographic challenges are even further highlighted by the alarming figures of the two most basic population development indicators – namely birth rate and mortality. According to the OECD 2011 global rankings (OECD, 2016), in year 2011 Latvia held the 18<sup>th</sup> place in the world in terms of crude death rate (13.9 ‰), contesting such states as Chad and Equatorial Guinea. The latest national CSB data for 2015 show even higher rate of 14.4 ‰ as a country's average. According to the same OECD dataset, in terms of crude birth rate, in 2011 Latvia had 226<sup>th</sup> place in the global ranking, showing similar result (9.1 ‰) with Italy. Latest available results posted by the CSB show some improvement – in 2015, the indicator has reached 11.1 ‰.

Furthermore, in Latvia, one can observe, that both crude birth rate (CBR) and crude death rate (CDR) figures vary among regions. However, the observed range of crude birth rate

by region is much lower than the variance of mortality indicators. Therefore, further analysis in this Thesis will have greater emphasis on the mortality issues.

Table 2.2 below shows the crude birth rate and death rate figures for the statistical regions of Latvia in 2015.

Table 2.2

**Crude birth rate and death rate values in the statistical regions of Latvia in 2015**  
*Vispārējie dzimstības un mirstības koeficienti Latvijas statistiskajos reģionos 2015. gadā*

Statistical (NUTS 3) region	Crude birth rate (‰)	Crude death rate (‰)
Latvia	11,1	14,4
Rīga region	11,8	13,7
Pierīga region	12,5	12,2
Vidzeme region	10,3	15,5
Kurzeme region	10,9	14,7
Zemgale region	10,6	14,5
Latgale region	9,0	17,7
<b>Range</b>	<b>3,5</b>	<b>5,5</b>

Source: Author's elaboration based on the CSB data.

It so happens that only the crude birth rate data in Latvia is available on the municipal territorial level, while the mortality indicators are only produced on the level statistical regions. This fact outlines a need to produce an estimated mortality data for the smaller administrative-territorial units by the way of standardisation. The process and results of such recalculations are presented and discussed by the author in the following Chapters of this Thesis.

All of the information offered above, as well as the specialised literature and official reports produced by various government agencies (e.g. see Berzins & Zvidrins, 2011, or SRDA, 2013) confirm that the key contemporary problems of regional demographic development in Latvia, which should be the primary focus of in-depth analysis, as well as any available corrective measures include:

- intensive out-migration (both long and short-term),
- depopulation and demographic deterioration of rural areas, and
- population ageing, as a result of:
  - high crude death rate;
  - low crude birth rate.

Furthermore, initial review of the available statistical data shows that the abovementioned issues and their associated problems vary in their territorial impact, with

some particularly grief cases located in the rural areas and/or peripheral regions, while others (usually, natural processes like fertility etc.) being distributed more evenly throughout the country. Such spatial distribution of the demographically challenged areas allow making a provisional conclusion that many regional demographic processes in Latvia are either directly, or indirectly linked with the socioeconomic context of the particular territory.

In case of Latvian statistical regions, the available structural data only support such assumptions, as the primary economic indicators of the planning regions follow the pattern of continuous divergence and generally correlate with the regional demographic trends since the restoration of independence in 1991. Already in 1997, one of the leading Latvian experts in the field of regional economics, Baiba Rivza has pointed out negative socioeconomic dynamics prevailing in the rural areas of the country (see Rivza, 1997).

Table 2.3 below presents some statistical examples of the structural economic disparities existing between Latvia's statistical regions.

Table 2.3

**Structural economic data for Latvia's statistical regions**  
*Latvijas statistisko reģionu strukturālie ekonomiskie dati*

		Latvia	Riga region	Pieriga region	Vidzeme region	Kurzeme region	Zemgale region	Latgale region
GDP per capita <sup>2</sup> (EUR) <sup>3</sup>	<b>2003</b>	4 170	7 100	3 112	2 512	3 768	2 634	2 020
	<b>2013<sup>1</sup></b>	11 309	18 836	9 305	6 944	8 497	7 152	6 159
	<i>Growth</i>	171%	165%	199%	176%	126%	172%	205%
Household disp. income per capita (EUR/month)	<b>2004</b>	N/A	189,01	145,33	109,07	117,12	117,08	102,76
	<b>2014</b>	N/A	472,88	424,44	322,26	359,09	331,08	261,40
	<i>Growth</i>	N/A	150%	192%	195%	207%	183%	154%
Economically active firms per 1000 inhabitants	<b>2014</b>	82	105	74	80	70	63	66
Unemployment rate (15-74)	<b>2005</b>	10,0	9,0	9,0	8,8	12,6	7,6	14,4
	<b>2015</b>	9,9	7,5	5,8	11,5	10,6	11,2	18,6
	<i>Change</i>	-1,0%	-16,7%	-35,6%	30,7%	-15,9%	47,4%	29,2%

*Notes:* 1) Latest available data in comparison with the same indicator values one decade earlier (if available). 2) Real prices. 3) 1 Euro = 0.7028 Latvian Lats in accordance with the Bank of Latvia exchange rate.

*Source:* Authors elaboration based on CSB, 2016 data

Since the restoration of independence, the difference in social and economic development between Riga and all other regions has remained among the main challenges for Latvian national regional policy. Key statistical indicators show that Latgale region is the

most problematic; however, the Vidzeme, Zemgale and Kurzeme planning regions also require constant support and attention.

A regional comparison of GDP reflects the location of the workforce and economic activity in Latvia. The role of Riga region in the economic structure of the country is clearly illustrated by the division of GDP. The volume of GDP per capita in Riga city in 2003 was slightly over €7,000, while after the turbulences of the economic crisis of 2008-2010 it has grown above the €18,800 by the year 2013, significantly surpassing the national average of just €11,300. In 2003-13, the Riga region registered GDP per capita growth of only 171 percent, whereas the poorest Latgale region has reached an impressive 205 percent growth. Thus, one can speculate about the presence of some level of catching-up effect among the Latvian regions, and assume that the negative economic growth during the recent crisis of 2008-10 has been accompanied by a narrowing of interregional economic disparities. It is also possible to observe, that the regional demographic issues described earlier seem to correlate with the actual GDP per capita figures and ignore the growth dynamics.

A similar initial historic disparity in economic development is reflected in the household disposable income data, where in both 2004 and 2014 Riga region and Pieriga regions surpass all other regions by a substantial margin. However, Riga and Pieriga are far from similar in terms of the number of enterprises per 1000 inhabitants, where Riga is a clear leader, while Pieriga falls below the country average. This observation underlines the difference of socio-economic functions of these territories.

Basic Employment statistics show an even more diverse picture. One can notice that over the last decade, in terms of Unemployment, agriculturally developed Vidzeme and Zemgale regions have traded leading roles with Riga and Pieriga, while Latgale had maintained the lowest position throughout the decade, reaching an alarming 18,6 percent unemployment rate in 2015.

It is both interesting and important to note, that due to the revaluation of the Latvia's population numbers caused by the final 2011 census data, various economic and social indicators measuring the selected phenomena per capita (or per 1000 inhabitants) had to be recalculated in 2012. Keeping in mind the reduction of the actual number of residents, many indicators, such as GDP, employment etc. now appear to be higher and demonstrate better performance even during the 2008-2010 economic crisis. Naturally, the negative socioeconomic statistical indicators have faced the reversed effects.

## 2.2 Demography and the national policy

The pressing need to better understand relations between local socio-economic and demographic dynamics and account for it in the national and EU-wide policy response was repeatedly underlined by many recent studies, including those carried out by the European Commission (e.g. see Fesus et al, 2008). It is well known, that there is a limited amount of factors capable of influencing the aforementioned socio-economic conditions on the national and / or regional level, and the direct policy actions carried out by the national or local government are among the most important of these factors, and the only ones, which can be adjusted on a relatively short notice.

The review of the limited amount of literature sources addressing the topic of corrective demographic policy measures (e.g. Pol & Thomas, 2013; Gauthier, 2007 or McDonald, 2006) in various countries provides some basic ideas on the possible directions and scope of such policy activities. First, a crude partition of the demographic policy measures can be made along the lines of their temporal direction:

- Reactive policy measures, addressing those demographic problems, which have already manifested themselves;
- Proactive policy measures, attempting to strengthen or improve the existing demographic situation and / or avoid the forecasted future challenges.

Furthermore, both kinds of policy measures can focus on a variety of demographic processes ranging from fertility to education attainment, or from economic activity to ethnic segregation. However, literature source suggest, that majority of the demographic policy tools may be classified under two sub-groups:

- Stimulating measures, aimed at boosting general demographic development or improving particular indicator (i.e. – CBR);
- Discouraging policies, trying to or reduce the effects some specific expanding demographic process (most often – overpopulation) (fine example has been provided by a Dutch-American demographer John Bongaarts, 2001).

Of course, the spatial characteristics of the policy actions must also be taken into account, because such measures can be applied either in a nationwide context or on the regional level, targeting specific demographically challenged territorial units. In their paper “*Global population trends and policy options*”, Kenyan demographer and health scientist Alex Ezeh, J. Bongaarts and their Nigerian-American colleague, sociologist Blessing Beru (2012) explain, that although in the past few decades, much attention of policy makers and researchers has been focused on high fertility in the developing countries, concerns about the

adverse effects of below-replacement fertility in economically advanced states are on the rise. The obvious lack or low prevalence of stimulating demographic policies in many developed countries, including Europe can be explained by several factors:

- a political disinclination to interfere with personal decision making concerning household size, childbearing and other subjective issues (e.g. Caldwell et al, 2002);
- Prevalence of views that demographic processes are mostly natural or self-regulating phenomena that will soon increase again without intervention, and the high cost of any intervention is therefore unjustified;
- Political inconsistency of advocating the traditionalist and nationalist pro-family / pro-birth policies at home, while supporting liberalisation of societies and reduction of fertility in developing countries (see Ezech et al, 2012 or Deminy, 2011).

However, as it was demonstrated in the previously mentioned high-level reports produced by the European commission or the EPRC, in recent years such political reluctance to address the demographic issues is now largely disappearing as the alternative costs of inaction becomes increasingly evident. However, despite the hopes of political leaders for the quick and decisive effects of directed demographic policy interventions, individual studies carried out around the world show that all forms of demographic policy measures could have different effects in different institutional, cultural, or economic environments (e.g. see Boccuzzo et al, 2008). This realisation emphasises the role of regional demographic studies as the mandatory tools for tailored policy planning on the sub-national territorial levels.

Another important demographic policy dimension, which has gained a renewed public attention in recent years in the economically advanced countries, is immigration. Increased inflow of foreign nationals capable of (at least temporarily) correcting the population age-structures, and potentially – introducing higher fertility models to the demographically declining regions is a subject of long and controversial debates among both, policy makers and demographic researchers. Despite the optimistic views of many European policy makers prevalent in the past decades, researchers estimate that hundreds of millions of immigrants will be required to keep the demographic pressure ratios constant in countries with particularly low fertility. Furthermore, many developed countries with low fertility such as Canada, Australia, the USA, France, Germany, and the UK are focusing on attracting increasing numbers of highly skilled workers. British demographer Robert Skeldon has argued that the effect of this pattern of migration on development in the countries of origin of the skilled immigrants, including Latvia is an unclear and controversial issue (see Skeldon, 2009).

In order to evaluate the role of demographic development priorities within Latvian public policy, author analyses the contents of several key Latvian national policy planning documents and relevant legal acts in the field of social, regional and cohesion policy, while searching for references or specific proposed actions concerning the nationwide and / or regional demographic issues. Table 2.4 below, shows number of references to the selected demography-related key-words within the main, currently relevant Latvian national policy planning documents. These results were obtained using a software-based adaptive content analysis methodology, following the basic principles outlined in the literature (e.g. see Lowe, 2002). Such methodology has been extensively reviewed and evaluated as a tool for the content analysis of the political texts and policy document by American political scientists Justin Grimmer and Brandon M. Stewart (2013).

Table 2.4

**Content analysis results of several key Latvian national planning documents with the selected key-words**

*Latvijas nacionālo plānošanas dokumentu satūra analīzes rezultāti, pielietojot atlasītus atslēgvārdus*

Document	<b>Key word</b>									
	<i>(number of references related to the regional context is given in the brackets)<sup>1</sup></i>									
	<i>Population</i>	<i>Demography</i>	<i>Birth rate</i>	<i>Mortality</i>	<i>Life expectancy</i>	<i>Migration</i>	<i>Immigration</i>	<i>Emigration</i>	<i>Family</i>	<i>Marriage</i>
1. <i>Sustainable Development Strategy of Latvia until 2030</i>	150 (24)	21 (0)	3 (0)	1 (0)	0 (0)	8 (6)	1 (0)	1 (0)	19 (0)	2 (0)
2. <i>National Development Plan 2014-2020</i>	139 (9)	6 (0)	6 (0)	4 (0)	3 (0)	2 (0)	2 (0)	6 (0)	32 (0)	0 (0)
3. <i>Declaration on the Planned Activities by the Maris Kucinskis' Cabinet of Ministers</i>	9 (0)	5 (0)	2 (0)	0 (0)	1 (0)	3 (0)	1 (0)	1 (1)	18 (0)	0 (0)
4. <i>National Regional Development Law</i>	3 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
5. <i>EU Structural and Cohesion Funds Operational Programme "Growth and Employment"</i>	250 (18)	15 (1)	1 (0)	10 (0)	3 (0)	4 (2)	0 (0)	2 (1)	57 (7)	0 (0)
6. <i>Addendum to the EU Structural and Cohesion Funds Operational Programme "Growth and Employment"</i>	62 (3)	1 (0)	1 (0)	0 (0)	2 (0)	2 (0)	0 (0)	0 (0)	22 (0)	0 (0)
7. <i>State family policy Guidelines 2011-2017</i>	88 (2)	44 (1)	45 (0)	13 (0)	2 (0)	9 (1)	1 (0)	2 (0)	811 (2)	109 (0)

Notes: 1) matches located in the same sentences with the regional context key-words (e.g. rural, urban, regional, municipal etc.)

Source: author's elaboration based on Saeima, 2010; State Chancellery, 2012; Cabinet of Ministers, 2016; Regional Development Law, 2002; Ministry of Finance, 2014, 2015 and Ministry of Welfare, 2011.

It is important to note that the data mining software tool utilised in this particular part of the study (RapidMiner) allows for some degree of fuzzy-logical search, meaning that not only

the exact key-word matches, but also the logically related word matches have been recorded and analysed (e.g. see Hofmann, M. & Klinkenberg R., 2013). The quantitative content analysis of the selected national planning documents shows that key words associated with “population”, “demography” and “family” are the most often used demographic terms in the policy planning documents. Term “Population” (and its various forms / combinations) has been frequently employed in the regional and or spatial context – together with terms “regional”, “rural”, “urban” etc. Most other terms, with some exceptions for terms “migration” and “family”, had little to none connections to the regional and / or spatial perspective.

“Sustainable Development Strategy of Latvia until 2030”, and “National Development Plan 2014-2020” (Saeima, 2010; State Chancellery, 2012) have the largest share of the demographic references for the majority of key words analysed, and the biggest total number of “regional population” mentions among all the documents under study. It is not surprising, since these strategic documents mainly address the long-term sustainability challenges for the country and its regions. On the contrary, “Declaration on the Planned Activities by the Maris Kucinskis’ Cabinet of Ministers” (Cabinet of Ministers, 2016), being the key short-term operational planning document for the government priorities, has only few sentences specifically addressing the demographic challenges and regional disparities. National Regional Development Law (2002) also contains but a few references to the demographic issues, demonstrating, that on the legislative level, demographic issues are still viewed separately from the regional development concept.

EU Structural and Cohesion Funds Operational Programme “Growth and Employment” as well as its Addendum (Ministry of Finance, 2014, 2015) contain surprisingly numerous references to both, nationwide and regional population development issues, which can be explained by government’s attempt to (at least partially) use the available EU funding for tackling the pressing regional disparities. Despite the numerous key word matches found in the “State family policy Guidelines 2011-2017” (Ministry of Welfare, 2011), this document mostly ignores the regional context of demographic development, what places it in one group with the Government Declaration discussed above.

Overall, document review indicates the prevailing duality of the policy approach to the regional demographic problems. On one hand, these texts recognise the existence of significant regional demographic challenges and the risks they pose for the sustainable regional development. On the other hand, the principal legal acts do not present any coherent and strategic approach towards tackling these issues on a regional or local basis, rather



With this in mind, author performs content analysis of the meeting proceedings of the Latvian national parliament – Saeima, accumulated over during the 2004-14 period. A recently developed search tool and repository of the Saeima debate records “Saeima Debate Corpus” was used for this particular part of the study (see Dargis et al, 2016).

Using the aforementioned tool, author was able to identify numerous occasions, when the demographic and regional demographic issues were referred to by the politicians and experts participating in the Saeima debate. By conducting the follow-up review of these debates, author attempts to associate them with some specific demography-related events (major reports and publications). Consolidated results of this analysis are provided in the Table 2.5 below.

Table 2.5

**Content analysis results of the meeting proceedings of the Saeima, focusing on the specific population-related events in 2004-2014 period.**

*Saeimas debašu satūra analīze 2004.-2014. gadu periodā, demogrāfisko notikumu kontekstā.*

<u>Event</u>	<u>Year (approx.)</u>	<u>Notable references in the Saeima debates (Who? &amp; When? / Topic / Context / Conclusions)</u>
<b>Fears of increase in economic out-migration after Latvia’s accession to the EU</b>	2004	<b>I. Ostrovska</b> [New Era MP], August 2004/ - Low birth-rate and poor socio-economic conditions in Latgale region/ - Proposal for changes in the State budget 2005 for better regional social support and education/ - <b>Proposal rejected by majority.</b>
		<b>ForHRUL MPs</b> , December 2005/ - Emigration and degrading demographic situation/ - Motion for extraordinary hearing on emigration and demographic risks/ - <b>Motion blocked by majority.</b>
<b>SRDA reports significant depopulation of rural areas due to the economic crisis</b>	2008	<b>I. Godmanis</b> [Prime Minister], December 2008/ - Poor regional governance as a cause of ineffective regional support policies and regional demographic risks/ - Motion to support law “On Administrative Territories and Populated Areas”/ - <b>Law approved.</b>
		<b>V. Buzajevs</b> [ForHRUL MP], April 2009/ - Unemployment and poverty leading to regional depopulation/ - Proposal for amendments to the “Unemployed and Job Seeker’s Support Law”/ - <b>Proposal denied by majority.</b>

<b>Academics publish estimations of the true emigration numbers</b>	2009	<b>I. Paradnieks</b> [All to Latvia - FF/LNNK], December 2011/ - Unregistered migration, low birth rate, rural depopulation/ - Proposal for the amendment to the “Rules of Procedure of the Saeima”, foreseeing assessment of all future legislative proposals by the Demography committee/ - <b>Proposal rejected by the majority.</b>
<b>Full 2011 census results published, confirming worst-case scenario estimations</b>	2012	<b>V. Dombrovskis</b> [Prime Minister], January 2013/ - Depopulation and high dependency ratio demonstrated by the 2011 census results as a risk for national stability and security/ - Annual National Security Report/ - <b>Largely dismissive reception, highlighting the need to focus on ethnic and geopolitical issues instead.</b> <hr/> <b>I. Vanaga</b> [Reform Party MP], March 2013/ - Depopulation and re-emigration/ - Report on thematic welfare programmes incl. “Re-emigration plan”/ - <b>Agreement on lack of financial resources for the Plan to be effective.</b>

*Source:* author’s elaboration based on Dargis et al, 2016; Hazans , 2003; SRDA, 2010; Hazans & Philips, 2010; CSB, 2012.

First, the analysis results indicate a clear time lag between the specific events and the associated indications in the Saeima debates, ranging from a few months up to several years. This is not surprising, as in most cases such references were used as mere tools for achieving different political goals, most often - with the purpose of supporting a position, motion or legislative proposal when necessary, for example: I. Godmanis speech in support of the law “On Administrative Territories and Populated Areas”, or V. Buzajevs proposal for amendments to the “Unemployed and Job Seeker’s Support Law”.

Second, it is interesting to note that over the first few years of the period under study, regional demographic issues were often called upon by the left-wing and the so-called “pro-Russian” opposition parties in support of their anti-EU sentiment. As a result, for a time, demographic topics have become associated with the opposition’s policy objectives and were received antagonistically and dismissively by majority of the members of parliament, irrespectively of the actual context. Some years later, with the onset of the 2008-2010 economic crisis, a similar situation had developed, when representatives of both, left and right-wing parties started using references to the regional demographic problems in order to question the economic austerity policies implemented by the government.

Third, following the publication of the official 2011 census results, one can notice a growing understanding among the legislators of the severity and urgency of the regional demographic problems in Latvia. However, there is still a substantial lack of political will and

decisiveness necessary to address these problems on the parliamentary level - either by allocating the necessary funding or by supporting the associated legislative proposals.

A more thorough review of the content analysis results presented above can be found in the author's publication "*Regional demographic development in Latvia – does policy matter?*" (see Dahs, 2016a).

### **2.3 Latvian regional and cohesion policy – is there a place for demography?**

The previous sub-section has shown, that in Latvia, the legal and planning documents alone do not always present the tools and solutions necessary for addressing the regional demographic problems in the country. The document review has also shown that there are some established mechanisms capable of and applied for alleviating regional disparities and delivering targeted regional support, namely – national regional and cohesion policy. Therefore, before theorising any further on the subject of what could or should be done in order to improve the situation, one has to understand the internal workings of these policies and determine – to which extent these can be used for tackling the regional demographic issues.

Materials provided in this sub-section were produced over the 2013 - 2016 period by the researchers of the Centre for European and Transition Studies at the University of Latvia Professor Tatjana Muravska, Jānis Aprāns and Aleksandrs Dahs within the framework of the international research project "The Objective of Economic Cohesion in the Economic Policies of EU Member States" managed by the European Policies Research Centre (EPRC).

Author begins this review by exploring the institutional and legal framework of the national regional and cohesion policy systems, while discussing actual and potential place of the demographics-related issues within the scope of these complex administrative structures. To begin from the very foundations - the Regional Development Law (2002) (*Reģionālās attīstības likums*), which was included in the previous assessment, sets out the institutional framework of Latvia's regional policy. According to this legal act, the highest authority regulating the national regional policy in Latvia is the Cabinet of Ministers, which approves the National Development Plan and the Regional Policy Guidelines, and determines the procedures for implementing, evaluating and financing State-funded regional policy activities.

Funding for the purely national instruments (i.e. those, not reliant on the EU cohesion policy or other Foreign aid programmes) of the regional policy, as well as the State budget allocations for the Financial equalisation scheme and the domestic earmarked grants described

in detail further in this Chapter, is administered by the Ministry of Finance and adopted by the Parliament for each budgetary year within the framework of State Budget Law.

At the operational level of national regional policy, the two key actors are the Ministry of Environmental Protection and Regional Development (MoEPRD) and the State Regional Development Agency (SRDA), which is accountable to the Ministry. MoEPRD is responsible for planning, implementation and coordination of the domestic regional policy, and has an important task of aligning the available cohesion policy resources with the needs of national regional policy objectives. Both Ministry and its Agency work closely with the Planning region councils and municipalities in order to facilitate the better implementation of the place-based and bottom-up approach for both, domestic support instruments and cohesion policy activities aimed at supporting the national regional policy objectives.

In the sphere of cohesion policy, the Managing Authority in 2007-13 and 2014-20 planning periods is the Ministry of Finance of the Republic of Latvia (MoF). The Managing Authority, in cooperation with responsible institutions and consulting its social, NGO and regional partners, is the central body responsible for developing EU funds programing documents, ensuring compliance with the EU guidelines, regulations and principles, as well. The Managing Authority also conducts the overall EU funds management, evaluation and communication activities (MoF, 2016b).

Further, within the context of cohesion policy, there are several levels of Intermediate Bodies operating between the Managing authority and the recipients in 2014-20. The first level (responsible Bodies) is made up of sectoral ministries and the State Chancellery, as in 2007-13. The main second level (co-operation) Body is the Central Financing and Contracting Agency (CFCA) – a public body subordinate to the Ministry of Finance, responsible for many aspects of EU Fund management, and monitoring. Other co-operation bodies include state agencies and various public bodies engaged in the particular field of support, as well as the State Treasury.

In order to facilitate coordination between the different planning dimensions of national policies and the EU structural and investment funding (ESIF) in 2014-20 period, the Cross-sectoral Coordination Centre (CCC) has been set up in 2012 under the jurisdiction of the Cabinet of Ministers. In recent years, the CCC experts have played a notable role in bringing together the institutions involved in various aspects of the regional and cohesion policy implementation. It is necessary to make a note here that the CCC is operating closely along the lines of the National Development Plan (NDP), which places demographic development high on the priority list, and is focusing on aligning the various sectoral policies (including

social, economic, regional, cohesion etc.) in favour of the NDP strategic objectives. This means, that the efforts of the Centre could be viewed positively in the context of regional population development. Unfortunately, despite the general support by the government, as of 2016, CCC was unable to provide the expected benefit to the national cohesion policy management system. In early 2016, Cabinet of Ministers has initiated discussions on possible disbanding or reorganisation of the Centre.

The 2014-20 planning period has been marked by some additional rearrangements in the national structures for managing cohesion policy. First, the CFCA has gained several new functions, augmenting its role in the entire process of the evaluation, oversight and auditing of the EU co-funded projects. It is envisaged that the CFCA will also gradually replace the planning regions' administrations as the sole body responsible for information distribution and communication with funding recipients. The second major development was the creation in September 2014 of a new centralised agency for managing and evaluating all financial instruments, namely the Development Finance Institution, which is a State joint stock company.

Both, Planning regions and the local municipal authorities (novadi) contribute to the implementation of many aspects of regional policy. Representatives of these regional/local bodies regularly participate in discussions and consultations with the MoEPRD, which has adopted a client-oriented approach towards them.

Furthermore, local municipalities are responsible for drafting their own development plans, which serve as the basis for substantial regional and cohesion policy funding allocations in line with the Integrated Territorial Investment strategy:

- For the cities and towns designated as the development centres of national or regional importance (9 and 21 respectively), municipal development plans are used directly as basis for the funding allocations in line with the Integrated Sustainable Urban Development principle laid out in the Article 7 of the ERDF Regulation.
- For other municipalities – local development plans contribute to the aid strategies for the development of the specific Target areas covering the municipality in question.

From the legal perspective, the objectives of Latvia's regional policy are set out in a number of laws and planning documents. In addition to the Regional Development Law, which sets the overall institutional and administrative framework of the national regional development, the key strategic documents for regional policy are the Sustainable Development Strategy of Latvia until 2030, the National Development Plan 2014-20 (revised in 2013), and the Regional Development Guidelines 2013-19 (MoEPRD, 2013).

The Law on Regional Development states that its purpose is “to promote and ensure the balanced and sustainable development of the State, taking into account the special features and opportunities of the entire State territory and of its separate parts, to reduce unfavourable differences between areas, and to preserve and develop the features characteristic of the natural and cultural environment of each territory and its development potential”. However, as the previous content analysis has shown, this legal act has little concern for any particular regional demographic issue.

As explained previously, the Sustainable Development Strategy of Latvia until 2030 provides main development vectors for the country and its regions, while identifying specific strengths, weaknesses and opportunities associated with particular territories of the country. Strategy highlights several types of territories as “Focus areas” for the regional policy interventions. The National Development Plan 2014-20 sets three more detailed regional development objectives under the Priority ‘Growth of regions’:

- to promote economic activity in the regions: unleashing the potential of the territories;
- to enhance the availability of services to create more equal employment opportunities and living conditions;
- to ensure the sustainable management of natural and cultural capital.

The Plan is particularly interesting, because it is used in preparing national Operational programme of the national cohesion policy.

Moving from the framework and policy documents on to the implementation level, the primary document one should be analysing from the perspective of the Regional demographic development is the document “Regional Development Guidelines for 2013-19”, as it sets out the specific mid-term objectives for the regional aid and outlines the tools for achieving them. The 2013-19 guidelines feature two core objectives:

- to promote business development and job creation, as well as to improve the quality and availability of local services (mainly via public investment in regional economic convergence and development);
- to strengthen the capacity of regional and local governments and their role in territorial development (mainly via support for administrative infrastructure and capacity-building at the level of the municipalities and development centres).

Unfortunately, neither of the objectives provided by the Guidelines addresses the demographic situation directly. This is not so surprising considering the conclusions drawn in the previous sub-section of this Thesis. With this in mind, it is important to comprehend the

scale and scope of aid measures foreseen by these Guidelines, and understand - what secondary (indirect) demographic effects may be expected from such regional support toolset.

Previous sub-sections have clearly demonstrated that regional disparities in Latvia are rather significant (also on the scale of the European Union). Preceding policy measures, implemented in the previous planning periods, have failed to achieve decisive change in narrowing the gaps in regional development indicators. Therefore, within the new Regional Development Guidelines, it was necessary to reassess the existing approach to regional development and to find new, more efficient solutions and tools. Hence, a need to address a number of previously ignored regional policy issues was recognised. It was also acknowledged, that there is a necessity to prioritise the implementation of the development programs for local municipalities and regions.

As a result, municipalities and planning regions are now to play more active role in the facilitation of the development of their respective territories. By far the greatest change in comparison with the previous planning period of 2007-13 is the transfer of some decision-making power and responsibility for investment planning to municipalities, alongside with providing them with greater flexibility in promoting entrepreneurship, capacity building and extension of available financial resources. In addition, a wider territorial approach towards investment provision has been adopted with municipal development programs becoming both basis and precondition for investment grants within the framework of the cohesion policy supported initiatives.

Within Regional Policy setting, provided by Regional Development Guidelines for 2013-19, territories of Latvia are no longer divided into more developed and less developed ones. Instead, it is set out that development opportunities should be available to every territory of Latvia and a joined approach to regional development must be applied. This covers:

- stimulation of the economy and improvement of the business environment at a local and regional level;
- accessibility and availability of service;
- addressing the demographic change.

The third point makes these Guidelines an only policy document (although just an executive-level) specifically naming demography as an issue for regional development in Latvia. Guidelines identify two main points for addressing the regional demographic issues. First, it stipulates that the depopulation and continuous demographic “erosion” of the remote and rural areas is an inevitable process. Therefore, local municipalities falling under these categories must adapt and reprioritise the available resources in order better facilitate their

sustainability under such conditions, and the regional aid measures should specifically focus on helping them to reshape their social and economic environment.

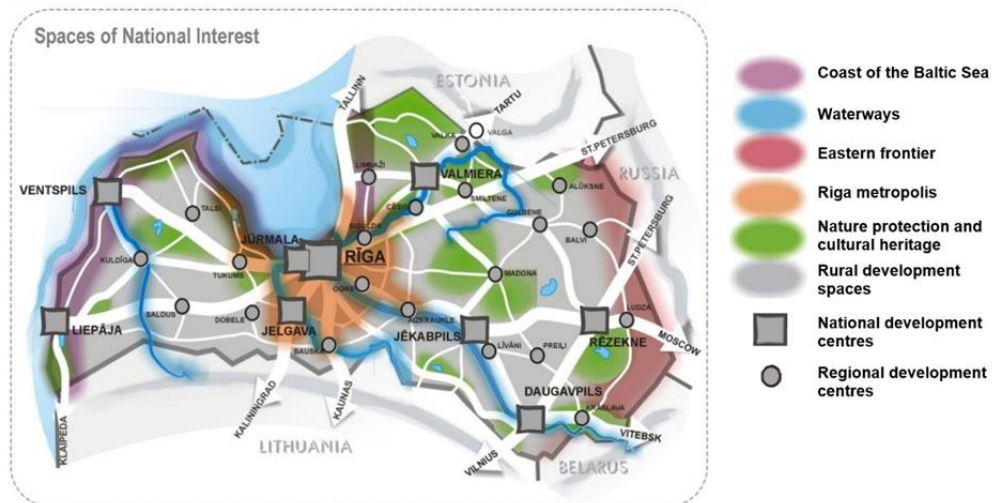
Second, cities and other Development centres of regional importance are identified as potential drivers in regional socioeconomic, and consequently – demographic development. The role of relational dynamics between these Centres and local municipalities (in terms of human capital, resource and investment flows) is highlighted as the primary source of regional demographic change. Therefore, one of the tasks for national regional policy is the search for flexible and innovative development solutions, which would incorporate exploiting and stimulating these spatial relations. In both cases, local municipalities are pointed out as the primary actors capable of shaping the regional policy actions and improving their own respective conditions.

As it has been already established that the regional policy in general, and the schemes dealing with the regional demographic conditions specifically, remain largely reliant on EU cohesion policy co-financing. Since 2014, apart from the Financial Equalisation Mechanism and State budget transfers to local authorities, the biggest instruments funded solely from domestic budgets are tax relief in free-ports and special economic areas. In addition, since 2012, each year, a small amount of direct Earmarked State budget grants has been awarded for small-scale development projects in municipalities. In order to compensate for the gap in cohesion policy funding in between the planning periods, in 2016, this amount has been increased nearly twofold (Law on State Budget 2016).

In order to align the available cohesion policy funding with the national and local regional policy needs in 2014-20, several intricate policy tools have been employed. Most notably, these involve the Integrated Territorial Investments principle, as well as the use of cohesion policy funding in combination with other foreign aid instruments (specifically - the Norway Grants) for the regional capacity-building schemes in the areas of entrepreneurship support and local infrastructure development. As a side note, it is important to mention that the European Commission approved Latvia's Regional Aid Map for 2014–20 on 9 April 2014, with the entire country (a single NUTS 2 region) being covered by Article 107(3)(a), as in 2007-13. Similarly, the whole of Latvia was covered by the Convergence Objective in 2007-13 and is classified as a Less Developed region in 2014-20. This makes Latvia and its regions eligible for all forms of Cohesion funding, including the EU Cohesion fund.

From the spatial perspective, as mentioned above, according to the national guidelines territories of Latvia are no longer divided into more and less developed. Instead, it is set out that development opportunities should be available to every territory of Latvia and a joined

approach to regional development must be applied. Nevertheless, it should be noted that within the framework of strategy “Latvia 2030”, special attention is devoted to the investment support for so called “Spaces of National Interest”, which, in the context of regional policy, are the national / regional development centres, rural development areas, Riga metropolitan area, and the Baltic sea coast alongside with the eastern frontier.



**Figure 2.5 Spaces of national interest in Latvia**  
*Nacionālās intereses teritorijas Latvijā*

Source: National Development Council (2010) Sustainable Development Strategy of Latvia until 2030

In line with this strategic vision, the following two groups of municipalities are highlighted in the current regional policy response: “Development centres of national or regional importance” (9 cities and 21 town) and three “Target areas” (Coastal area, Eastern border area and Riga city area).

In order to incorporate and prioritise support for the abovementioned areas in the regional policy response and to provide more decision-making and planning powers to the local municipalities, in 2014-20 period, the new approach of “Integrated Territorial Investment” (ITI) was introduced. It allows the responsible government bodies to allocate the available cohesion policy funding for the selected projects of chosen municipalities, that are selected in accordance with the development needs and capabilities of the particular territories. In turn, these needs and capabilities are identified by analysing the local municipal development programmes (MoEPERD, 2016). Several Special Support Objectives (SSO) have been introduced under the 2014-20 cohesion policy Operational programme “Growth and Employment” (most notably – SSO 3.3.1. and SSO 5.6.2.), aiming specifically at providing aid specifically for improving the socio-economic environment and infrastructure in the supported areas:

- For the cities and towns designated as the development centres of national or regional importance, ITI approach mainly provides opportunities for obtaining the cohesion policy funding for urban development.
- For the three Target areas, ITI framework outlines individual priorities for granting the cohesion policy funding:
  - Coastal areas: public infrastructure facilitating business development;
  - Eastern border area: infrastructure for accessibility, promoting economic activity, transit & logistics services;
  - Riga city area: support for projects of national significance.

In all cases, project applications submitted by the municipalities included in the support area and falling under the relevant cohesion policy SSO, are shortlisted to be funded and implemented in accordance with the Limited project selection procedure. This procedure allows the invited applicants to submit their project proposals at the early stages of planning of the particular cohesion policy activity. As the result, the pre-selected projects can then be approved faster and with significantly reduced competition (CFCA, 2015).

The main difference between the two ITI target groups is that the Development centres of national or regional importance can submit project proposals based directly on their own development programmes, while municipalities in the three Target areas have to meet the project objectives set for them by the national authorities (although, these objectives are defined for each of the Target areas on the basis of the municipal development programmes prepared by the local municipalities of the particular area and time period).

From the legal perspective, selection of the aforementioned Target areas is based on the Parliament's amendment of the Regional Development Law in April 2014 and on the Regional Policy Guidelines for 2013-19. The amended Law (Section V) defines the Target areas as 'territories with specific challenges and development potential'. The target territories replace the historical list of 'specially supported areas' (at the level of novadi) which was regularly updated until the end of 2012, and where firms were eligible for automatic tax relief and direct grants (MoEPRD, 2010).

Further, the development programme of the Latvia's easternmost Latgale region is still viewed as a viable option for strengthening the region's socio-economic conditions in the future. In 2016, Parliament of the Republic of Latvia (Saeima) has adopted legislation developed by MoEPRD, which provides for the establishment of Latgale Special Economic Area in Latgale region. Legislation lays down basic criteria for evaluation of Latgale region territories, based on which status of Special Economic Area can be granted to the specific

municipalities, including, but not constrained to, the territorial type, infrastructure conditions and the foreseen investments (Law “Latgales speciālās ekonomiskās zonas likums”, 2016). Territory of the Latgale Special Economic Area will be determined by the government in the by-laws, but according to MoEPRD estimations, this area could reach 2,040.7 hectares and cover many underdeveloped municipalities. The size of Special Economic Area will not exceed 5 percent of the total Latgale region territory. Scheme will be operational at least until December 31st, 2035.

Focusing on the cohesion policy - Latvia’s Partnership Agreement was formally submitted to the European Commission on 15 January 2014, and the single Operational Programme on ‘Growth and employment’ was submitted to the Commission on 4 March 2014. It was finally approved by the Commission on 11 November 2014. Latvia will receive a total of €4.3 billion from cohesion policy in 2014-20 (including €4.2 billion under the Investment for Growth and Jobs goal, €82 million for European Territorial Cooperation and €27 million for the Youth Employment Initiative, all at 2011 prices). This is a 8.5 percent reduction in funding compared to 2007-13, when Latvia received approximately €4.7 billion (at 2011 prices).

Instead of three Operational Programmes in 2007-13 (for Infrastructure and Services, Entrepreneurship and Innovation, and Human Resources and Employment), there is a single multi-Fund OP in 2014-20. Due to the unexpected delays in adopting the national by-laws regulating specific OP activities, most cohesion policy aid activities and grant schemes planned for 2014-15 are just starting to become available in mid-2016.

The 2014-20 OP states that cohesion policy also aims to ensure specific support for territories, which the Latvian Regional Policy Guidelines for 2013–19 identify as particularly vulnerable to demographic, social, and poverty risks. In particular, the OP includes project selection criteria relating to these territories under the Priority axis for SME support and the Priority axis for Environmental protection and the efficient use of resources. In line with these plans, new OP includes several SSO’s falling under the Integrated Territorial Investment scheme and focusing particularly on the re-development of “degraded” territories and attracting investments to the underdeveloped regions.

In 2014-20, cohesion policy aims to provide more specific and tailored support to municipalities under the aforementioned Integrated Territorial Investment framework. Particular examples of the cohesion policy Strategic support objectives (SSO) aiming to promote the socioeconomic activity and infrastructure development in the underdeveloped areas are:

- SSO 2.2.1 “To ensure growth in re-usage of public data and efficient interaction between public administration and private sector” (137.5 m EUR for the 2014-2020 period);
- SSO 3.3.1 “To increase the amount of private investment in the regions, by making investment for entrepreneurship development according to the economic specialization of territories set in the municipal development programs, as well as based on the local entrepreneurs’ needs” (11.8 m EUR for the 2014-2020 period);
- SSO 5.6.2 “Revitalisation of territories through regeneration of degraded territories according to municipal integrated development programmes” (23.7 m EUR for the 2014-2020 period);
- SSO 8.4.1 “To improve professional competence of people employed” (27.0 m EUR for the 2014-2020 period);
- SSO 9.2.2 “To improve the quality of alternative social care services and availability of services that provide a feeling of family environment for people with disabilities and children” (47.2 m EUR for the 2014-2020 period).

Concerning the general policy planning issues, since 2014, Latvia has recognized the necessity for more broad-scaled cooperation between national and municipal institutions in the regions, as well as the importance of delegating more functions to the Planning Regions (PR), especially in relation to the business-support policy planning and implementation. According to the Law on Regional Development, sources of financing of PRs can be the state budget, local government budgets, and foreign financial assistance mechanisms, as well as payments from legal and natural persons (including donations).

Since 2015, PRs are being provided with additional State budget financing within the framework of new initiative for 2015-2017 "Access to public services provision in accordance with the one-stop shop principle". The initiative derives from the success of the pilot project Latgale Business Centre (LBC) that has been endorsed under the action plan for Latgale region 2012-2013 “Latgale of Opportunities” and has been launched with the objective to become a one-stop-shop for business support: to provide support to the existing businesses as well as to facilitate business start-ups. LBC became a unified advisory network based on the principles of mobility and cooperation and it has established a territorial network in Latgale region, providing access to a specialist in each municipality.

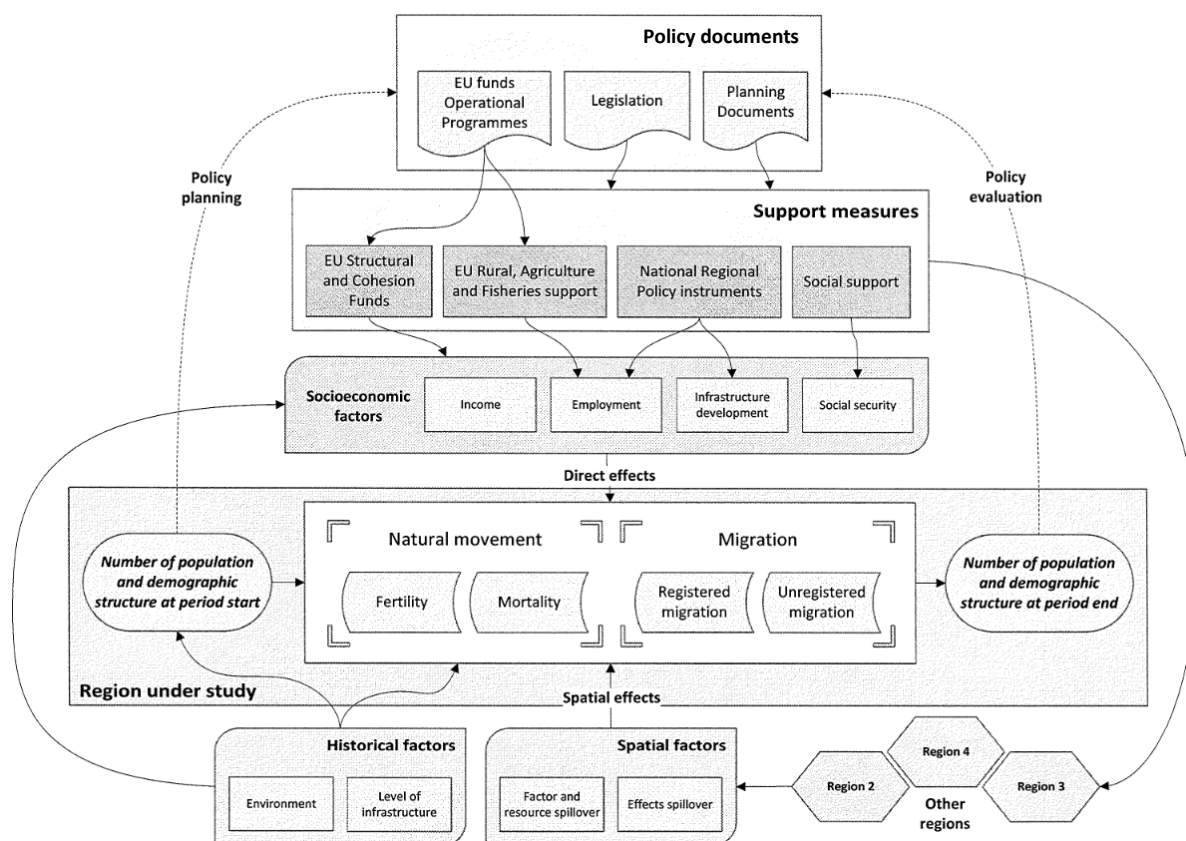
The aforementioned LBC project has been largely supported by the Norway Grants funding. Based on this positive experience, obtaining the Norway Grants co-funding for the implementation of the new Business Support Centres in other PRs is among the MoEPRD

priorities for the 2016. Development support dimension in Latvian regional policy in 2015-16 remains to be the Capacity building. Development planning capacity and Entrepreneurship support capacity of the PRs and local authorities has been successfully boosted in recent years by the projects implemented with the financial support of the Norway Grants. Such programmes aim primarily at training and attracting the highly skilled experts to the work in local public administrative bodies. Depending on the availability of funding (incl. Norway grants) the initiative will continue in the years to follow.

To summarise the material provided above, one may draw parallels with the results of the document content analysis carried out in the previous sub-section, and conclude that Latvian national regional and cohesion policy lacks a unified approach towards the regional demographic issues. Although, mostly ignored at the legislative level, demography is recognised among the main regional development challenges at the policy implementation level. Both proactive and reactive measures can be identified in the policy programmes. Growing role of individual municipalities in the decision-making processes facilitates a more tailored approach, allowing the demographically challenged regions to plan their own means of dealing with the situation – either by adapting and restructuring their internal socioeconomic environment, or by focusing on territorial integration with the local or national development centres. Either way, the most intensive support is provided by the means of targeted cohesion policy funding aiming at improving local infrastructure and socioeconomic conditions.

This Chapter has demonstrated the complex and multi-faceted nature of the socioeconomic, legal and political environment shaping the regional demographic development in Latvia, as well as the current regional policy framework and its primary tools.

To summarise the findings of this Chapter and its sub-sections, Figure 2.6. below offers a schematic representation of the inter-relations of policy factors, support measures, spatio-temporal context and regional demographic development. It highlights the complexity and multi-layered nature of the demographic development process within one region and incorporates the inter-regional spatial interactions which will be discussed in more detail in Chapter 3 of this Thesis.



**Figure 2.6 Determinants of the regional demographic development – schematic representation**

*Latvijas reģionu demogrāfisko attīstību ietekmējošie faktori – shematisks atveidojums*

Source: Author's elaboration

Information provided in the Figure above provides sufficient basis for proceeding towards the discussion of data requirements and methodological aspects of this Thesis.

*From the available statistics, literature sources and policy documents one can loosely determine the principal socio-economic factors capable of influencing the regional demographic processes are income, employment, infrastructure development and social security.*

*Even before proceeding with the complex analysis of the regional demographic processes, one can observe the evident links between the demographic and socioeconomic trends of the individual municipalities or planning regions, with some territory-specific peculiarities and evident spatial dependencies. Review of the specialised literature and available reports helps in identifying that the main regional demographic issues in Latvia as registered and unregistered out-migration of rural population, demographic degradation of the particular areas as well as the general population ageing.*

*Analysis of the primary legal and planning documents has indicated that while there is a recognition of significant regional demographic challenges and the associated risks, there is an evident lack of any coherent and strategic approach towards tackling these issues on a regional or local level. It is also possible to note, the close dependence of those proposed or implemented regional policy schemes addressing the regional demographics, on the cohesion policy funding. This may be seen as a result of some dissonance between the executive and legislative levels of governance and the shortage of financial resources. In addition, on the legislative level, one can observe several important issues, such as the delayed response to emerging demographic issues or association of the proactive demographic policies with the opposition's political goals.*

*In recent years, in terms of the regional demographic development, the national regional policy response has become much more pragmatic and goal-oriented. A much greater emphasis is placed on the role of the individual municipalities and their own development programmes, while the cohesion policy funds are identified as the main sources of funding for regional change and / or adaptation.*

### 3 DATA AND METHODOLOGY FOR REGIONAL DEMOGRAPHIC RESEARCH

As it may be concluded from the various academic studies discussed in the first Chapter of this Thesis (e.g. Zvidrins, 2009) and official reports produced by the State Regional Development Agency (SRDA, 2013), on the regional level, Latvia, just like many other European Union (EU) Member States and regions identified as “Less developed” under the 2014-20 cohesion policy, faces significant challenges of spatial heterogeneity and divergence in terms of both economic and demographic development. Continuous depopulation of rural areas and border regions, growing influence of capital city in the internal migration and settlement processes and other region-specific demographic issues comprise the long list of the regional population development problems, which Latvian authorities have to address on the daily basis. The pressing need to account for such processes in the regional policy response has been repeatedly underlined by many studies, including those discussed in the previous Chapters of this Thesis.

Statistical data (CSB, 2016 or SRDA, 2013) show, that the available national and / or municipal funding aimed at tackling the aforementioned population development issues remains scarce and is reliant upon the established social support and welfare structure, which cannot provide the solution for more fundamental socio-economic issues. Therefore, relevant regional aid instruments, capable of creating the necessary positive socio-economic conditions for demographic change, remain largely reliant on the co-funding from the EU cohesion policy instruments, which are subject to changing priorities of nationwide growth support measures and targeted regional aid.

With this in mind, author begins this Chapter by explaining the main indicators and data sources related to the regional demographic challenges in Latvia, as well as outlining the datasets available for capturing the existing aid / support measures. Then, author addresses the spatio-temporal factors capable of influencing the regional population development processes, reviewing the sources and quality of historical population data and describing the methodology employed for adjusting the historical population data in line with the contemporary administrative-territorial boundaries. Last sub-section provides the detailed methodological layout of the studies conducted within the framework of this Thesis, and addresses the principle dilemmas posed by the use of model-based approach in the analysis of regional demographic dynamics.

### **3.1 Regional demographic and socioeconomic development indicators in Latvia and the related data sources**

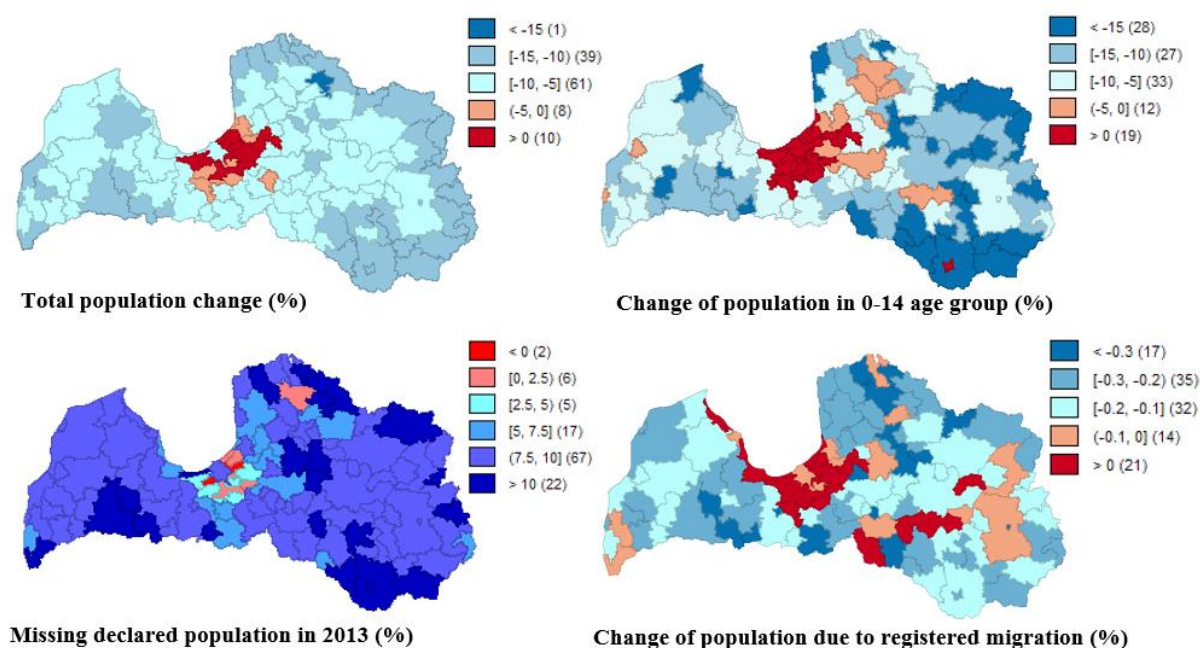
Logic dictates that prior to conducting any quantitative based study or evaluation, it is necessary to identify the available data and understand the associated limitations. First, one has to identify the datasets to be used in the proposed model-based analysis, identifying the potential dependent (demographic) and independent (socioeconomic / policy) parameters. If necessary, new indicators, rates or indices have to be developed, produced or standardized in order to capture the dynamics of the regional processes in question. Then, considering the spatial and temporal scope of this research, author has to address the availability and validity of the historical population trends for the territorial units under study. Last, but not least, it is important to consider the spatial framework to be used in the evaluation, focusing on the available means for capturing and quantifying the spatial relations.

It was established previously in this Thesis that in Latvia, local municipalities (Novadi and Cities under state jurisdiction) present the most interesting and scientifically fruitful spatial reference framework for regional demographic research. This, however, brings some unavoidable data limitations. Latvian administrative-territorial reform of 1999-2009, has resulted in the completely new single-level system of the local administrative units (LAU) with only 119 units: 110 local municipalities or “Novadi” and 9 Cities of republican significance. The NUTS 3 region structure of the country remained unchanged, with 6 statistical regions: Riga, Pieriga, Kurzeme, Vidzeme, Zemgale and Latgale. For the purpose of this study, author uses the available data on local demographic processes, socioeconomic factors, as well as policy spending, aid and investment on the LAU territorial level. Unfortunately, due to dramatic changes in territorial planning caused by the abovementioned reform, there is a very limited availability of such kind of data prior to 2009, what limits the scope of the primary model-based analysis to the period after 2009 (Law "Administratīvi teritoriālās reformas likums", 1998).

Main regional demographic indicators available for the analysis of Latvian LAUs have been previously identified in this Thesis and other studies on related topics (e.g. see Zvidrins 2012, Eglite 2008, Krisjane and Bauls 2007 or Paiders 2007). These include: change of estimated population over the period of time (as estimated by the CSB); change of registered population due to natural movement or registered migration (as recorded by the OCMA); change in number of population below 15 or within age of economic activity (15-74) and other population indicators discussed in Chapter 2 of this Thesis.

As previously explained, in case of Latvia, particular problems are posed by the unregistered migration. It is often measured by comparing the census-based or estimated factual population data (provided by CSB) with the number of declared population in the municipality (as given by OCMA). As it has been suggested by the author, the resulting difference between declared population and factual population (missing declared population - MDP) may be accepted as a crude estimation of number of unregistered migrants currently located in different regions or other countries (see Expression 2.1).

Figure 3.1 below, depicts several of the abovementioned regional demographic tendencies in Latvia during the period under study.



**Figure 3.1 Regional demographic trends in Latvia in 2009-2014**

*Reģionālie demogrāfiskie trendi Latvijā 2009-2014 gados*

Source: Authors elaboration based on CSB, 2016 and RDIM data.

Furthermore, with the purpose of capturing the dynamics of the observed changes, several indicators were recalculated by the author, and represented as change rates or change indexes (using year 2011 as base – 100). On the other hand, impact parameters, described below, had to be recalculated per capita (using the estimated official CSB population data), in order to ensure their comparability.

After reviewing the fertility indicators used for regional population studies (Demeny & McNicoll, 2003) author has chosen not to use the already available CBR, but rather calculate a more accurate General Fertility Rate (GFR), also known as Special Fertility Rate for the

local female population within the reproductive age groups. The GFR figures will be used in the further chapters of this Thesis as a main local fertility indicator.

As it was discussed in Chapter 2 of this Thesis, regional mortality in Latvia presents a particular interest for the demographic research. With the publication of 2011 population census results in Latvia, a completely new set of regional and municipal-level demographic data have become available for further study and analysis. Unfortunately, these data still did not include the sufficiently detailed mortality indicators with regional cross-section. This fact highlighted a need and opportunity for developing new standardised regional mortality indicators.

Already in 2006, in the paper “Population health, mortality and life expectancy in Latvia: trends, factors, perspectives” (“Iedzīvotāju veselība, mirstība un mūža ilgums Latvijā: tendences, faktori, perspektīvas”) Juris Kruminš has identified and discussed some significant disparities in standardised mortality rate values among the various districts of Latvia (see Kruminš, 2006). Furthermore, the recent study on regional mortality differences in Germany carried out by Eva Kibele at the University of Groningen (see Kibele, 2012) has demonstrated that the regional / area contexts are linked with people’s health and longevity even after accounting for important individual-level characteristics and the historical East-West Germany dichotomy. Kibele has also theorised that the strength of the effects of those individual-level factors may as well depend on context factors.

Furthermore, extensive research has been already carried out on the regional level in Latvia, proving the presence of significant heterogeneity of both socio-economic and demographic indicators among regions and municipalities of the country (see Zvidriņš, 2009, or Krišjāne, 2005). Complementing previous study, a new calculation of the regional standardised mortality rate (SMR) has been carried out within the framework of this Thesis, using the results of the latest national population and housing census of 2011 and focusing on the municipal administrative level.

Upon evaluating the available statistical data and previous academic work in this direction, author has selected a well-proven indirect standardisation technique, which is widely described in the literature and has been applied in many studies for the analysis of demographic processes of small areas. Age and gender structure of the entire country has been set as a standard for this recalculation.

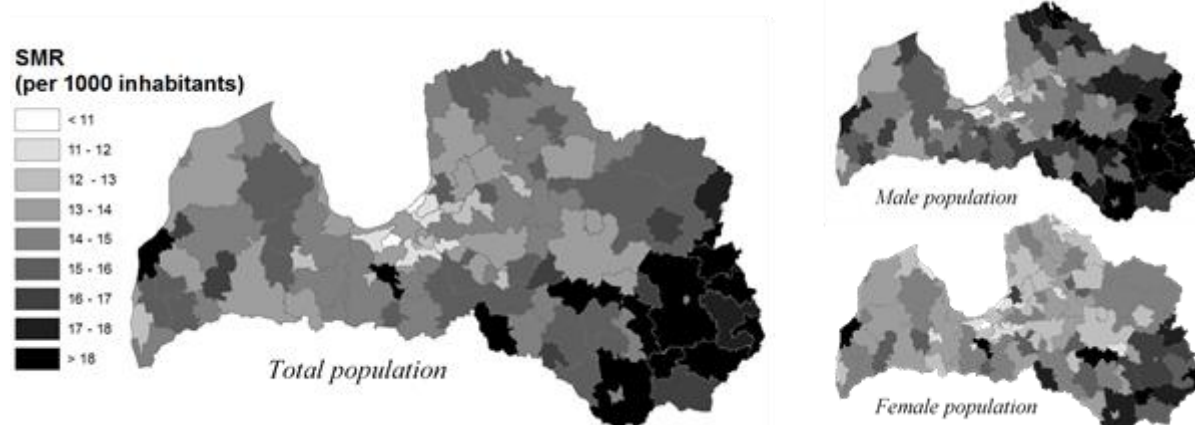
The classical indirect standardisation formula, described in detail by Russian mathematician Ilya Venetsky (1971) was applied:

$$SMR = \frac{M}{\sum_x t_x^{std} P_x''} M' \quad (3.1)$$

where *SMR* is the standardised mortality rate in the particular municipality; *M* – is the total crude mortality rate in the municipality under study (six-year weighted average calculated by the author using the number of death and population size data provided by CSB); *M'* stands for the crude death rate in the standard population (six-year weighted average values);  $t_x^{std}$  denotes the age-specific mortality rates in the standard population (six-year average values for five-year age groups) and  $P_x''$  represents the age distribution of the population in the municipality under study (calculated as shares (%) of five-year age groups in the total local population – census data were used).

In order to improve the precision of acquired standardised regional mortality indicators for the particularly small municipalities (in terms of population count) author uses year of the census (2011) as a base year, as well as calculates and uses average and / or weighted average (for the period 2008-2014) values of several statistical parameters used in the standardisation process: number of annual deaths in municipalities, countrywide mortality rate, number of deaths by age and gender groups in the country (e.g. see Davis, 1995). Further, author uses average annual population of each municipality as weights applied in the recalculation process. Data set produced as a result of the standardisation process have been later expanded by adding the spatial information, which facilitates its graphical representation and spatial analysis opportunities.

Figure 3.3 below, shows the spatial distribution of the SMR among local municipalities of Latvia in 2011 for the total population, as well as for males and females separately.



**Figure 3.2 Standardised mortality rate in Latvian municipalities in 2008-2013**

*Standartizēts mirstības līmenis Latvijas pašvaldībās 2008.-2013. gadā*

Source: Author's calculations, CSB data.

Complete datasets produced by these calculations, as well as the more detailed quantile maps are available in Annex 1 of this Thesis.

As in case with the dependant demographic indicators described above, the number of possible impact (independent) variables is limited by the amount of data available on the municipal level.

Table 3.1 provides the overview information on some of the most spatially diverse impact factors, which have been considered in this study. Data has been acquired via the Regional Development Indicator Module (RDIM, 2016) of the national Territorial Development and Planning Information System, which accumulates the most up-to-date statistical information produced by the related ministries and government agencies. In all cases, the CSB estimates of the total actual population have been used for producing the per capita values (CSB, 2016).

Table 3.1

**Regional investment and policy instruments in Latvia in 2009-2013**  
*Reģionālās investīcijas un politikas instrumenti Latvijā 2009.-2013. gadu periodā*

Investment / aid instrument	Total per period (thousand EUR)	Average (per year & per capita)		
		National average (EUR)	Maximum (EUR) [municipality]	Minimum (EUR) [municipality]
<i>EU Structural and Cohesion funds [SF&amp;CF] (CF, ESF, ERDF) incl. national co-funding</i>	<b>2 893 179</b>	<b>278</b>	<b>811</b> [Ventspils city]	<b>23</b> [Garkalnes novads.]
<i>Other EU funds [OF] (EFF, EAFRD, EAGF) incl. national co-funding</i>	<b>2 082 690</b>	<b>200</b>	<b>1 423</b> [Jaunpils novads]	<b>4</b> [Rezekne city]
<i>Foreign Direct Investment [FDI]</i>	<b>5 981 112</b>	<b>569</b>	<b>3 626</b> [Priekulu novads]	<b>0</b> [Neretas novads]
<i>Municipal spending on social support and social security [SocSup]</i>	<b>571 694</b>	<b>55</b>	<b>94</b> [Vilanu novads]	<b>17</b> [Kekavas novads]

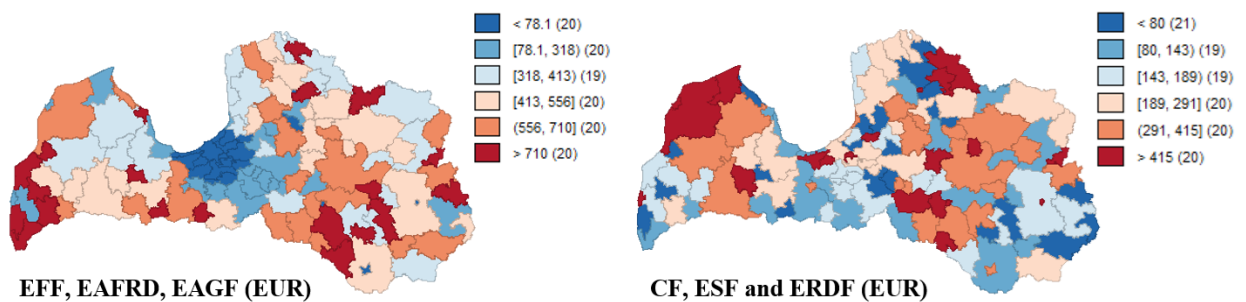
Source: Author's calculations based on CSB and RDIM data.

These and other impact factors considered in this study are used in different combinations, depending on the issue under study, and can be generally divided in the following groups:

- Income and economic activity (including the average collected Personal income tax (representing the average income level of inhabitants) and its change over time, net local wages, or the local unemployment rates);

- Cohesion policy and foreign investment (i.e. EU Structural and Cohesion funds, Other EU funds, Foreign Direct Investment);
- Components of the municipal or state budget (e.g. social support spending, municipal healthcare spending etc.);
- Some population factors that can be used for controlling selected demographic effects within the models (major ethnic groups, rate of registered marriages).

Figure 3.2 below shows the spatial distribution of the EU funding across Latvian cities and municipalities during the period under study.

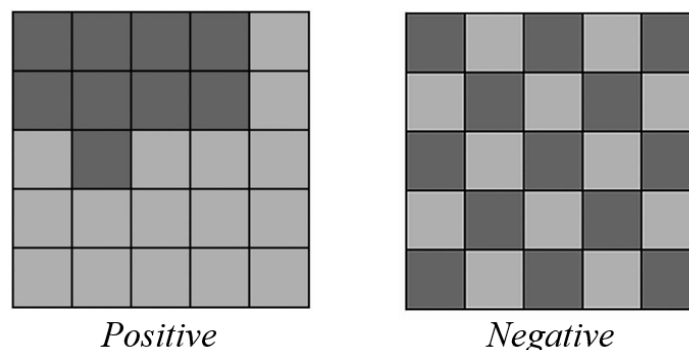


**Figure 3.3 Average EU funds spending per year per capita in municipalities in 2009-2013**

*Vidējais ES fondu izlietojums novados gadā uz vienu iedzīvotāju 2009.-2013. gados*

Source: Authors elaboration based on CSB and RDIM data.

After examining the information provided in the Chapter 2 of this Thesis, or in the maps included in Figure 3.1, and particularly considering the relatively small size and interconnectedness of the local municipalities, it is impossible to deny, that the regional demographic indicators in Latvia are (at least in part) subject to noticeable Spatial autocorrelation. In order to understand this term better, some analogy may be drawn with the temporal autocorrelation in the time-series analysis.



**Figure 3.4 Examples of positive and negative spatial autocorrelation patterns**

*Pozitīvās un negatīvās telpiskās autokorelācijas piemēri*

Source: Author's elaboration.

Previous research in spatial distribution of socioeconomic indicators shows that, when the observed phenomena are represented graphically on the map, spatial proximity usually results in some level of value similarity. Meaning that “high values tend to be located near other high values, while low values tend to be located near other low values, thus exhibiting positive spatial autocorrelation” (Voss et al, 2006).

The spatial autocorrelation may be caused by either spatial spillovers of the indicator under study (i.e. clustering of population around regional economic centre) or by the preceding spillovers of its impact parameters from/to the neighbouring regions. The nature and implication of these spillovers will be further explained in the sub-section 3.3.

In order to factor the spatial spillovers between the municipalities into the econometric analysis, one needs to quantify the spatial relations by using some form of the spatial weights matrix ( $W$ ) as explained by Ward and Gleditsch (2008, p.13) or Anselin (2003). The easiest possible approach is to capture the general spatial relations of the observed territorial units is to use the inverse values of geometric distances between the geographical coordinates of centroids or assigned central points of the regions under study. However, many authors, including Anselin (2003) show, that with the available precise cartographic information (preferably – in form of compiled shape-files), the more advanced connectivity matrixes (representing the layered neighbourhood structure of the units with common borders, to the number of  $k$  layers) may be more precise and useful in representing the actual interactions between territories under study.

With this in mind, two spatial weights matrices were developed by the author to be used in the spatially weighted regression (SWR) model estimations and bivariate spatial autocorrelation tests applied in the following Chapters of this thesis:

- Square ( $n=119$ ) spatial connectivity weights matrix ( $k=1$ ). This simplest weights matrix captures direct connectivity between the borders of local municipalities to the level of first neighbour. For example: Carnikava municipality has common border with Riga city, Garkalne, Ādaži and Saulkrasti municipalities; therefore, the respective row of the matrix representing the Carnikava municipality will have the 0.25 values at the intersections with Riga, Garkalne, Ādaži and Saulkrasti. All other cells in this row will hold zeroes. The sum of any row or column equals one.
- Square ( $n=119$ ) centre-point distance matrix. This matrix captures geographic distance between the central points of each municipality to the central point of each other municipality. For example: closest territorial unit centre-point to the centre-point of Carnikava is Ādaži and the farthest one is Zilupe; therefore the corresponding matrix

cell in the intersection of Carnikava and Ādaži municipalities will have the highest value, while the intersection of Carnikava and Zilupe – the lowest one. All other cells in this row will hold values between 0 and 1, depending on the distance in question. The sum of any row or column also equals one.

Last, but not least, one must address the data to be used in the model-based analysis and forecasts of the relations between the demographic change and creative potential of the population under study. Considering the reasoning provided in the sub-section 1.4 of this Thesis, two major data sources should be addressed. First source is the accumulation of empirical research in the form of individual papers, reports and data tables concerning the GCI and its three main components. In this particular case, author relies mainly on the data presented in the 2015 report “The Global Creativity Index” developed by the Martin Prosperity Institute (Martin Prosperity Institute, 2015). Although, the report is somewhat outdated, it remains to be the most complete and relevant accumulation of the GCI data. Report includes the rankings of 139 world countries by the each of the three CGI components and provides the resulting GCI scores for each evaluated country.

Second source is the statistical data on relevant demographic indicators, as well as reliable population forecasts. For the purpose of this study, Eurostat tables on population age distribution, education attainment levels in the EU28, as well as the population size and age distribution forecasts for the three Baltic States are used. In order to match the period of the GCI report, one can only use statistical information for the year 2015. The crude forecasts envisaged in the framework of this particular study on the development of population creativity will be limited with the year 2050 (Eurostat, 2016).

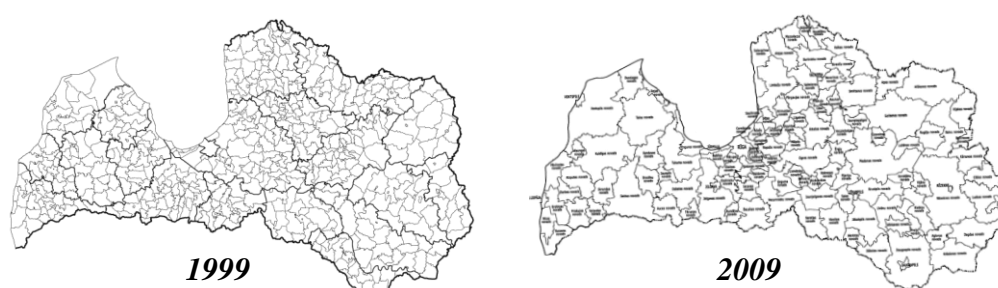
### **3.2 Regions of Latvia – historical data and trends**

As it was explained in the sub-section 1.3 of this Thesis, historical population trends are instrumental in understanding the wider picture of the demographic processes and environment of the particular territory. Unfortunately, obtaining the reliable and most importantly – comparable historical data may prove to be a challenge, requiring serious academic and creative approach.

At the detailed spatial level of the local administrative units (LAU), any sort of comparative and/or historical demographic research is hindered by the complex nature of the historical administrative rearrangements and the resulting incomparability of the historical population data. In Latvia, in the period since 1959, several significant administrative rearrangements were conducted during both the period of Soviet occupation and the following

years of independence. Between general population censuses of the Soviet Republics of 1959 and 1970, 649 Level two Local administrative units (LAU2), known as Rural Councils and Cities were gradually reorganised into 539 Parishes and Cities. According to the previous research, this number was further reduced to 465 LAU2 by the census of 1989 (Skinkis, 1999). It has been explained in the literature that both models and functions of administrative units have changed since Latvia regained independence in 1991 (e.g. see Ramute, 2008).

A new socio-economic formation of the country demanded further changes in the regional structure and policy that resulted in the introduction of an administrative-territorial reform, which was envisaged in 1998, gradually carried out in the period from 1999 to 2009, and resulted in the completely new single-level system of the local administrative units with only 119 LAUs: 110 local municipalities or “Novadi” and 9 Republic cities.



**Figure 3.5 Administrative division of Latvia before and after the administrative-territorial reform of 1999-2009**

*Latvijas administratīvais iedalījums pirms un pēc 1999.-2009. gadu administratīvi-teritoriālās reformas*

Source: Law "Administratīvi teritoriālās reformas likums" of 21.10.1998.

It has been already established that in order to conduct any form of spatial demographic analysis aimed at identifying the long-term trends, as well as having a reliable and, most importantly, comparable results, one needs to obtain historic data, which would fit within a single frame of reference. In the case of Latvia, the historic population census results from the period after World War II may be used for such a purpose. Census years in this period include 1959, 1970, 1979, 1989, 2000 and 2011. However, due to the numerous territorial rearrangements over the period in question, these data cannot be compared in the initial form and need to be recalculated manually. Fortunately, the key population indicators since 1991, as well as 2000 population census results have been recently adjusted to the current administrative division by the CSB. Further recalculation of the historical population census data for the 1959-1989 period has been conducted by the Author within the framework of the European Commission's DG REGIO 2012 tender "Population Data Collection for European

Local Administrative Units from 1960 onwards” carried out under the direction of “Spatial Foresight” GmbH in 2011-2012 (Gloersen and Luer, 2013).

There are several population territorial data recalculation methods and technical solutions available to modern researchers, ranging from the development of geographic information systems (GIS), where population data are first geo-referenced to the points on digitised historical maps and then digitally overlaid layer by layer, while estimating population figures according to territory, number of settlements or specific algorithms (e.g. see MPIDR 2011), down to the statistical estimations and retrospective projections for regions with missing historical data.

Due to shortage of cartographic information and the scale of territorial rearrangements in Latvia, a combined method has been developed and applied, which uses population census data along with the available archive information in form of documents and maps (if available), in order to trace the boundary and name changes of the territorial units and perform the necessary recalculations. The population census of 2011, carried out after the completion of the administrative-territorial reform, was set as a base for the entire recalculation process. Taking into account the consolidating (merging) nature of administrative rearrangements in the territorial structure during the entire 1959-2011 period, a backward approach has been used for assembling the population data and tracing name and boundary changes.

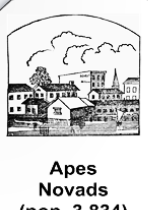

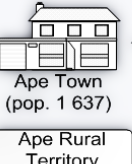
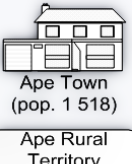
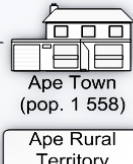

	2011	2000	1989	1979	1970	1959
Territory	 <p><b>Apes Novads</b> (pop. 3 834)</p>	 <p>Ape Town and Rural Territory (pop. 2 088)</p>	 <p>Ape Town (pop. 1 637)</p> <p>Ape Rural Territory (pop. 624)</p>	 <p>Ape Town (pop. 1 518)</p> <p>Ape Rural Territory (pop. 855)</p>	 <p>Ape Town (pop. 1 558)</p> <p>Ape Rural Territory (pop. 1 019)</p>	 <p>Ape Workers' Town (pop. 2521)</p>
		<p>Gaujienas Pagasts (pop. 1 153)</p>	<p>Gaujienas Pagasts (pop. 1 333)</p>	<p>Gaujienas Pagasts (pop. 1 240)</p>	<p>Gaujienas Pagasts (pop. 1 278)</p>	<p>Gaujienas Rural Council (pop. 1 166)</p>
		<p>Trapenes Pagasts (pop. 1 009)</p>	<p>Trapenes Pagasts (pop. 1 056)</p>	<p>Trapenes Pagasts (pop. 1 073)</p>	<p>Trapenes Pagasts (pop. 1 260)</p>	<p>Trapenes Rural Council (pop. 1 319)</p>
		<p>Virešu Pagasts (pop. 832)</p>	<p>Virešu Pagasts (pop. 874)</p>	<p>Virešu Pagasts (pop. 823)</p>	<p>Virešu Pagasts (pop. 957)</p>	<p>Virešu Rural Council (pop. 1 075)</p>
Total	3 834	5 082	5 524	5 509	6 072	6 081

Figure 3.6 Example of the recalculation process of the historical Census data for 1959-2011

*Vēsturisko Tautas skaitīšanu datu pārrēķina procesa piemērs 1959-2011 gadiem*

Source: Author's elaboration

In 2000-2011 period, due to the effects of the administrative-territorial reform in Latvia, population data of all territories were recalculated by the CSB. It was convenient to trace boundary and name changes by using information contained in the annexes to the national Law "On the administrative-territorial reform" (1998). Analogically, the aforementioned list of 558 administrative units from the year 2000 was compared and linked with the data set containing 590 units from the year 1989. For the older data of late Soviet era, the archive information (mostly Decisions of the Supreme Council of Latvian SSR on the territorial rearrangements) and specialised literature sources (e.g. Berze, 1997) have been used in order to determine the name and boundary changes of the territorial units, as well as to find the location and association of the unidentified LAUs. Similar method was used for all the previous periods, digitising the population data from paper sources using Optical Character Recognition software and translating local names from Russian to Latvian when necessary. In cases, where LAUs were split over time, the population count in their parts was estimated using the available information on population numbers in its towns and rural areas.

With the double purpose of capturing the population development in the individual municipalities as the dynamic process, as well as making the data more comparable between the municipalities of different size, population growth rates for each observed territorial unit were calculated for every time interval between the populations censuses under study (see Table 3.2). Such approach also made it easier to analyse the spatial population dynamics in both temporal and spatial cross-sections.

Table 3.2

**Preview of the population dynamics in the territories of modern Latvian municipalities between censuses of 1959-2011, based on recalculated data**

*Iedzīvotāju dinamikas analīzes piemērs mūsdienu latvijas pašvaldību teritorijās par 1959.-2011. gadiem, izmantojot pārrēķināta datus.*

Municipality	Population growth rate				
	1959-1970	1970-1979	1979-1989	1989-2000	2000-2011
<i>Aglonas novads</i>	-0.215	-0.120	-0.152	-0.163	-0.283
<i>Aizkraukles novads</i>	3.673	0.344	0.390	-0.076	-0.138
<i>Aknīstes novads</i>	-0.074	-0.111	-0.135	0.039	-0.217
<i>Alojas novads</i>	0.014	-0.031	-0.067	-0.029	-0.257
<i>Alsungas novads</i>	0.219	-0.170	-0.037	-0.052	-0.292
<i>Amatas novads</i>	-0.133	-0.125	-0.070	0.026	-0.186
...	...	...	...	...	...
<b>Total population change:</b>	<b>0.131</b>	<b>0,064</b>	<b>0,065</b>	<b>-0,108</b>	<b>-0,129</b>

Source: Author's calculations based on historical census data provided by the Central Statistics Bureau of Latvia.

The complete results of the recalculations carried out by the Author within the framework of the project “Population Data Collection for European Local Administrative Units from 1960 onwards” can be found at the Eurostat homepage (Eurostat, 2016) and in the Annex 2 of this Thesis.

Using this recalculated historical data, in the following Chapters, author complements the model analysis with the exploratory analysis of the adjusted historical population data of the Latvian municipalities using a range of research tools, including clustering analysis and spatial autocorrelation analysis as suggested in the literature (e.g. Voss., et al, 2006).

### **3.3 Quantitative methods and models for the analysis of regional demographic development**

Considering the scope and specifics of regional demographic issues addressed in this Thesis, as well as the data availability discussed in the previous sub-section of this chapter, a unique combination of quantitative analysis tools have been developed by the author in order to achieve the sufficiently reliable and credible analytical results under the imposed limitations. This sub-section deals with a variety of methodological issues, starting with the selection of most suitable econometric models for the analysis of the intertwined socioeconomic and demographic processes, explaining the necessity and means to capture and study the spatial relations and historical patterns among municipalities, and concluding with the tools applied for forecasting the change of creative potential within population. At the end of this sub-section author provides a “roadmap” graph, explaining the sequence and relations of the quantitative analysis tools applied within the framework of this Thesis.

Most previous sociological and demographic studies concerning Latvia’s regional development treat individual geographical units, such as parishes (*pagasti*), local municipalities (*novadi*), cities or whole statistical regions as independent isolated entities, rather than as a system of interconnected geographic units which may and do interact (e.g., through everyday commuting, cross-border family settlement, provision of services etc.). However, in the international scientific literature, and particularly in studies of population dynamics, such spatial effects have long been theorized and applied via several disciplines of social sciences such as geography and regional science, including, but not limited to: spatial diffusion theory, growth pole theory, central place theory and new economic geography theory (Chi G. & Zhu J., 2008).

From the basic review and statistical analysis of the municipality-level data presented in the Chapter 2, as well as previous sub-sections of Chapter 3 an interesting observation can be

made, namely that the actual returns of specific public capital investments, regional and social policy instruments, or aid measures, in most local municipalities, are not perfectly proportional to the inputs. For instance, in some territories, positive demographic effects of social policy spending or improvement of economic situation do not result in a proportional improvement of migration flows or fertility indicators and vice versa.

Although, it poses a serious problem for the classical model-based studies, from the purely logical perspective, this fact is not surprising. Apparently, geographical disaggregation of data may result in different (usually lower) productivity of policy instruments or positive economic stimuli. Similar finding has been attributed in the literature to the existence of spatial spillovers from one region into neighbouring territories (Anselin, 1999). These spatial spillovers are explained as the result of the network effects, that is, since most basic elements of demographic development have network characteristics (e.g., everyday commuting, cross-border family settlement etc.) the application of specific policy measures or improvement of socio-economic situation in one region are expected to positively affect demographic development in other regions. On the other hand, it has also been argued that a form of negative spillovers may also exist between territories. The argument is that stimulating policy or general improvement of social and economic conditions in one location can draw resources (e.g. population) away from other locations as *“it enhances the comparative advantage of that location relative to other places”* (Boarnet, 1998).

The general issue of spatial spillovers has also been widely approached in other areas of social and economic research. In the literature devoted to economic growth, for instance, it is theorised that fast-growing countries and regions tend to cluster together, implying that both location and neighbourhood structure is important for economic growth (e.g. Moreno and Trehan, 1997). In classical economics, some researchers are trying to evaluate the degree to which government spending of some countries is influenced by the similar spending of neighbouring states (e.g. Case et al., 1993). Some other scientific papers try to test the Core-Periphery hypothesis or Growth Pole theory both of which imply that the development of some regions may have a positive influence on nearby regions. Finally, in regional development studies, many spatial studies conclude that regional convergence capabilities are highly correlated with the location factors of the given territory (e.g. Vaya et al., 2004).

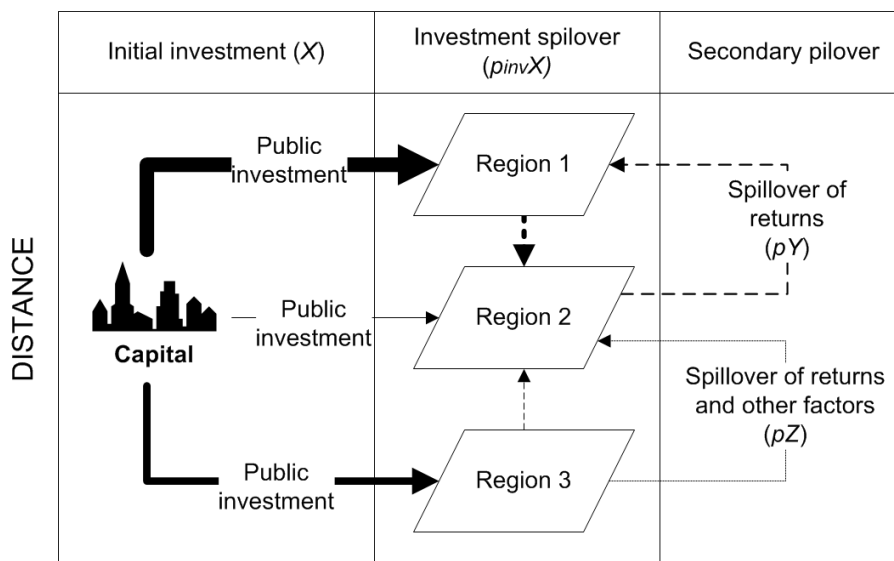
At the first stage of the quantitative analysis included in this Thesis, author aims to apply model-based analysis techniques in order to evaluate spatial inter-dependency aspects of several key demographic indicators of Latvia's local municipalities covered by the most recent population census of 2011 and other statistical surveys, while attempting to identify the

associated socio-economic factors and estimate their impact. By the later comparison of the results of the classical analysis methods with the results derived from the corresponding spatially adjusted models, author attempts to measure the levels of spatial spillover of the particular types of social and economic factors, distinguishing those having the direct local application, and those, which may later demonstrate a spatial dispersal effect. Such comparison is also instrumental for comparing pros and cons of the available models.

A conventional approach to examine the impact of the particular policy instrument or economic factor is to estimate the simple econometric model, like one demonstrated below:

$$Y = \beta X + \gamma Z + \varepsilon \quad (3.2)$$

Where vector  $Y$  denotes the indicator under study, vector  $X$  stands for the instrument / investment / factor, whose effects are being assessed and matrix  $Z$  – other factors and characteristics instrumental in explaining the variance of  $Y$ .  $\varepsilon$  represents the model error. Value and significance of coefficient  $\beta$  is then assumed to present the impact of the factor under study. This approach can be easily exposed to criticism from both logical and spatial perspective for not considering the effect arising from the interactions with the neighbouring territorial units and the spilled over effects of the factor  $X$  from / to them.



**Figure 3.7 Schematic representation of the spatial spillover effects of investment between regions**  
*Investīciju starp-reģionālās pārteces efektu shematisks atveidojums.*

Source: Author's elaboration

As it was stipulated earlier, even the spatial distribution of the indicator  $Y$  itself is capable of creating additional positive or negative effect through agglomeration of resources as well the unexpected externalities caused by other forms of interaction (Parr, 2002). Figure 3.7 above has been developed in order to better illustrate the shortcomings of a classical

model in the context of measuring actual effects of some particular factor/investment in a real-world regions.

The diagram shows some form of centralised public investments (vector  $X$ ) into three regions, where “Region 1” is getting the biggest share, “Region 2” – the smallest and “Region 3” – medium amount. First, a classical model (3.2) would ignore the neighbourhood structure of the regions, as well as geographical / economic distances between them. The proximity of the units under study should be captured in a model, as these are not fully independent and isolated territories, but rather just parts of a single social and economic system / network.

Second, the standard approach only estimates the direct impact of the investment (1<sup>st</sup> column of the diagram), ignoring the effects of later interactions (dashed lines). For example, on the first level (2<sup>nd</sup> column), the received investment itself will have some rate of dispersion into the neighbouring regions through everyday economic interactions like wages, procurements etc. and, therefore, besides the local impact parameter ( $\beta$ ) should have some associated spatial dependency parameter ( $p_{inv}$ ) often also denoted as theta ( $\theta$ ). On the second level (3<sup>rd</sup> column), the returns from the local investment and its spatial spillovers, as well as other production factors will not necessarily remain only in their respective regions, but rather tend to agglomerate around the strongest region, as suggested by most modern theories of economic development like Growth Pole theory or the New Economic Geography theory. This secondary spillover (commonly known in the literature as the “spatial lag”) can be captured as the regression parameter ( $\rho$ ) of the spatially weighted mean of the same endogenous parameter in the surrounding regions ( $\rho WY$ ), and, if needed – of all other factors ( $\rho WZ$ ). In both cases,  $W$  denotes a spatial weights matrix capturing the geographical, geometrical or economical neighbourhood structures of the units under study.

In other terms, in the abovementioned example, each of the three regions receives a noticeable positive or negative additional effect of the indicator under study through the spatial interactions with other two regions. The resulting improvement of the local indicator  $Y_i$  in the particular region has the further effects on the returns of the investments  $X$  in the other two. Ignoring such secondary effects, classical methods, obviously, omit an important set of impact determinants.

The spatially adjusted empirical model may be constructed based on the classical model (3.2) in combination with the framework of spatial econometrics concepts as discussed in the previous sub-sections of this Thesis.

The most basic spatially adjusted or Geographically Weighted Regression (GWR) model explicitly incorporate spatial dependence between observations by adding a “spatially lagged” dependent variable  $y$  on the right hand side of the regression equation. This model goes by many different names. Typically, however, the term “Spatially Lagged Model” (SLM) is applied, since the model’s main feature is the presence of a spatially lagged dependent variable among the covariates. The Spatially Lagged Model is appropriate when there is a reason to believe that the values of  $y$  in one unit  $i$  are directly influenced by the values of  $y$  found in  $i$ ’s “neighbours” and that this influence is above and beyond other covariates specific to  $i$ . Basic representation of such model may be given as follows:

$$y_i = \beta x_i + p \sum_{i=1}^n w_i y + \varepsilon_i \quad (3.3)$$

where  $y_i$  on the left-hand side of the equation denotes the indicator under study,  $\beta$  is a classical regression parameter,  $x_i$  stands for the factor, whose effects are being assessed,  $p$  is the model parameter associated with the spatial lag,  $w_i$  denotes the connectivity vector (i.e., row  $i$  from square spatial weights matrix showing spatial relations between the observation  $i$  and other territorial units) and  $y$  on the right-hand side represents the values of the indicator under study in all other territories except for  $i$ .  $\varepsilon_i$  stands for the classical error term. With variable  $y$  being on both sides of the equation, it is obviously problematic to solve such model using the traditional “ordinary least squares” (OLS) method; therefore, it is commonly suggested to use the “maximum likelihood estimator” or similar approach (Voss et al, 2006).

If there is a reason to believe, that that  $y$  is not influenced directly by the weighted value of  $y$  among its neighbours, but rather there is some spatially clustered feature that influences the value of  $y$  for territory  $i$  and its neighbours, but is omitted from the model specification, one may consider an alternative model which incorporated spatially correlated error term. In such a model, the spatial dependence is entered through the error, rather than through the systematic component of the model. Such model is typically called the “Spatial Error Model” (SEM) (Ward M. D. & Gleditsch K. S., 2008).

$$y_i = \alpha + \beta x_i + \varepsilon_i + \lambda w_i \xi_i \quad (3.4)$$

where  $y_i$  on the left-hand side of the equation denotes the indicator under study,  $\beta$  is a classical regression parameter,  $x_i$  stands for the factor, whose effects are being assessed and  $\varepsilon_i$  stands for the classical error term. What is new in this model – is a parameter  $\lambda$  indicating the extent to which the spatial component of the errors  $\xi_i$  are correlated with one another for nearby observations, as defined by the spatial weights vector  $w_i$ . Such type of spatial

regression models should have special attention in the regional demographic research, as it allows for controlling the previously unspecified spatial effects.

Considering the multi-level structure of the expected spatial interactions (Figure 3.7), the “Spatial Durbin Model” (SDM) has been chosen among the key analysis tools within the framework of this Thesis. Good examples of the potential applications for such type of spatial models may be found in various fields of study, for example, Tran and Pham (2013) use the SDM method to estimate the spatial spillovers of foreign direct investment, while Autant-Bernard and LeSage (2009) discuss the potential spatial knowledge spillovers model from a non-spatial model, arriving at a conclusion that SDM is the most relevant model for examining both types of spatial spillovers on various territorial scales.

In general, SDM incorporates the properties of both Spatial Lag and Spatial Error models; and therefore, captures spatial lag parameter of the dependent and independent variables alike at the right hand side of the equation. The main difference about it is the replacement of the “unknown” spatial factors assumed by the SEM with the spatially weighted effects of the “known” impact factors.

The simplest linear formulation of an SDM model elaborated based on the classical model (3.2), SLM (3.3) and SEM (3.4) can be described as follows:

$$Y = \rho WY + \beta X + \theta WX + \varepsilon \quad (3.5)$$

where  $Y$  is the vector denoting the indicator under study in the regions,  $W$  is weighting matrix (discussed above) and  $\rho$  is a spatial lag parameter capturing the secondary spillover of the outcome variable ( $Y$ ) from/to the neighbouring regions. Further,  $X$  is a matrix of explanatory variables,  $\beta$  stands for a regression parameter measuring primary effects of the explanatory variables within the target region and  $\varepsilon$  stands for error. While, these are all the standard notations found in a basic SLM model (3.2), the new component  $\theta$ , however, is introduced in the SDM in order to expand the equation and accommodate the spatially lagged (with the help of the same weights matrix  $W$ ) explanatory variables contained in the matrix  $X$ . In other words,  $\theta$  is the spatial lag parameter describing the effect of the explanatory variables of the surrounding regions on the indicator in the observed region (e.g. primary spillover shown in the Figure 3.7).

Further discussion on the application of the GWR models for demographic research can be found in author’s publication “*Demographic Implications of the 2007-2013 Regional and cohesion policy Actions in Latvia*” (see Dahs, 2016b).

With the issue of the spatial spillovers settled, we can return to the wider methodological issues addressed in this Thesis. Literature indicates, that before proceeding

with the spatial spillover modelling, it is both necessary and useful to conduct a simple, but effective exploratory analysis of the available regional data using the spatial autocorrelation testing tools, which will allow either accepting or discarding the hypothesis that municipalities with similar indicator values are more spatially clustered than would normally be expected. Oliveau and Guilmoto (2005) explain that there is a wide methodological toolset available to the contemporary demographers for the investigation of the nature and extent of spatial correlation between regional demographic variables. These methods constitute what is known as “Exploratory Spatial Data Analysis” (ESDA). Primarily, ESDA is based upon various visual and quantitative methods used to demonstrate the spatial properties of a variable, or to describe its specific distribution in space, extreme values or outliers, and to identify any geographical clusters. Two forms of quantitative spatial autocorrelation measures are most frequently referred to in the specialised literature.

- Global indicators of spatial autocorrelation produce one statistic summarising the whole area under study;
- Local indicators of spatial autocorrelation (often addressed in abbreviation – LISA), help finding specific clusters of territorial units, where values of the variable under study are both extreme and geographically homogeneous by calculating Local autocorrelation values for each spatial unit and evaluating their statistical significance.

The most commonly used statistical test for estimating the levels of global spatial autocorrelation is the Global Moran’s I test first introduced by Patrick A. P. Moran in his 1950 paper "*Notes on Continuous Stochastic Phenomena*". The Global Moran’s I test in its generalised form can be defined as:

$$I = \frac{n}{S} \frac{\sum_i \sum_j w_{ij} (x_i - \mu)(x_j - \mu)}{\sum_i (x_i - \mu)^2} \quad (3.6)$$

where  $n$  is the number of observations (in our case  $n=119$  municipalities and cities) indexed in the matrix notations by  $i$  and  $j$ , while  $x$  stands for the variable of interest (with mean  $\mu$ ), and  $w_{ij}$  is a corresponding element of a matrix of spatial weights  $W$ .  $S$  is a scaling constant produced by the sum of all weights:

$$S = \sum_i \sum_j w_{ij} \quad (3.7)$$

For testing the hypothesis on present spatial autocorrelation of the particular indicator, the test statistic is compared with its theoretical (expected) mean, which would appear under conditions of fully random spatial pattern of values.

A simple and versatile measure of Local spatial autocorrelation can now be produced from the Global Moran's I equation (3.6):

$$I_i = \frac{(x_i - \mu)}{M} \sum_j w_{ij}(x_j - \mu) \quad (3.8)$$

where  $x$  stands for the variable of interest (with mean  $\mu$ ) indexed in the matrix notations by  $i$  and  $j$ , while  $w_{ij}$  is a corresponding element of a matrix of spatial weights  $W$ .  $M$  is a local weighted constant:

$$M = \frac{\sum_i (x_i - \mu)^2}{n} \quad (3.9)$$

where  $n$  represents the total number of observations, just as in the Global test expression (see Anselin, 1995).

Furthermore, from the formulas presented above, one can conclude that the sum of all local indices  $I_i$  should be proportional to the (global) value of Moran's statistic:

$$I = \sum_i \frac{I_i}{n} \quad (3.10)$$

where  $I$  is the Global Moran's I,  $I_i$  represents all the LISA values and  $n$  stands for the total number of territorial units on the map.

For the purpose of this Thesis, author has chosen a combined approach towards measuring and visualising spatial association, which is based upon the concept of Global Moran's I statistic and the associated Moran's scatter plot. Luc Anselin (1999) explains, that the Global Moran's I statistic for spatial autocorrelation can be defined as a regression coefficient in a bivariate spatial lag scatter plot. That is - in a bivariate scatter plot with the spatially lagged values of the indicator under study are placed on the vertical axis and the actual local values recorded at each location - on the horizontal one.

In such a case, calculated value of the global Moran's I corresponds to the slope of the regression line plotted through the points of the scatter diagram. Closer study of this particular methodology, indicates, that it allows for a sufficiently detailed simultaneous assessment of both Global (i.e. the slope of the line) and local spatial association (local trends/clusters observed in the scatter plot). The further evaluation of these local associations is done by the decomposition of scatter area into four quadrants, each representing different type of spatial associations.

In order to evaluate the existing regional demographic divergence from the long-term perspective, it would be extremely useful to know, whether there are some distinctive types of territories present with similar development trends within and divergent trends between them. The right analytical tool for this purpose would undoubtedly be the clustering.

Warren (2005) explains that the goal of clustering is to identify structure in a data set by objectively organising data into homogeneous groups where the within-group-object similarity is minimized and the between-group-object dissimilarity is maximized. Clustering is useful regardless of whether the data are binary, categorical, numerical, interval, ordinal, relational, textual, spatial, temporal, spatio-temporal, image, multimedia, or mixtures of the above data types. The bulk of widely used and discussed clustering methods may be easily applied to static data.

The historical population trends addressed in this Thesis, however, are not static, and in fact, represent a dynamic time-series, which significantly complicates and limits their clustering possibilities. Unlike static data, the time series comprise values changing with time. Similarly to static data clustering, time series clustering requires an algorithm or procedure to form clusters from a given set of data objects. The choice of the most suitable clustering algorithm depends both, on the type of data available and on the particular purpose of the study.

As it can be seen from the available methodology reviews (see Liao 2005), some limited number of algorithms have been developed to cluster different types of time series data. However, majority of these tools, attempt to use the existing static algorithms, while converting the time series data into the form of static data by obtaining some specific and static measure of similarity between the time series (e.g. correlation measures, fitted model parameters etc.).

For the purpose of this study, an agglomerative hierarchical clustering method has been chosen. Such method works by grouping data objects into a tree of clusters, starting by placing each object in its own cluster and then merging clusters into larger and larger groups, until all objects are in a single cluster or until certain termination conditions such as the desired number of clusters, or a “cut-off” similarity measure are satisfied. For the measure of similarity, a simple correlation coefficient is used for capturing individual similarity / dissimilarity for every permutation of observations in form of a square ( $n=119$ ) correlation matrix.

In order to better suit the hierarchical clustering algorithm, and taking into consideration the positive and negative values of the correlation coefficient, the correlation matrix has been changed into the distance matrix via transformation:

$$Dist_{ij} = 1 - Correlation_{ij}, \quad i, j = (\overline{1,119}) \quad (3.11)$$

where the *Dist* and *Correl* variables represent the respective cells in the new distance matrix and the original correlation matrix, indexed by matrix row and column notations *i* and *j*.

The resulting distance matrix may now be used as a basis for agglomerative hierarchical clustering process. At his point, the main problem is a choice of the clustering degree or “cut-off” distance, which would define the number and structure of individual clusters. Kavitha and Punithavalli (2010) report, that the available scientific literature does not provide single solution for this issue. It is therefore acceptable to choose these parameters based on the desired number of clusters and / or researcher’s knowledge of the data at hand.

After the clustering process is complete, it is useful to understand the nature of divergence between the clusters. In our case, simple average values of the population growth rates of the municipalities within the identified clusters are sufficient to help one understand the general historical population growth rate tendencies within the identified homogenous groups. The results of the clustering process and the subsequent analysis will be describes in sub-section 4.3 of this Thesis.

This brings us to the last methodological issue to be addressed within the framework of this Thesis, namely – the analysis of the demographic determinants of Creativity. First, before proceeding with the selection of the quantitative analysis tools, one must understand the possibilities offered and limitations imposed by the available empirical data for the indicators and processes under scrutiny. It is critically important to find, evaluate and retrieve the most relevant quantitative information for the particular geographical scope and time of the study.

As it was explained in sub-section 3.1, in this particular study, author uses the data presented in the 2015 report “The Global Creativity Index” developed by the Martin Prosperity Institute (The Martin Prosperity Institute, 2015). The fact that the GCI data is only available for the country level, denies the possibility to conduct a more detailed regional demographic analysis. Therefore, for the purpose of this study, it was determined to estimate the level of influence of the demographic factors on to the country’s GCI and its components by studying the links between these two groups of indicators observed within the 28 EU Member States.

Furthermore, the Eurostat tables on population age distribution, education attainment levels and population age distribution forecasts for the three Baltic States are employed. In order to match the time of the GCI report, one can only use statistical information for the year 2015 (Eurostat, 2016).

Considering the straightforward nature of this research task and the format of the data to be used, the research methodology applied is based on the sequential estimation of the simple linear regression model. At first, the model for the GCI itself is estimated:

$$GCI_i = \beta_j X_{ij} + \beta_k Z_{ik} + \beta_c C_i + \varepsilon \quad (3.12)$$

where  $GCI_i$  is the GCI index value of the country  $i$ ,  $X_{ij}$  is a share of population in the specific age group  $j$  (groups of under 15, 15-24, 25-34, 34-44, 45-54, 55-64 and 65-75 years respectively) in country  $i$ ,  $Z_{ik}$  stands for the rate of education attainment to the level  $k$ , (secondary education, and tertiary education respectively, in accordance with the ISCED 2011 system (see UNESCO, 2012)) in country  $i$  within the population aged between 15 and 64.  $C_i$  represents the total rate of population change in the country  $i$ .

Model parameters  $\beta_j, \beta_k$  denote the estimated regression parameters for the age group  $j$  and education attainment level  $k$ . Parameter  $\beta_c$  stands for the regression coefficient of the total rate of population change  $C$ . Then we proceed with the follow-up estimations for the global rank of each GCI component (Talent, Tolerance and Technology) in each particular country:

$$T_{li} = \beta_j X_{ij} + \beta_k Z_{ik} + \beta_c C_i + \varepsilon \quad (3.13)$$

where  $T_{li}$  is the respective GCI component's  $l$  rank of country  $i$ . Other parameters and abbreviations for these sub-models remain the same as in the GCI model (3.12).

Furthermore, using the model estimation results (particularly – the  $\beta$  coefficients of the various age groups and the Population change rate) and relying upon the available population forecasts produced by Eurostat (main scenario) it is possible to make a crude forecast, predicting the change in creative potential of the selected countries resulting from the demographic change over the years. In order to produce such a forecast one needs to use the model (3.12) in form of a complete equation, with the GCI index value or the respective rank of the country playing the role of an unknown variable. Then, by multiplying the estimated values of the relevant  $\beta$  parameter values by the forecasted values of the respective model variables ( $X$ ,  $Z$  and  $C$ ) on the right hand side of the equation, it is possible to produce the

desired predicted value of the dependant variable. Same forecasting can be done for the three GCI components.

In the Thesis, author has chosen to focus the forecasting efforts on the three Baltic States – Estonia, Latvia and Lithuania, which share a rather unique population age and gender structure (see sub-section 2.1 and Figure 2.3). The forecasted share of population in the specific age group ( $X$ ) values and crude population change rate ( $C$ ) for years 2030 and 2050 can be obtained from the Eurostat EU population forecast tables (Eurostat, 2016). Keeping in mind the limited data availability, no change is assumed in the education attainment levels.

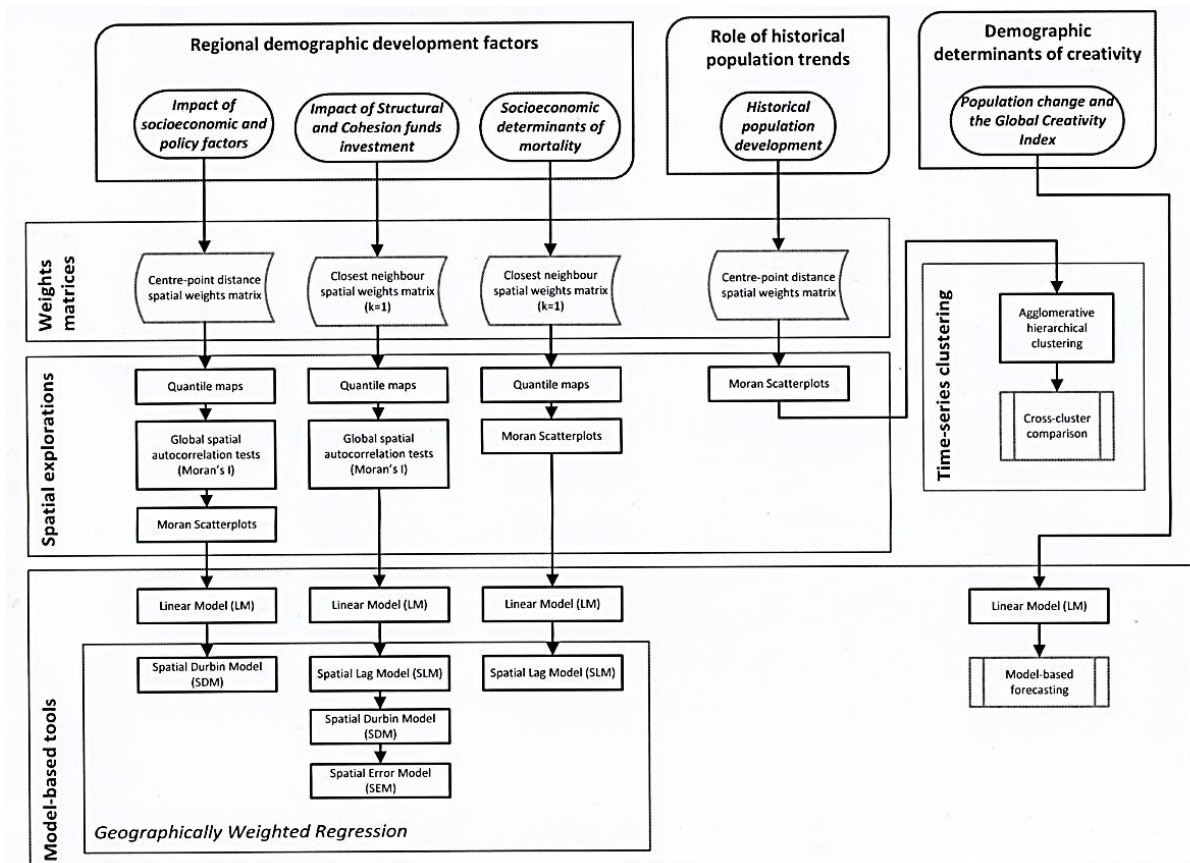


Figure 3.8 Methodological map of the quantitative analysis conducted in this Thesis

*Promocijas darba ietvaros veiktās kvantitatīvās analīzes metodoloģiskā karte*

Source: Author's elaboration

Figure 3.8 above summarises the information provided in this Chapter, showing a condense schematic representation of the various quantitative analytical tools applied within the framework of this Thesis. The analysis results discussed further in this Thesis will rely upon the methodological groundwork presents in this chapter and outlined in this figure.

*This Chapter has addressed the diverse methodological challenges associated with the quantitative analysis of the regional demographic processes. From the information presented above, one can see that the availability of reliable data unavoidably limits the scope and methodological toolset available for the regional demographic research. In order to at least partially overcome this challenge and broaden the analysis limits, one can conduct various recalculations, standardisations and estimations based on the available statistical data.*

*Particular attention is required when dealing with the historical population trends. The shifting territorial boundaries and limited availability of digital data demand especial scrutiny on the part of the researcher in order to make the historical demographic data trustworthy, comparable and ready for spatial and econometric analysis.*

*The model-based approach to the demographic research is not an innovation, as various forms of econometric models have been applied on par with the statistical evaluation methods since the rise of the discipline as such. However, in this chapter, author has shown that, when it comes to the regional demographic analysis at the sub-national level, there is still some room for improvement. Geographically weighted regression models have their benefits and shortcomings, but are irreplaceable at studying the complex regional processes, that happen in the small local territorial units, which can and do interact on various socioeconomic levels.*

*Finally, in this Chapter author has discussed the possibilities for conducting a simple evaluation of the impact of demographic change on to the creativity potential of the EU Member States, and presented some ideas on the possible creativity forecasting methodology to be used for predicting the future creativity level of the human capital in three Baltic States.*

#### 4 QUANTITATIVE ASSESSMENT OF THE LINKS BETWEEN SOCIOECONOMIC DETERMINANTS, POLICY MEASURES AND THE REGIONAL DEMOGRAPHIC DEVELOPMENT

It has been established in the previous Chapters of this Thesis that on the regional level, Latvia deals with noticeable challenges of spatial heterogeneity and divergence in terms of demographic development. Considering the specifics of the available national and municipal instruments available for directly tackling the pressing regional demographic issues, it was shown in sub-section 2.2, that it is highly recommended to evaluate the actual and potential demographic impact of the relevant regional policy tools co-funded by the EU cohesion policy instruments as well. Taking into account the provisional conclusions of the sub-section 1.3., such an evaluation should necessarily include spatial and historical factors.

Following the methodological framework established in the Chapter 3, this Chapter, starts with the spatial exploratory analysis of the key regional demographic indicators, as well as the historical population data trends with the purpose of determining the significance of spatial effects existing between the local municipalities in Latvia in terms of the demographic processes under study. Spatial autocorrelation tests help author to confirm the necessity in application of GWR models during the further analysis steps, and help to uncover interesting spatial details about the historic regional population change in Latvia.

Second sub-section of this Chapter aims to measure the regional demographic implications of the investments carried out under the Latvian national regional and cohesion policy, and to evaluate the significance of these effects in comparison with other local socio-economic factors. In order to examine the links between specific types of investments and policy instruments and their resulting effect on regional demographic processes, author uses both classical and spatially adjusted models together with the exploratory data analysis on the scale of local municipalities in the period of 2009-2013.

Then, author uses the previously recalculated 1959-2011 population census data for the historical exploratory study based upon the established methodology of the hierarchical time-series clustering. Results of such evaluation will be instrumental in determining the long-term groups of local municipalities sharing some persistent commonalities in terms of the historical population dynamics.

Final sub-section of this Chapter is devoted to the analysis of the demographic determinants of creativity within the EU Member States, by estimating the level and significance of the effects which specific demographic factors appear to have on the

countries' GCI index, as well as its component rankings. Furthermore, in accordance with the methodology explained in sub-section 3.4, the model estimation results will be used for elaborating a simple forecast of the change in the human capital's creative potential of the Baltic States until the year 2050.

#### 4.1 Exploratory spatial analysis of the population development indicators in Latvia's municipalities

Following closely the methodological steps explained in the previous Chapter, and considering the importance of the initial exploratory spatial analysis highlighted by Paul Voss, Katherine Curtis-White and Roger Hammer in their trendsetting 2006 paper "*Explorations in spatial demography*", author devotes this sub-section to the presentation and discussion of the most noteworthy results of various spatial autocorrelation tests carried out for the regional demographic indicators, as well as historical population change figures in Latvian municipalities.

Using the available centre-point distance and spatial connectivity weights matrices, described in sub-section 3.1., it is now possible to perform a series of Global Moran's I spatial autocorrelation tests for any of the observed regional demographic indicators. Author begins this exploratory study by applying this test to several demographic indicators of Latvian municipalities described in the previous Chapters and employing the centre-point distance weights (see Table 4.1 below).

Table 4.1

##### Results of the Global Moran's I test for selected demographic indicators of Latvian municipalities in 2011

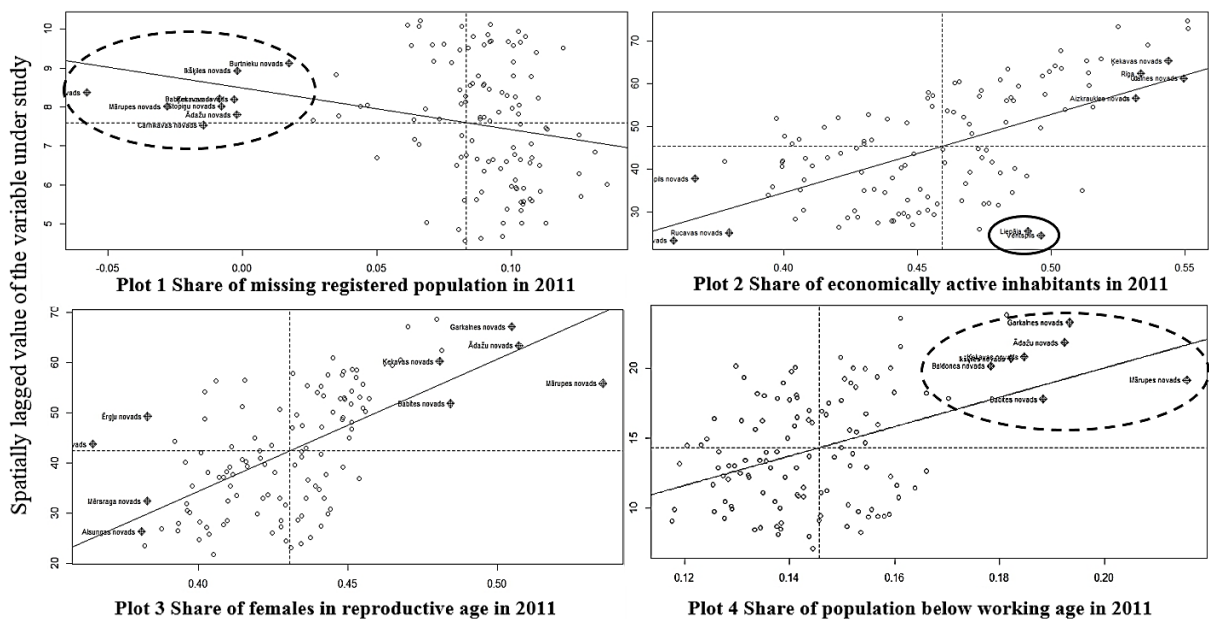
*Globālo Morana I testu rezultāti Latvijas pašvaldību demogrāfiskajiem rādītājiem 2011. gadā*

Variable	I statistic	Expectation
Missing registered population	0.26194	
Share of economically active population (15-64)	0.22045	
Share of females in reproductive age (15-49)	0.20557	
Share of population below working age (0-14)	0.19703	-0.00847
General fertility rate	0.06890	
Registered net migration as % of population	-0.01136	

Source: author's calculations based on the Central Statistics Bureau data.

Even from the results of this simple test it is possible to see, that the Moran's I values are positive for all of the observed indicators except the registered net migration. However, significance of the values is a different issue. It is obvious that Moran's I values are significant (i.e. notably differ from the expectation) for the first four indicators: missing registered population, share of population below working age, share of females in reproductive age and share of economically active population. While GFR and registered net migration both show very insignificant differences from the expected mean.

This suggests that the last two indicators can be analysed using classical models, with no risk of missing the spatial spillover component. From the practical point of view, this also indicates that the uneven distribution of natural population increase in the entire country, often mentioned in various publications (e.g. see SRDA 2013), is not caused by spatial variance in the fertility rates, but rather is a result of a significant difference in the current female population structure in the regions (i.e. share of females in their reproductive age). Parallel conclusion may be drawn for the migration numbers, where registered migration shows zero spatial autocorrelation, while the unregistered migration (in our case represented by the share of missing registered population - MRP) shows an evident spatial clustering.



**Figure 4.1 Moran's scatter plots of the selected indicators in Latvian municipalities in 2011**

*Morana korelogrammas Latvijas pašvaldību demogrāfiskajiem indikatoriem 2011. gadā*

Source: author's elaboration based on the Central Statistics Bureau data

When looking for the more precise and less generalised spatial autocorrelation analysis tools, Moran Plots are the first things that come to mind. With the help of Moran Scatterplots that show the individual Moran's I values for each municipality included in the global

Moran's I test conducted above, it is possible to continue spatial analysis in search of local spatial dependencies and anomalies without resorting to the scrutiny of LISA analysis for each individual municipality (Anselin L., 1995). Figure 4.1 combines Moran Scatterplots for four of the previously mentioned regional demographic indicators, which have shown a significant spatial autocorrelation, highlighting outlying observations, hot / cold spots and trend-setters in the local spatial structure.

High-resolution versions of the Moran Scatterplots presented in the Figure 4.1 are available in Annex 3 of this Thesis.

Graphical evaluation for these indicators reveal, that for two of them (Share of missing registered population and Share of population below working age – Plots 1 and 4 respectively) spatial autocorrelation pattern is not as strong as expected from the global test results. In both these cases the slope of the trend line (global Moran's I) is mostly defined by the uncharacteristic values shown by the municipalities located in the direct area of influence of the Riga city (dashed circles), while all other observations are distributed quite randomly through all four quadrants of the plot. It is necessary to note, that the Moran Scatterplot for the Share of missing registered population appears inversed (negative trend slope) due to the nature of the indicator (i.e. less missing population – better result).

The other two indicators (Share of economically active inhabitants and Share of females in reproductive age – plots 2 and 3 respectively), demonstrate a classic case of agglomerative spatial structure (see Krisjane, 2005) with extremely high values tending to be located closer to each other (and generally concentrate around Riga) and extremely low values being pushed to periphery. All other observations are distributed more or less gradually along the trend lines. The similarity of these two indicators is not surprising as they both are partially dependant on the overall population age structure. Two interesting irregular points with high indicator values and extremely low spatial dependency can be found in Plot 2 (solid circle). These represent the cities of Ventspils and Liepāja, which, unlike Riga city, apparently have very little spatial population spillover effect on their surrounding municipalities. In other terms, unlike in case of Riga, active population of these coastal cities prefer to settle within the city limits and do not tend to reside in the suburban areas at all.

To conclude the findings so far, the global tests indicate spatial autocorrelation of the parameters associated with the population age structure and economic activity, while such indicators as Long term registered migration and General fertility rate appear to be distributed evenly throughout the country. Moran Plots show that the spatial clustering of indicators representing share of population below working age and short-term emigration is not as

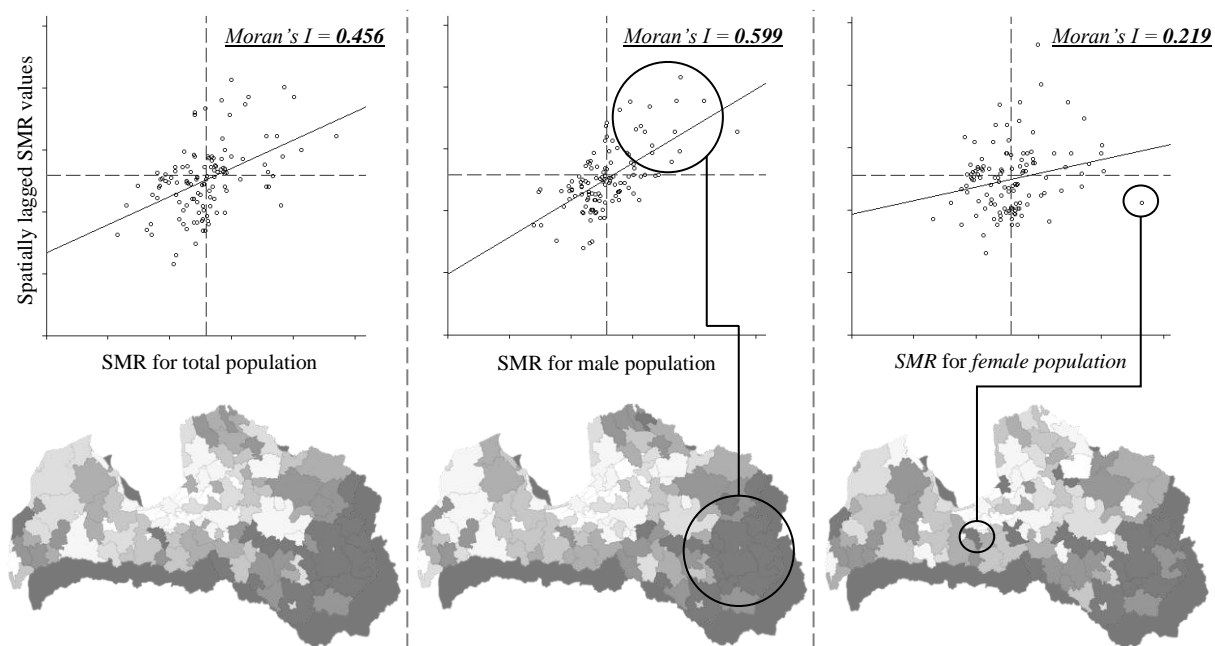
common in the whole country as first expected, and is largely caused by the socio economic impact of Riga city. Some hot and cold spots were found for all indicators with significant spatial autocorrelation. The municipalities in comparatively worse situation are mostly located on the periphery – close to the borderland as expected, while high values tend to concentrate within close proximity to Riga. Surprisingly, other big and economically developed cities have shown little to none spatial autocorrelation of some key indicators with their neighbouring municipalities. This all hints, at the possibility that different forms of socio-economic factors, policy instruments and/or aid measures in Latvian municipalities may indeed have different tendencies towards spatial spillover.

Having observed the research benefits provided by the use of Moran Plots, author proceeds with the spatial exploratory analysis of the municipal Standardised Mortality Rate data produced by the author in line with the methodology described in sub-section 3.1 of this Thesis. In case of the regional SMR, spatial autocorrelation may be caused by a variety of reasons and, similarly to the indicators addressed above, may be subject to both, the spatial spillovers of the indicator under study (i.e. clustering of high SMR values around the area associated with particular health hazards) or by the preceding spillovers of its impact parameters (i.e. transfer of negative socio-economic factors from/to the neighbouring regions).

In order to precisely measure the spatial autocorrelation SMR and account for the spatial context factors in the further model-based analysis, author employs previously developed spatial connectivity weights matrix (see sub-section 3.1). This matrix has been selected over the aforementioned centre-point distance matrix, due to its ability to better capture the effects of the direct neighbourhood, which is particularly important when studying the mortality figures (e.g. see Anselin, 2003 or Voss et al, 2006).

The role of municipality's spatial location is presented using the Moran Plots (for the total population, males and females respectively), while the overall spatial autocorrelation of SMR in Latvia is measured and presented on the graphs using Global Moran's I test described in detail in the previous Chapter.

Figure 4.2 below shows Moran Scatterplots for the local SMR values, identifying the outlying observations, hot/cold spots and trend-setters in the spatial structure and linking some observations (used as examples) with the SMR maps.



**Figure 4.2 Moran's scatter plots of the SMR values of Latvian municipalities in 2008-2013**

*Morana korelogrammas Latvijas pašvaldību SMR rādītājiem 2008.-2013. gadā*

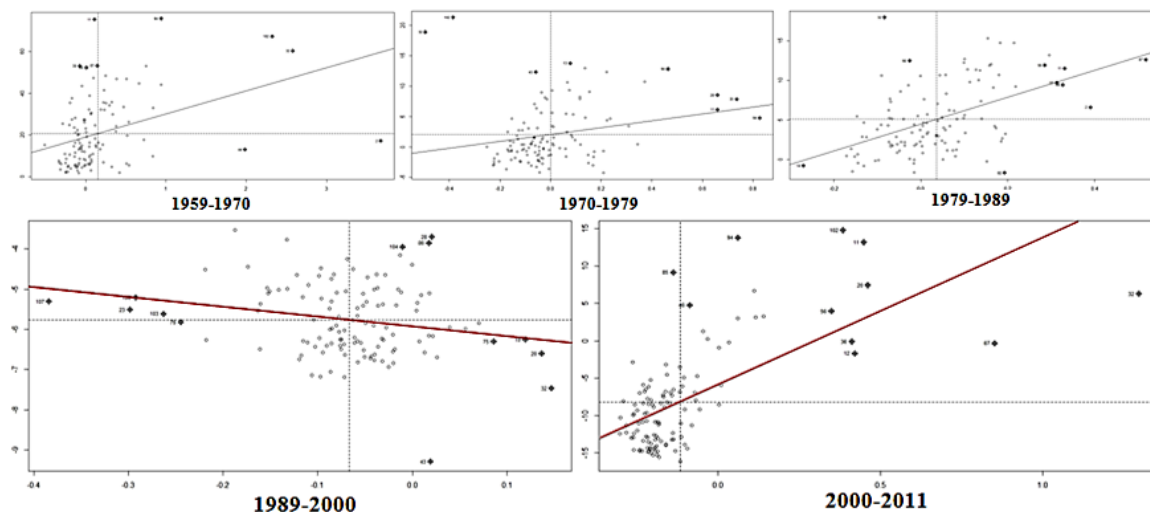
Source: Author's calculations, Central Statistics Bureau data.

The spatial autocorrelation analysis results for the SMR values in Latvian municipalities, show a presence of strong spatial grouping for a total population SMR throughout the country. However, the further decomposition of the total population SMR figures into the separate male and female SMR data sets, present a much more interesting picture. Global Moran's I value for male SMR demonstrates an unprecedented level of spatial autocorrelation, suggesting a definite influence of a significant spatial factor in determining the standardised male mortality in Latvia. Furthermore, the associated Moran Plot reveals a surprisingly tight fit of the individual observations, placing the majority of municipalities in either first or third quadrants of the plot. This means, that the factor of spatial location remains to be determining for male mortality throughout the entire country.

Female mortality, however, holds even more surprises, as, unlike the male SMR figures, it shows comparatively small Global Moran's I value and poor trend fit, with the individual observations spread across all four quadrants of the plot. This means, that there is a clear and undeniable difference in the role, which the spatial location of the particular municipality within the country has to play in determining standardised mortality for males and females. Considering these results, further analysis of the SMR indicators using the spatially-adjusted model is highly recommended.

In the conclusion of this sub-section, using the developed simple centre-point distance spatial weights matrix together with the produced population dynamics data, it is now possible to conduct a series of spatial autocorrelation tests and construct the corresponding scatter plots for the previously calculated historical population growth figures in the given time intervals (see Figure 4.3 below).

The high slope of the Moran's I trend in all plots allows one to reject the null-hypothesis of zero-autocorrelation for all of the observed periods with a high degree of certainty, which indicates that a noticeable level of spatial autocorrelation in terms of population growth was present between the territories of modern Latvian municipalities in all five time intervals considered within this study.



**Figure 4.3 Moran scatter plots showing spatial autocorrelation tendencies of the historical population trends in modern Latvian municipalities in 1959-2011 period**

*Morana korelogrammas, kas attēlo iedzīvotāju skaita dinamikas telpiskās autokorelācijas tendences mūsdienu Latvijas pašvaldību teritorijās 1959.-2011. gados*

Source: Author's elaboration

Further analysing the produced plots, it is interesting to note, that during the period of socioeconomic and political transition (1989-2000), Moran's I value in Latvia turns negative, which can be seen clearly from the associated scatter plot. In simpler terms, this means, that in all of the observed periods, territories with comparatively higher population growth rates were spatially close to each other, with the exception of 1989-2000 interval, when the situation was reversed.

In many aspects, 1959-1970 and 2000-2011 scatter plots are the most similar, both having nearly empty fourth quadrant (high growth and low spatial lag), which indicates that in these periods there was a noticeable tendency towards urbanisation and concentration of population inhabiting rural areas. While the causes of such a dynamic in 1959-1970 may be easily explained by rural collectivisation and influx of foreign labour force into cities and urban areas, the 2000-2011 period presents a more complex picture.

In this regard, one may theorise that in both cases the trend is defined by the same groups of territories (clusters), which show the presence of similar spatial demographic processes influenced by the (once again) growing role of cities and development centres as

focal points of economic and social activity. This theory will be put to the test when reviewing the cluster analysis results presented in sub-section 4.3 of this Thesis.

This conclusion brings important implications for the existing and future population development programmes. Among other cases, it may partially help explaining the inconclusive results of the early demographic support programmes implemented in most post-soviet countries (including, Russia and Belarus) during late 1990's – early 2000', where governments tried providing additional economic stimuli in the form of financial support and/or tax reliefs for the families with more than one/two children, which resulted in even greater population growth in the big cities and apparently did not affect rural depopulation processes (see for example FSSS, 2014).

The unusual negative Moran's I statistic value and the underlying rural population increase during the transition period of 1989-2000 requires further research, as it was most likely linked with the whole set of economic, social and political processes present after the restoration of independence and widely discussed in the literature (e.g. see Eglite, 2010, or World Bank, 1993).

## **4.2 Model-based assessment of the socio-economic and regional policy factor influences**

Having established the presence and specifics of the spatial autocorrelation among the Latvian municipalities in terms of regional demographic development, it is now possible to proceed with the model-based assessment of the socio-economic and regional policy factor influences. Using the datasets selected and produced in the previous chapters of this thesis, author begins by discussing the most interesting results of the model estimations carried out for the selected indicators of Latvian municipalities for the year of the latest population census 2011. In order to verify the previous assumptions on the utility of the GWR models, the estimation results of the classical Linear Model and the Spatial Durbin Model will be compared. The centre-point distance weights matrix is used in the SDM model for capturing the spatial distance effects throughout the entire country.

Table 4.2 below shows examples of the SDM modelling results for such indicators as share of economically active inhabitants (*empl\_active\_pop\_2011*), share of population below working age (*pop\_2011\_0-15*) and GFR in 2011. For the purpose of this study, socio-economic and pre-existing demographic factors like ethnic composition of population (share of ethnic Latvians per other nationalities) ( $\beta_1$ ), rate of registered marriages per total number of families ( $\beta_2$ ), unemployment levels ( $\beta_3$ ), average net wages ( $\beta_4$ ), as well as municipal

budgetary spending on social protection per capita ( $\beta_5$ ) are used as the explanatory variables. As mentioned above, in order to demonstrate the advantages of the spatial modelling approach, results produced by the LM model for the same variables are shown in the table and compared with the SDM outputs using the Logarithmic Likelihood model fit values as suggested in the literature (e.g. Ward & Gleditsch, 2008). The spatially lagged components of the explanatory variables are denoted by theta ( $\theta$ ) with the same numbers as the corresponding betas.

Table 4.2

**Comparison of the SDM and classical Linear Model fitting results for the selected indicators of Latvian municipalities in 2011**

*SDM modeļa un klasiskā lineārā modeļa aprēķinu rezultātu salīdzinājums par atlasītiem indikatoriem Latvijas pašvaldībās 2011. gadā*

Parameter	Spatial Durbin Model (SDM)			Linear Model (LM)		
	<i>empl_active_pop_2011</i>	<i>pop_2011_0-15</i>	<i>GFR_2011</i>	<i>empl_active_pop_2011</i>	<i>pop_2011_0-15</i>	<i>GFR_2011</i>
Rho ( $\rho$ )	-0.00486	-0.00890	-0.01303	-	-	-
Share of Latvians ( $\beta_1$ )	-0.06866**	0.01486	2.99226	-0.07065**	0.00621	5.21212
Spat. lagged share of Latvians ( $\theta_1$ )	0.00574**	-0.00110	-0.11982	-	-	-
Rate of registered marriages ( $\beta_2$ )	0.07072	0.01798	10.23354	0.01510	0.04753	3.24496
Spat. lagged share of registered marriages ( $\theta_2$ )	0.00585	-0.00063	-2.02353	-	-	-
Unemployment ( $\beta_3$ )	-0.11229	-0.05141	-1.83002	-0.18350*	-0.08762**	-26.55611
Spat. lagged unemployment ( $\theta_3$ )	0.01532*	-0.00248	-0.96088	-	-	-
Net wages ( $\beta_4$ )	0.00025***	0.00006 ^	0.02139	0.00039***	0.00012***	0.03432
Spat. lagged net wages ( $\theta_4$ )	0.00002***	0.00001 ^	0.00101	-	-	-
Social prot. ( $\beta_5$ )	-0.00011 ^	0.00004*	-0.02037	-0.00011	-0.00006*	-0.01626*
Spat. lagged social prot. ( $\theta_5$ )	-0.00000	0.00000	-0.00284	-	-	-
<b>Logarithmic likelihood</b>	<b>264.9</b>	<b>355.9</b>	<b>-395.4</b>	<b>249.9</b>	<b>345.4</b>	<b>-400.4</b>

Significance codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1.

Source: author's calculations based on the Central Statistics Bureau data.

The results presented in the table above, only confirm the previous assumption on the even distribution and equally low levels of the GFR throughout the entire territory of Latvia – SDM did not show any significant impact factors for this indicator, while linear model only marginally highlighted the municipal social protection expenditure having a negative

correlation. This may be explained by the fact that the regions having higher social protection spending were already facing a variety of other socio-economic challenges.

For the Share of economically active population, SDM model has highlighted average net wages (both local and spatially lagged from the neighbouring regions) as the key explanatory variable, while spatially lagged unemployment has demonstrated a small, but rather significant inverse spatial spillover effect. This can be explained by the fact that unemployment in neighbouring regions is driving economically active population towards the local development centres or simply the regions, where there are more available jobs. The ethnic composition in this case should be taken into account as a representation of the differences in the age structure and socioeconomic behaviour of the ethnic groups.

Regarding to the most important hypothesis on the spillover effects, comparing the impact of the “Net wages” variable estimated by the SDM and LM models, one may observe, that the  $\beta_4 = 0.00039$  effect shown by the LM, is actually spatially decomposed by the SDM into a local effect of  $\beta_4 = 0.00025$  and the average spillover effect of the neighbouring municipalities of  $\theta_4 = 0.00002$ .

For the population below working age, the results are similar with the average net wages of parents having the decisive effect on the indicator. Spatial spillover of the net wages is also present, which is not surprising, especially when analysing these results in the cross-section with the data on population employed outside of their respective municipalities. Social protection expenditure, as expected, shows zero spatial spillovers, as most social support measures are provided only to the population registered in the particular municipality, therefore preventing the network effects.

The difference in the log-likelihood values of the model pairs is proportional to the previously determined levels of spatial autocorrelation of the indicators under study; however, it may not be considered particularly significant in all three cases, as it is small enough to be caused by a difference in the number of the degrees of freedom for each given pair of models. This, in turn, means, that in the given cases, SDM models do not necessarily provide a better model fit, but rather should be used specifically as means for a precise analysis of the spatial spillovers of explanatory factors.

Further, it is necessary to recall the observations made in the sub-section 2.2 of this Thesis, concerning the notion that the most significant regional aid schemes, either directly or secondarily addressing the regional population change, are planned and funded under the national cohesion policy framework. With this in mind author proceeds with the model-based

assessment of the EU funding impact on the selected regional demographic processes, comparing it with the influences of some other regional policy and socio-economic factors.

As previously explained in sub-section 3.1, the pool of independent variables used in this assessment comprise the average annual per-capita values of the EU Structural and Cohesion funds (CF, ESF, ERDF) including national co-funding[SF&CF], other EU funds (EFF, EAFRD, EAGF) including national co-funding [OF], Foreign Direct Investment [FDI] and municipal spending on social support and social security [SocSup], as well as the average annual local unemployment rate in each municipality. Subject to the data availability, all figures are used for the period 2009-2013. The dependant parameters represent the change rates of the four regional demographic indicators (total population change, change in number of children (0-14), change of the Missing Registered Population index and change of the number of population due to registered migration in each municipality over the same period of 2009-2013.

Author begins with the estimation of the linear model for each of the demographic indicators, incorporating all of the explanatory variables listed above in the right-hand side of the model (3.2). Table 4.3 below shows the estimation results, as well as the corresponding residual Moran's I test values (based on the direct connectivity weights matrix).

Table 4.3

**Effects of regional investment / policy instruments on selected demographic indicators in 2009-2013: Linear model results**

*Reģionālo investīciju / politikas instrument ietekmes novērtējums uz atsevišķiem demogrāfiskajiem rādītājiem 2009.-2013. gadu period: Lineārā modeļa rezultāti*

Parameter	Indicator			
	Total pop. change	<15 pop. change	MRP change index	Pop. change due to reg. migration
SF&CF	-0.00342	-0.00295	-0.00215 *	0.00036 *
OF	0.00248 ‘	-0.00152	0.00065	0.00015
FDI	-0.00015	-0.00032	0.00012	-0.00006
SocSup	-0.01447	-0.04147	0.01203	-0.00556 *
IncTax	0.04057 ***	0.08979 ***	-0.00147	0.00179 ***
Unempl	0.17032	0.59820 ***	-0.02783	0.02615 **
R <sup>2</sup>	0.80532	0.83928	0.11095	0.26709
Moran's I of residuals	0.07103	0.07679	0.16280	0.13681

Significance codes: 0 ‘ \*\*\* ’ 0.001 ‘ \*\* ’ 0.01 ‘ \* ’ 0.05 ‘ ‘ ’ 0.1 ‘ ‘ ’ 1.

Source: Author's calculations based on CSB and RDIM data.

From the LM estimations above, one may see, that the average collected income tax is highlighted as the most significant predictor for total population change, change of population below working age and the change of population due to the registered migration. Unemployment levels appear to be just as significant for the increase of young population and the registered migration. Average per capita spending of other EU funds (EFF, EAFRD, EAGF) has been slightly significant for the total population change, hinting at the role of these investments in the development of rural / coastal areas and the resulting improvement of economic and social conditions.

Low Moran's I values of the residuals for the total population change and change of population below working age, combined with the high R-squared, suggest that the LM model is suitable in these cases, and the spatial models should not yield much improvement in the fitness of the estimations.

Surprisingly, LM estimation shows that the only (moderately) significant factor for the reduction of the MRP rate in the regions is the average EU Structural and Cohesion funds investment per capita, which may be explained by the improvement in infrastructure and public services impacting individual's choice regarding the temporary (or unregistered) employment abroad / in different region. However, the very low R-squared value for this estimation indicates, that the model is missing several key impact factors. In addition, moderately high Moran's I value of the residuals indicate that these missing external factors must be noticeably spatially correlated. This is also relevant for the last indicator.

Average EU Structural and Cohesion funds investment per capita has also a moderately significant positive impact on the population change caused by the registered migration, which can be easily explained by the benefits of improved infrastructure and public services for the registered residents of the particular municipality actively involved in the SF&CF projects.

Considering the potential spatial spillovers of the large-scale aid and investments, as discussed in sub-section 3.3 and shown in the Figure 3.7, author proceeds by analysing the same set of parameters and indicators, as above, by applying all three popular forms of the GWR models – SLM, SDM and SEM (using connectivity matrix,  $k=1$ ).

Table 4.4 below provides the estimation results of the three types of SWR models, estimated using the methodology widely explained in the previous Chapter of this Thesis and demonstrated by Bivand (2002).

Table 4.4

**Effects of regional investment / policy instruments on selected demographic indicators in 2009-2013: SWR model results (SLM, SDM and SEM)**

*Reģionālo investīciju / politikas instrument ietekmes novērtējums uz atsevišķiem demogrāfiskajiem rādītājiem 2009.-2013. gadu period: Ģeogrāfiski svērto modeļu rezultāti (SLM, SDM un SEM)*

Parameter		SLM				SDM				SEM			
		Indicator											
		Total pop. change	<15 pop. change	MDP change index	Pop. change due to reg. migration	Total pop. change	<15 pop. change	MDP change index	Pop. change due to reg. migration	Total pop. change	<15 pop. change	MDP change index	Pop. change due to reg. migration
Direct effects ( $\beta$ )	SF&CF	-0.00303 c	-0.00196	-0.00222 **	0.00037 *	-0.00269 *	-0.00271	-0.00191 *	0.00033 c	-0.00342 *	-0.00244	-0.00219 **	0.00036 *
	OF	0.00270 **	-0.00152	0.00082	0.00016	0.00221 *	-0.00103	0.00045	0.00009	0.00277 **	-0.00160	0.00088	0.00016
	FDI	-0.00017	-0.00035	0.00015	-0.00006	-0.00014	-0.00044	0.00019	-0.00006	-0.00020	-0.00050	0.00021	-0.00006
	SocSup	-0.01769	-0.04791	-0.00099	-0.00571 *	-0.01354	-0.02827	0.00934	-0.00546 *	-0.01715	-0.04752	0.00540	-0.00584 *
	IncTax	0.03729 ***	0.08229 ***	0.00925	0.00175 ***	0.03456 ***	0.08428 ***	-0.00370 c	0.00153 **	0.04070 ***	0.08943 ***	-0.00164	0.00180 ***
	Unempl	0.18204 **	0.60759 ***	-0.02508	0.02622 **	0.19273 c	0.70316 **	-0.03733	0.02908 c	0.17321 c	0.62119 ***	-0.01880	0.02679 **
Spatially lagged effects ( $\theta$ )	SF&CF	-	-	-	-	0.00161 c	-0.01102 c	0.00205 c	0.00041 c	-	-	-	-
	OF	-	-	-	-	-0.00338	0.00174	-0.00156	-0.00002	-	-	-	-
	FDI	-	-	-	-	0.00123	0.00372	-0.00074 c	0.00000	-	-	-	-
	SocSup	-	-	-	-	0.05663	0.07473	0.04897 c	0.01356 c	-	-	-	-
	IncTax	-	-	-	-	0.00054	0.00527	0.00063	-0.00007	-	-	-	-
	Unempl	-	-	-	-	-0.12681	-0.32300	-0.06214	-0.02845	-	-	-	-
Spatial indicators	$\rho$ (spat. lag. dep. var.)	0.16922 *	0.14102 c	0.30717 **	0.05530	-	-	-	-	-	-	-	-
	$\lambda$ (spat. error)	-	-	-	-	-	-	-	-	0.19713	0.20248	0.36608 **	0.08630
Model fit	R <sup>2</sup>	0.81196	0.84364	0.16622	0.26862	-	-	-	-	0.80957	0.84309	0.18908	0.27050
	Log. likelihood	-	-	-	-	-256.43	-355.88	-210.30	-33.09	-	-	-	-

Significance codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1.

Source: Author's calculations based on CSB and RDIM data.

As expected, all three types of the spatially weighted models, have brought only slight improvements to the model fit results for the first two indicators under study. The SLM model results demonstrate moderate to high role of spatially lagged dependant variable for the first three indicators, resulting in 0.1-0.5 improvement in R-squared values.

The moderate negative influence of the SF&CF investment on the total population change in conjunction with the present positive effects on the migration-related indicators (MRP and registered migration) suggests, that these funds were applied more intensively in the regions with highly negative population change due to natural movement, and were unable to improve the situation over such a short time period.

SDM model shows a very good fit for the population change due to registered migration (indicated by higher Logarithmic likelihood value), which suggests the important role of Type 2 spatial spillovers of the EU Structural and Cohesion funds as well as municipal social support spending. This is logical, as both these factors provide known benefits (social services, social aid, public infrastructure etc.) for the inhabitants officially registered in the particular municipality or residing in the direct vicinity. SDM also hints at the moderately significant spatially distributed effects of the EU Structural and Cohesion funds on both change of population below working age (possibly, due to investment in education, medical and social care facilities in rural centres) and the reduction of MRP.

By demonstrating a high significance of the spatially correlated error term, the SEM confirms and underlines the presence of an unaccounted external spatially correlated factor(s) affecting the MRP rate in the local municipalities. This points out the need for additional in-depth study of this important social, economic and demographic phenomenon. Although, very useful in understanding the nature of regional demographic processes, the analytical approach presented in this Chapter should be further expanded by inclusion of individual-level data and wider use of qualitative information regarding the socio-economic situation in the particular groups of municipalities. Therefore, the use of historical information and historical population data is highly advisable.

Overall, results of the spatial econometric analysis allow to confirm that, while the OPs of the Latvian national cohesion policy 2007-2013 did not specifically foresee to tackle the regional demographic issues, in comparison to all other available policy tools, investments performed under these programmes had some (indirect) impact on the local demographic processes, namely – change of population due to official migration, and the change in the missing registered population rate.

Although, the positive effect has been lower than predicted by some of the national planning documents, including the National Development Plan 2007-2013 (MoRDLG, 2006). Further, it is determined that, depending on the type of investment / aid instrument used, its effect may be either localised (affecting only the target region) or spatially lagged (having effect not only in the target region, but also having some measurable spilling-over to the neighbouring territorial units).

Last, but not least, in this sub-section author presents the model-based assessment of the effects of several local socio-economic factors on to the standardised mortality rate for all inhabitants, as well as for male and female populations individually. Considering the particularly high global spatial autocorrelation levels of this indicator throughout the country,

and lack of any predictions about the known impact factors, the basic SLM model has been chosen for this analysis. Same as before, author applies the direct connectivity spatial weights matrix  $k=1$ , as it is most suitable for capturing the spillover effects of the localised impact factors like the municipal budget spending or the local income level.

Realising the limited availability of data, the model results presented below include the following explanatory variables: collected income tax per capita in the given municipality, local unemployment rate, municipal healthcare spending per capita, municipal social support policy spending per capita, as well as municipal culture and recreation spending per capita. In order to control for the mortality differences between ethnic groups, the share of ethnic Russian population (%) has been added to the model.

Table 1 shows the consolidated and structured SLM estimation results, showing the modelled effects of the selected regional socio-economic and policy factors on the standardised mortality rate in the municipalities of Latvia in 2011. Standard error values are provided in brackets.

Table 4.5

**Effects of regional socio-economic and policy factors on standardised mortality rate in the municipalities of Latvia in 2008-2013: SLM estimation results**

*Sociāli-ekonomisko un politikas faktoru ietekmes novērtējums uz standartizētiem mirstības rādītājiem Latvijas pašvaldībās 2008.-2013. gadā: SLM aprēķina rezultāti*

Parameter	Standardised mortality rate (‰)		
	Total population	Male population	Female population
Collected income tax per capita	-0.00636 *** (0.00145)	-0.00801 *** (0.00169)	-0.00404 * (0.00169)
Local unemployment rate	0.15242 *** (0.04335)	0.21959 *** (0.05184)	0.09891 * (0.04845)
Mun. healthcare spending per capita	0.00804 (0.01008)	0.00113 (0.01172)	0.01001 (0.01193)
Mun. social support policy spending per capita	0.00214 (0.00287)	-0.00047 (0.00334)	0.00422 (0.00339)
Mun. culture and recreation spending per capita	-0.00459 ' (0.00332)	-0.00414 (0.00387)	-0.00435 ' (0.00393)
Share of ethnic Russian population (%)	3.52329 ' (2.38277)	6.17783 * (2.76966)	1.88484 (2.82011)
$\rho$ (spatially lagged SMR)	0.08498 ' -----	0.17747 **	0.03369
$R^2$	0.60046	0.69626	0.31941

Significance codes: 0 ' \*\*\* ' 0.001 ' \*\* ' 0.01 ' \* ' 0.05 ' ' ' 0.1 ' ' ' 1.

Source: Author's estimations, CSB and SRDA data.

At the first glance, both the Moran's I test and the significance of  $\rho$  value in the model estimation results confirm that the male population mortality in Latvia has a noteworthy spatial autocorrelation. This can be explained by several reasons including the spatial spillovers of the predetermining socio-economic factors, negative endogenous influences /

environmental conditions and the spatial distribution of Russian ethnic group (which has demonstrated a higher male mortality rate).

Further, the average collected income tax per capita and unemployment indicators included in the model have proven that the overall income and employment factors are the key determinants for the regional mortality in male population and play important role in shaping female mortality. Such finding is not surprising, and is well supported by the observed minimal effects of the regional government spending for healthcare and social support. Combined with the first observation on spatial autocorrelation, this allows to theorise that in specific areas of the country, high personal income level is crucial for ensuring the necessary level of healthcare, quality of life and other endogenous conditionalities necessary for a longer lifespan. Such assumption supports the findings of previous studies carried out by Latvian authors (e.g. see Kruminis, 2006).

Finally, regional female mortality has shown a much smaller rate of spatial dependency and only moderate reaction to income and employment factors. A somewhat significant positive reaction to the government spending in the areas of culture and recreation has also been observed for the female population. These results suggest, that regional female mortality in Latvia is generally a more complex process than the male mortality, and is determined by a series of exogenous factors, possibly including the historical specifics of the given region, like economic specialisation (see sub-section 4.3), and the existing long-term social / environmental conditions theorised by many authors (e.g. see Johansson, 1991).

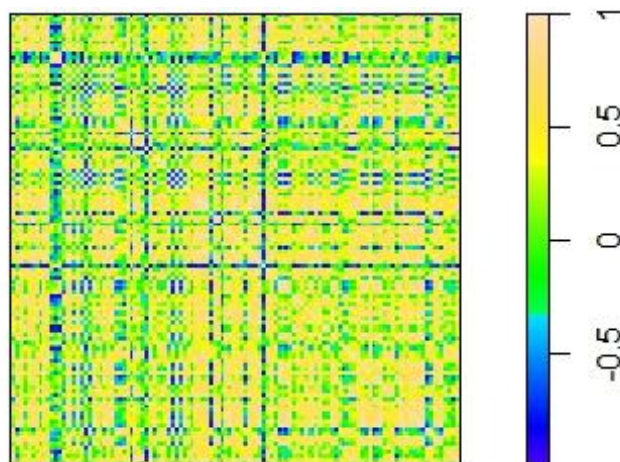
### **4.3 Defining the historical clusters of population development in Latvia**

As it was previously shown, there is a very high probability of historical demographic and socio-economic specifics playing a role in the contemporary population development processes on the regional and municipal administrative-territorial level. Using the historical population trend data sets reviewed in the sub-section 3.2 of this Thesis, author attempts to uncover the existence of historical population development commonalities between the groups of contemporary cities and local municipalities by conducting a hierarchical time series cluster analysis.

For the purpose of this study, an agglomerative hierarchical clustering method has been chosen. The methodology and reasoning behind this choice has been already explained by the author in the sub-section 3.3 of this Thesis. Such method works by grouping data objects into a tree of clusters, starting by placing each object in its own cluster and then merging clusters

into larger and larger groups, until all objects are in a single cluster or until certain termination conditions such as the desired number of clusters are satisfied.

Considering the nature and scope of the available data, a simple correlation coefficient is used as the measure of similarity, for capturing individual similarity / dissimilarity for every permutation of observations in form of a simple square (n=119) correlation matrix (see Figure 4.4).



**Figure 4.4 Correlation matrix graph of the population dynamics in modern Latvian municipalities between population censuses of 1959-2011**

*Korelācijas matricas diagramma, kas attēlo iedzīvotāju dinamikas izmaiņu korelāciju starp mūsdienu Latvijas pašvaldību teritorijām laika posmos starp tautas skaitīšanām 1959.-2011. gadu laika periodā*

Source: Author's elaboration

It was already explained, that according to the established methodology for the hierarchical clustering, it is considered acceptable to choose the clustering degree or “cut-off” distance (defining the number and structure of individual clusters) based on the desired number of clusters and / or researcher’s knowledge of the data at hand.

With this in mind, the cut-off distance of 1.25 is chosen for the purpose of this study, as it provides the acceptable number of clusters (k=7) and captures known historically similar municipalities (e.g. *Iecavas*, *Ādažu* and *Ķeķevas*) in separate clusters, while avoiding unnecessary splitting of the more homogenous groupings. The detailed results of the cluster analysis results are available in Annex 4 to this Thesis.

Figure 4.5 below presents visualised results of the hierarchical clustering process (also known as dendrogram), identifying the seven historical groups of territories to be addressed individually further in this study. The high resolution version of the dendrogram is available in Annex 5 to this Thesis.

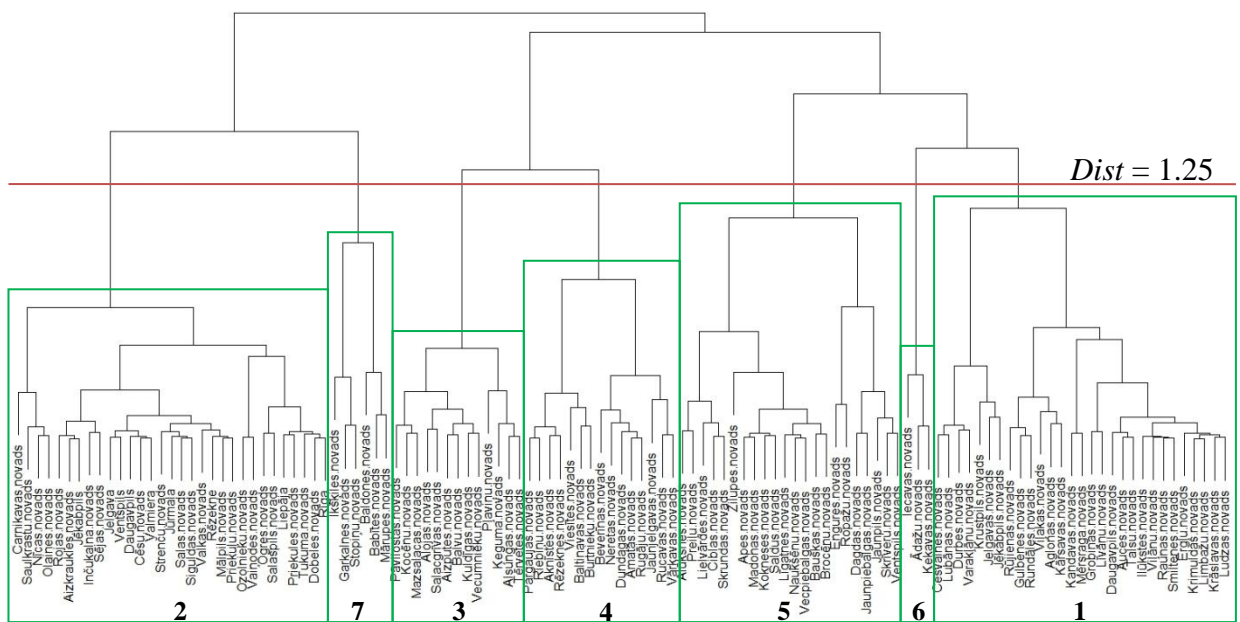


Figure 4.5 Dendrogram showing hierarchical clustering of modern Latvian municipalities by similarity of their historic population trends in 1959-2011

Koka diagramma, kas attēlo mūsdienu Latvijas pašvaldību teritoriju hierarhiskās klāsteru analīzes rezultātus pēc to iedzīvotāju skaita trendu līdzības 1959.-2011. gadu laika periodā

Source: Author’s elaboration

After the clustering process is complete, it is useful to understand the nature of divergence between the clusters. In our case, values of the population growth rates of all the municipalities in the particular identified clusters (as shown in Table 4.6 below) are sufficient to help one understand the general historical population growth rate tendencies within the identified homogenous groups.

Table 4.6

Comparison of the average population growth rates within the identified clusters  
Iedzīvotāju skaita dinamikas vidējo lielumu salīdzinājums starp identificētiem klāsteriem

Cluster	Population growth rate					1959-2011
	1959-1970	1970-1979	1979-1989	1989-2000	2000-2011	
1	-0,142	-0,041	-0,022	-0,062	-0,195	<b>-0,392</b>
2	0,327	0,147	0,100	-0,137	-0,123	<b>0,267</b>
3	0,056	-0,061	-0,022	-0,026	-0,186	<b>-0,232</b>
4	-0,126	-0,149	-0,112	-0,016	-0,197	<b>-0,478</b>
5	-0,016	-0,047	0,083	-0,079	-0,170	<b>-0,223</b>
6	-0,046	0,588	0,216	-0,052	0,260	<b>1,201</b>
7	0,710	-0,127	0,134	-0,013	0,552	<b>1,591</b>

Source: Author’s calculations based on historical census data provided by the Central Statistics Bureau of Latvia.

An interesting tendency may now be observed: those groups of municipalities (Clusters 2, 6 & 7) which had an unnaturally high population growth during one or both of the first two

observed time intervals, on average, show better results during the entire 1959-2011 period, and, most importantly, are demonstrating far better comparative results even in modern times (2000-2011 interval).

Furthermore, the repeated review of individual measurements presented on the related Moran Scatterplots (Figure 4.3 in sub-section 4.1) generally confirms the results obtained from the clustering process. As in almost all cases, territories belonging to one of the identified clusters are occupying the same quadrant of the Moran scatter plot diagram. In addition, the trend-setter units (extremes) in 1959-1989 and 2000-2011 scatter plots normally belong to Clusters 2, 6 and 7.

In this regard, one may theorise that in both cases the trend is defined by the same groups of territories (clusters), which show the presence of similar spatial demographic processes influenced by the (re-emerging) growing role of cities and development centres as focal points of economic and social activity.

This tendency may be generally explained by the politically driven and mostly externally-funded urbanisation and industrialisation processes of the 1959-1979 period, which fostered an exponential development of economic and social infrastructure only in specific rural areas, regional centres and cities (Cluster 2), and resulted in the creation of the territory (Clusters 6 & 7) now often referred to in the official publications as Riga area of influence (see SRDA 2013). Despite losing much of its industrial potential during the transition period of 1990s, this area became a popular place of residence with high population growth, given that, due to the well-established transport and housing infrastructure, it facilitates classic push-pull migration flows as described by Dorigo and Tobler (1983) and high intensity exchange of services with the national capital city.

On the other hand, in the most rural areas that are remote from republican cities and/or national development centres (Clusters 1, 3, 4 & 5), a continuous depopulation tendency with only short comparative improvements during the pre-transition period of 1979-1989 and/or transition period of 1989-2000 may be seen.

These observations clearly underline the particular importance of the pre-existing infrastructure, as well as direct access to the long-established regional / national economic and social centres as defining population development factors of the modern Latvian municipalities. Such an assumption may be safely transferred to most of the Eastern Partnership countries and Russia, as these share common history of Soviet-governed urban and rural development with Latvia.

It may also be concluded that, those groups of municipalities currently showing similar population dynamics may have divergent historical trends leading to the current situations. Therefore, from the population development perspective, these clusters of municipalities have different underlying strengths and weaknesses in terms of available infrastructure, reproduction potential and migration behaviour. This also means that different long-term reactions to the various policy instruments and regional aid measures should be expected from the different groups of apparently similar regions.

Finally, it is also possible to notice that the general long-term tendencies of the population dynamics of the identified clusters are following the similar development trends over the whole period under investigation despite the economic, social and political changes. In other terms, groups of territories with similar initial development trends do not tend to converge, but rather continue to diverge over the course of time. This observation seems to at least partly support the assumption on the constant nature of the regional demographic development trends in the former Soviet countries in the long time periods, as it has been theorised in the literature (see Golc, 2004).

#### **4.4 Forecasting the role of creative human capital in the future national development**

Proceeding in line with the methodological framework established in the sub-section 3.3, author concludes this Chapter by conducting a wider scale assessment of the theoretical impact that the change in demographic structure can have on to the development of human capital on a regional or national level, using the concept of “creativity”, discussed in sub-section 1.4 as an example.

Considering the data availability and a wider geographical framework of this study (28 EU Member States used as base units), author does not apply the previously used GWR models, but rather relies on the straightforward analytical toolset based upon a simple linear regression models for determining the impact of the demographic parameters on to the total Global Creativity Index of a country (see Equation 3.12) and its main components (see Equation 3.13).

Before interpreting the model estimation results it is important to note, that, while GCI itself is an index limited by values between 0 and 1 (where 1 is the best possible result), its component rankings represent the actual rank of the country on the global scale; and therefore – the lower rank number (i.e. 1 out of 100) stands for the best result.

Table 4.7 shows the main estimation results for the models described above.

Table 4.7

**Linear model estimation results of the impact of selected demographic factors on the GCI and its component global ranks in the 26 EU countries in 2011**

*Lineārā modeļa aprēķinu rezultāti, kas parāda atlasītu demogrāfisko faktoru ietekmi uz GCI un tā komponentu globālām pozīcijām 26 ES dalībvalstīs 2011.gadā*

Parameter	GCI	Talent rank	Technology rank	Tolerance rank
Population aged under 15 (%)	5,491 *	-3,476	0,915	-17,932 ***
Population aged 15-24 (%)	-1,148 ‘	0,001	8,373 **	-5,506
Population aged 25-34 (%)	-5,158 ‘	2,761	17,751	-4,630
Population aged 35-44 (%)	1,784	-1,593	1,337	-7,069
Population aged 45-54 (%)	4,312 ‘	-3,792 ‘	6,019	-19,834 *
Population aged 55-64 (%)	7,324 *	-8,254 *	-1,771	-17,308 ‘
Population aged 65-74 (%)	4,465	-5,223	6,779	-19,462 ‘
Crude population change (%)	0,010 **	0,056	-2,369 ***	-1,352 ‘
Secondary education att. (%)	0,000	-0,219	-0,733 *	1,391 **
Tertiary education att. (%)	0,010 **	-1,966***	-1,420 **	0,224
<b>R<sup>2</sup></b>	0,866	0,729	0,876	0,779
<b>F</b>	10,955	0,569	0,804	0,649

Significance codes: 0 ‘\*\*\*\*’ 0.001 ‘\*\*\*’ 0.01 ‘\*\*’ 0.05 ‘\*’ 0.1 ‘.’ 1.

Source: authors’ calculations based on the Eurostat data.

As before, parameters R<sup>2</sup> and F included in the table are the traditional indicators for the overall quality-of-fit for each particular model, and have been extensively explained in the specialised literature (e.g. see Seber & Lee, 2012).

Model estimations clearly demonstrate that EU countries with higher shares of population in “15-24” and “25-34” age groups significantly lag in terms of the GCI. Countries with relatively higher share of population in “15-24” group face significant challenges in terms of Technology, with 1% increase in this population group, in average, leading to loss of 8 positions in global ranking), while “24-34” age group shows notable (although statistically insignificant) impact on both Talent and Technology.

Presence of the high share of population under 15 years of age in the country shows strong positive impact on GCI through highly significant influence on the Tolerance rank. Cohorts of 45-54 and 55-64 appear to boost the country’s GCI, through moderately significant but numerically high impact on Talent and Tolerance components. Observing model estimation results for the Tolerance ranking, it is possible to theorise the existence of distinct dichotomy between the two major age groups of population: 15-44 cohort has a mixed and mostly negative effects on this rank, while population above 45 years of age is contributing significantly to the improvement of Tolerance in the country.

Countries with higher Crude population change rate tend to have higher GCI, as growing populations seem to facilitate a much higher Technology rank and the above average Tolerance. However, the lack of any clear indication of positive effects of the remaining “35-44” age group may be partially explained by the complex sub-division of this group by education, qualification, social status and other characteristics, leading to the future formation of the “Creative Class group” when this cohort progresses in time reaching the highly effective age of 45-64 – as suggested by R. Florida (2010) and confirmed by model estimations.

The picture is quite clear with the education attainment parameters, with tertiary education attainment level being positively significant for the GCI in general and its Technology and Talent components: 1% increase in tertiary education attainment, in average, resulting in the 0.01 increase of GCI and bringing a country two steps higher in the global Technology and one step higher in the global Talent ranking. Secondary education attainment appears to have only moderate positive effect on Technology, while significantly degrading the country’s Tolerance position.

From the limited information produced by this exploratory analysis, one can make a conclusion that at the time period of the study, in the EU Member States, residents in the age group of 45-64 with the completed tertiary education were the most likely representatives of the much speculated “Creative Class”.

Further, using the model estimation results (particularly – the  $\beta$  coefficients of the various age groups) and relying upon the available population forecasts produced by Eurostat (main scenario) it is now possible to make a crude forecast predicting the change in creative potential of the selected countries resulting from the change in population age structure over the years. Keeping in mind the limitations of this study, no change in the education attainment levels is assumed.

In this projections, author has chosen to focus the forecast on the three Baltic States – Estonia, Latvia and Lithuania, which share a rather unique population age and gender structure described in sub-section 2.1 (see Figure 2.3). As explained before, unlike the majority of the 28 EU Member States, Latvia, as well as its Baltic neighbours Estonia and Lithuania had shown a temporary increase in birth rate during the late 1980’s and early 1990’s, referred to as the “baby-boom”, followed by the just as rapid fall in fertility later on. Considering this information, it is interesting to observe the change in the forecasted indicators, as the wider population cohorts in Latvia and two other Baltic Countries identified in Figure 2.3 reach the age of different modelled cohorts in 2030 and 2050 respectively.

Accordingly, Table 4.8 below presents the projections of the GCI levels and the change in global rankings of the GCI components for three Baltic countries in years 2030 and 2050, while using year 2015 as a base.

Table 4.8

**Forecast of the GCI and its component rankings of the Baltic States, based on estimated parameters and Eurostat demographic projections (2030 and 2050, main scenario)**

*Uz modeļa parametru vērtībām balstīta GCI un tā komponentu ranga prognozes Baltijas valstīm, izmantojot Eurostat demogrāfiskās prognozes (2030. un 2050. pamata scenāriji)*

Country	Year	GCI	Talent rank	Technology rank	Tolerance rank
Estonia	2015	0,625	16	33	87
	<b>2030</b>	<b>0,946</b>	↑22 (-6) <sup>1</sup>	↑50 (-17)	↑27 (60)
	<b>2050</b>	<b>0,727</b>	↓15 (21)	↑9 (-26)	↓73 (133)
Latvia	2015	0,563	22	54	77
	<b>2030</b>	<b>0,914</b>	↑29 (-7)	↑59 (-5)	↑15 (62)
	<b>2050</b>	<b>0,512</b>	↓44 (37)	0 (-5)	↓105 (167)
Lithuania	2015	0,49	12	65	105
	<b>2030</b>	<b>0,949</b>	↑36 (-22)	↑67 (-2)	↑42 (63)
	<b>2050</b>	<b>0,320</b>	↓75 (53)	↓4 (2)	↓153 (216)

Notes: <sup>1</sup> here and further in the table - relative rank change in comparison with the previous forecast year (actual predicted rank is shown in brackets)

Source: author's elaboration based on the Eurostat data.

When analysing the predictions made in Table 4.8, it is crucial to remember, that the presented scenario is only valid for the three Baltic countries under the conditions that all other countries participating in the ranking remain at their 2011 levels without change. Therefore, these results should only be addressed as an analytical tool showing the potential dynamics of the GCI and its components under the influence of the future population change.

Projections indicate that in terms of GCI and its components, by 2030, all three countries are going to benefit from the cohort of “baby-boomers” (born in late 1980’s and early 1990’s) reaching the “Creative Class” age group of “35-64”. All three countries show similarly good potential for this period of time.

By 2050, however, as the same cohort will move on into the “over 65” age group, the significant reduction in the creative potential is to be expected, with Talent remaining as the only high ranking component in all three countries. Latvia and Lithuania face the risk of returning to the 2015 levels of GCI, while Estonia might retain a higher creativity level owing to its higher Technology rank. Comparing to other Baltic States, Estonia had the highest GCI

and Technology index rankings in 2015 that in the context of appropriate demographic changes provides for this country more positive forecast and better opportunities in the future.

*Results of this Chapter allow author to conclude that investments performed under 2007-2013 Cohesion and Regional policy actions had some impact on the local demographic change, although, the positive effect has been somewhat lower than expected. Author also determines that effects of various impact factors may be either localised or spatially distributed, implying opportunities for better planning of the future investment.*

*On the other hand, historical analysis, combined with the extensive review of theoretical materials and historical information, leads to several conclusions regarding spatial specifics of regional demographic development in Latvia. These include a formation of distinct groups (clusters) of municipalities with similar historical population development paths and stable spatial relationships, along with the noticeable long-term divergence of demographic development trends between these groups, as well as the presence of spatial spill over effects between municipalities, both in terms of economic and demographic development.*

*Confirming the conclusions of previous studies, the various model estimations show that the personal income (represented by average collected income tax) remains to be the most significant predictor for main regional demographic indicators.. Furthermore, unemployment levels appear to be just as significant for the increase of young population and the registered migration.*

*From the SDM estimation results, one may draw a conclusion about noticeable spatial spillovers of the EU Structural and Cohesion funds as well as municipal social support spending in relation to the population change due to registered migration. Similar conclusion may be made concerning a spatially distributed effect of the EU Structural and Cohesion funds on both change of population below working age and the reduction of MDP. Both these observations suggest that some of these instruments may be applied in a more centralised manner (i.e. concentrating on regional development centres), while sustaining sufficient spatial coverage.*

*Further comparison of the linear and spatial model estimations (particularly – SEM model) for the MRP indicator allows to assume the existence of an unknown highly spatially-correlated factor (or series of factors) influencing the individual decisions regarding the temporary or unregistered migration for economic or other*

*purposes. This underlines the necessity to conduct further qualitative and quantitative studies of this complex process, using both classical and spatially adjusted tools.*

*Most importantly, it may also be concluded from the Latvian example that those territories currently showing similar population dynamics may have arrived to the present situation by the divergent historical trends. Therefore, from the population development perspective, those territories may have different underlying strengths and weaknesses in terms of available infrastructure, reproduction potential and migration behaviour. This also means that different long-term reactions to the various policy instruments and regional aid measures should be expected from the different clusters of apparently similar contemporary regions.*

*Finally, the forecast of GCI and its components development for the three Baltic States has shown, that by 2030, all three countries are going to benefit from the cohort of “baby-boomers” (born in late 1980’s and early 1990’s) reaching the “Creative Class” age group of “45-64”. However, by the year 2050 the same cohort will move on into the “over 65” age group, the significant reduction in the creative potential is to be expected, with Talent remaining as the only high ranking component in all three countries.*

## CONCLUSIONS

1. Contemporary literature sources dealing with the concept of “Regional demography” often place this research dimension within the scope of wider disciplines, such as population statistics, population geography or spatial demography. Further, one can observe that many authors attempt to analyse the underlying social, economic or environmental factors preceding the regional demographic change, but only a handful of studies focus specifically on the intentional or unintentional demographic effects of the public investment or policy actions.
2. Content analysis results of the key national planning documents indicate that from the perspective of national legislation and the specific national support programmes, regional population issues are viewed separately from the general regional development concept, which leads to the obvious lack of normative basis for a comprehensive policy-based response to the contemporary demographic challenges.
3. Latvian Government’s responsible institutions tend to rely on the use of available EU funding for tackling the pressing regional development needs (including demographic problems), hence the national cohesion policy planning documents include numerous references to the regional population development issues.
4. It is possible to observe a growing understanding among the Latvian legislators about the importance of the contemporary regional demographic situation in Latvia. However, there is still a substantial lack of political will and decisiveness required for tackling this issue on the legislative level. In the majority of Saeima debate transcripts addressed in this Thesis, demographic issues have been called upon only when required in order to gain support for a position, motion or a legislative proposal. As the result, there is a general time lag between specific demographic events and the associated reactions within the Saeima debates.
5. In the political discussions analysed by the author, the regional demographic issues have been often referred to by the opposition parties (both far right and far left) with the obvious purpose of supporting their own political agendas. Consequently, for a time, it has made these topics undesirable for the ruling coalition and the government, irrespectively of the actual problems under question.
6. With the help of empirical examples employing limited set of the demographic indicators and their potential explanatory variables, geographically weighted regression models

have been proven as feasible and reliable tools for measuring spatial spillovers of the exogenous factors in the basic regional demographic processes.

7. A positive global spatial autocorrelation was estimated for the majority of the observed demographic indicators of Latvian municipalities. Most indicators demonstrate a classic case of agglomerative spatial structure with high values tending closer to each other and extremely low values being located separate from each other on the periphery. Special cases are presented by the general fertility rate and registered net migration, which have shown very little spatial autocorrelation tendencies. Therefore, one may conclude that the observed uneven distribution of natural population increase in the entire country is not caused by spatial variance in the fertility rates, but rather can be attributed to the significant differences in the current female population structure of the regions.
8. More detailed spatial autocorrelation analysis, employing graphical tools, has indicated that for some of the measured indicators (incl. share of missing registered population) spatial autocorrelation pattern is not as strong as expected from the global test results. In such cases, the global autocorrelation figure has been influenced by the anomalous values of the municipalities located in the direct area of influence of the Riga city.
9. Both spatial analysis and model estimation results allow author to conclude that personal income and employment remain to be the key determining factors for the regional population mortality in Latvia, as high personal income level is crucial for ensuring the necessary level of healthcare, quality of life and other conditions facilitating longer and healthier life of an individual.
10. Model estimations help determining that in terms of regional demographic change, European Structural and Cohesion funds had a moderately significant direct and partly significant spatially distributed impact on the migration-related indicators under study. On the other hand, the per capita spending of rural development and agriculture-related funds (EFF, EAFRD, EAGF) has been slightly significant for the total population change, hinting at the role of these investments in the development of rural or coastal areas and the resulting improvement of economic and social conditions. Furthermore, detailed Spatial Durbin Model estimations have indicated noticeable spatial spillovers of the EU Structural and Cohesion funds as well as municipal social support spending in relation to the population change due to registered migration. Similar conclusion may be drawn concerning spatially distributed effect of the EU Structural and Cohesion funds on both change of population below working age and the reduction of missing registered population.

11. The model-based estimations of the standardised mortality indicators show that the overall influence of spatial dependences does not seem to be high, with the exception of the economic explanatory factors like average net wages and unemployment levels. However, these economic factors, in conjunction with the spatial context effects, appear to be much more relevant for male population, indicating their vulnerability to risk and stress factors induced by economic hardships, as well as the pre-existing spatial spillovers of these negative aspects. Judging by the model results, female mortality appears to be less spatially concentrated and partially determined by exogenous factors not directly linked with the social and economic context.
12. Those territories currently showing similar population dynamics may have arrived to the present situation by the divergent historical trends. Therefore, from the population development perspective, those territories may have different underlying strengths and weaknesses in terms of available infrastructure, reproduction potential and migration behaviour. This also means that different long-term reactions to the various policy instruments and regional aid measures should be expected from the different clusters of apparently similar contemporary regions.
13. The spatial econometric analysis of historical regional population trends indicates that those clusters of municipalities, which had an unnaturally high population growth during the 1959-1979 period, on average, show better results during the entire 1959-2011 period, and, most importantly, are demonstrating far better comparative results even in modern times. These observations in combination with spatial analysis, underline a particular importance of the pre-existing infrastructure and direct access to the long-established regional/national economic and social centres as defining population development factors even in the modern times.
14. Estimation of the regression model developed for the analysis of the demographic determinants of human capital creativity allows assuming that by affecting the demographic development of the country or region one can indirectly change various aspects of its creative potential and global competitiveness, which is crucial for the long-term economic and regional development planning. Model estimations also demonstrate that the EU28 countries with higher shares of population in “15-24” and “25-34” age groups significantly lag in terms of the GCI, while cohorts of 45-54 and 55-64 appear to boost the country’s GCI the most, through the impact on Talent and Tolerance components. Tertiary and secondary education attainment level is positively significant for the GCI and its Technology and Talent components.

15. The forecast of GCI and its components development for the three Baltic States shows, that by 2030, all three countries are going to benefit from the cohort of “baby-boomers” (born in late 1980’s and early 1990’s) reaching the most creative and productive age group of “45-64”. However, by the year 2050 the same cohort will move on into the “over 65” age group, the significant reduction in the creative potential is to be expected, with Talent remaining as the only high ranking component in all three countries. Same results also suggest that until the year 2050 Latvia and Lithuania will face serious risk of returning to the 2015 levels of GCI, while Estonia might retain a higher creativity level owing to its higher Technology rank, all of the Baltic States will be characterized with extremely low level of Tolerance by that time.

*The conclusions presented above allow author to **confirm the first Hypothesis** of this Thesis - level of personal income and employment are indeed crucial determinants of the positive local demographic development, significantly outmatching all other factors included in this study.*

*The **second Hypothesis has been confirmed** by the model estimation results, showing a positive demographic effects of the mid and long-term activities carried out with the support from the European Union Structural and Cohesion funds.*

## RECOMMENDATIONS

*For further research:*

1. To researchers working in the field of regional demography and human geography in Latvia: The unique historical and territorial situation of Latvia presents an interesting case for detailed spatio-temporal analysis, as territories currently showing similar population dynamics may have arrived to the present situation by the divergent historical trends. With this in mind, adding the time and space dimensions to the classic regional demographic research methodology can help uncover new, previously unseen issues of regional demographic development.
2. To the Central Statistics Bureau of Latvia, other statistical authorities and scholars: It is both technically possible and practically useful to perform a recalculation of the historic population data in accordance with the single spatial frame of reference, even in the countries with noticeable rearrangements in their administrative division. Further exploratory analysis of such spatially-standardised data may reveal previously unseen patterns and allow discovering various time and place-specific disparities and/or anomalies in population trends.
3. To the academic institutions and researchers working in the field of human geography: From the methodological perspective, one may observe that it is highly useful to test the spatial autocorrelation of the indicators under study using multiple different types of the spatial weights matrices, including those incorporating not only the geographic, but also economic, social and other forms of distances. Such approach could potentially allow identifying the spatial factors instrumental in the propagation of inter-regional spillover effects with a greater precision. Therefore, further theoretical and practical development of such matrices is highly recommended.
4. To all researchers working in the fields of spatial demography, regional economics or human geography in Latvia: Comparison of the linear and spatial model estimations for the “missing registered population indicator” allows to assume the existence of an unknown highly spatially-correlated factor (or series of factors) influencing the individual decisions regarding the temporary or unregistered migration for economic or other purposes. This underlines the necessity to conduct further studies of this complex process, using both classical and spatially adjusted tools.

*For policy planning:*

5. To the Ministry of Economics, Ministry of Environmental Protection and Regional Development and the Cross-sectoral Coordination Centre of the Republic of Latvia: Human capital and its demographic determinants have undeniable and important role in shaping the regional and national development potential; and therefore, must be considered in relevant policy planning efforts.
6. To the Ministry of Finance and Ministry of Environmental Protection and Regional Development of the Republic of Latvia: From the demographic perspective, there is a need to re-evaluate and expand some of the methodologies associated with the planning of national regional and cohesion policies, by incorporating more advanced spatial analysis tools. Approach demonstrated in this Thesis provides opportunities for better planning of the future investment / aid priorities and allows one to identify those forms of investment instruments needed to be applied locally and those, which may be used in a more centralised manner in order to achieve better results.
7. To the Ministry of Finance of the Republic of Latvia (as EU funds Managing Authority): Model estimations concerning the spatially distributed effect of the EU Structural and Cohesion funds on several regional demographic indicators suggest that, after a thorough evaluation, these instruments may be applied in a more centralised manner (i.e. concentrating on regional development centres), while sustaining sufficient spatial coverage.
8. To the Ministry of Welfare and Ministry of Environmental Protection and Regional Development of the Republic of Latvia: Public policies aimed at tackling the regional demographic issues should be planned minding the possibility that clusters of apparently similar contemporary regions may demonstrate diverging long-term reactions to the policy instruments and regional aid measures due to their divergent historical development paths and differences of the underlying long-term socioeconomic processes.
9. To the Ministry of Economics of the Republic of Latvia: Considering the emerging population trends and the provided competitiveness projection results, it is safe to propose that a comprehensive and pre-emptive policy measures need to be implemented on both EU and national levels in order to avoid the expected demography-induced downturn in the human capital creativity levels of Latvia, the Baltic States and EU as a whole.

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## ANNEXES

Annex 1

**Standardised mortality rate and Standardised mortality ratio in Latvian municipalities  
in 2008-2013** (\* Significant at p = 95%)

*Standartizēts mirstības līmenis un standartizēti mirstības koeficienti Latvijas pašvaldībās  
2008.-2013. gadā* (\* Nozīmīgs pie p = 95%)

Standardised mortality rate			
Municipality	Total	Male	Female
Aglonas novads	20,244	21,179	18,879
Aizkraukles novads	12,732	13,574	12,185
Aizputes novads	13,993	14,099	13,505
Aknīstes novads	16,925	18,873	14,648
Alojas novads	15,708	17,426	14,061
Alsungas novads	16,021	17,959	14,340
Alūksnes novads	15,206	15,879	14,468
Amatas novads	14,369	14,800	13,376
Apes novads	14,942	14,601	14,804
Auces novads	13,979	15,578	12,327
Ādažu novads	11,514	11,474	11,623
Babītes novads	11,830	11,830	11,600
Baldones novads	14,667	15,503	14,029
Baltinavas novads	19,296	21,915	17,932
Balvu novads	15,934	17,660	14,458
Bauskas novads	14,939	15,947	14,006
Beverīnas novads	14,650	14,486	14,189
Brocēnu novads	15,357	15,276	15,178
Burtnieku novads	14,985	15,338	13,855
Carnikavas novads	9,870	9,572	9,778
Cesvaines novads	13,159	13,583	12,662
Cēsu novads	12,211	12,565	11,964
Ciblas novads	18,858	21,459	16,309
Dagdas novads	18,280	18,920	17,236
Daugavpils	14,241	15,575	13,388
Daugavpils novads	18,437	18,562	17,793
Dobeles novads	14,374	14,867	13,847
Dundagas novads	14,201	16,059	12,092
Durbes novads	15,068	15,002	14,204
Engures novads	13,787	13,899	13,125
Ērgļu novads	14,385	15,128	13,345
Garkalnes novads	11,792	10,149	13,076
Grobiņas novads	15,521	15,908	14,791
Gulbenes novads	15,932	17,533	14,533
Iecavas novads	14,814	15,173	14,331
Ikšķiles novads	11,021	10,113	11,626
Ilūkstes novads	15,763	17,922	13,779
Inčukalna novads	12,243	12,755	11,860
Jaunjelgavas nov.	15,462	16,711	14,053
Jaunpiebalgas nov.	14,766	16,681	13,027
Jaunpils novads	12,565	12,758	11,834
Jelgava	12,568	13,399	11,938
Jelgavas novads	14,909	15,544	14,172
Jēkabpils	14,315	15,570	13,449
Jēkabpils novads	15,794	15,707	15,157
Jūrmala	13,755	14,318	13,413
Kandavas novads	15,423	15,514	14,843
Kārsavas novads	19,842	23,861	17,061
Kocēnu novads	14,676	16,184	13,114
Kokneses novads	15,932	18,400	13,636

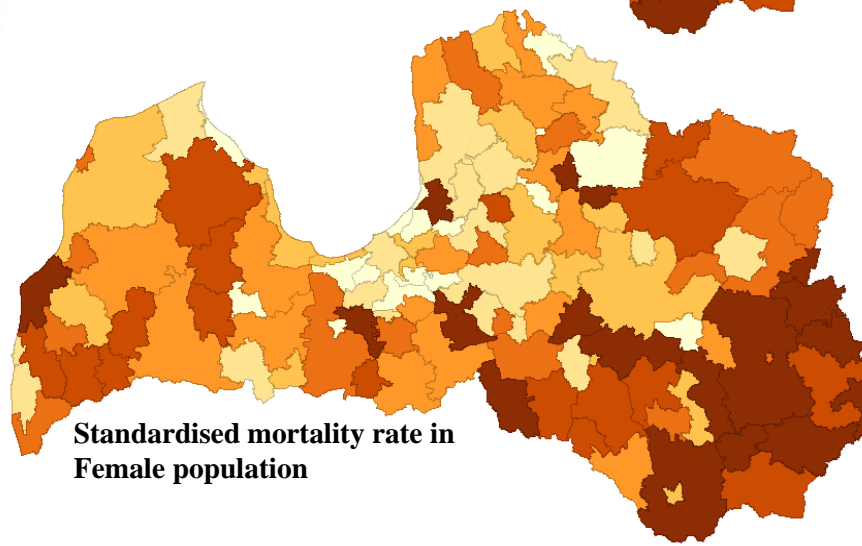
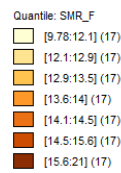
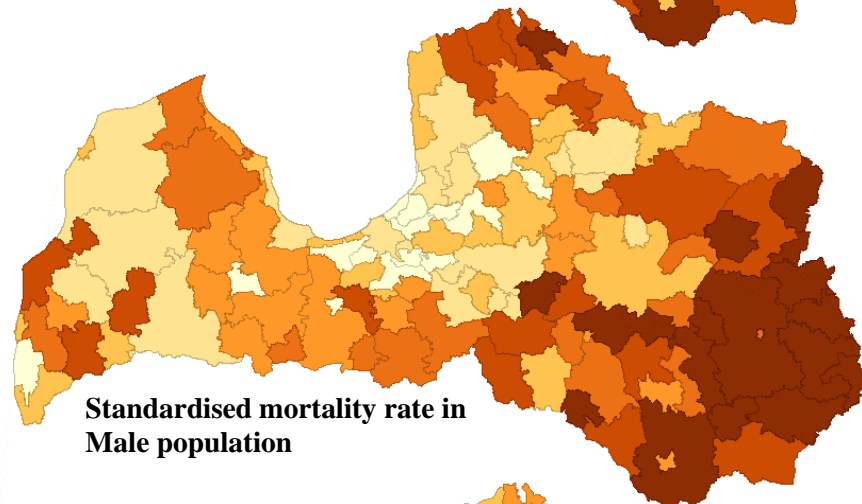
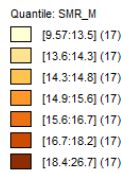
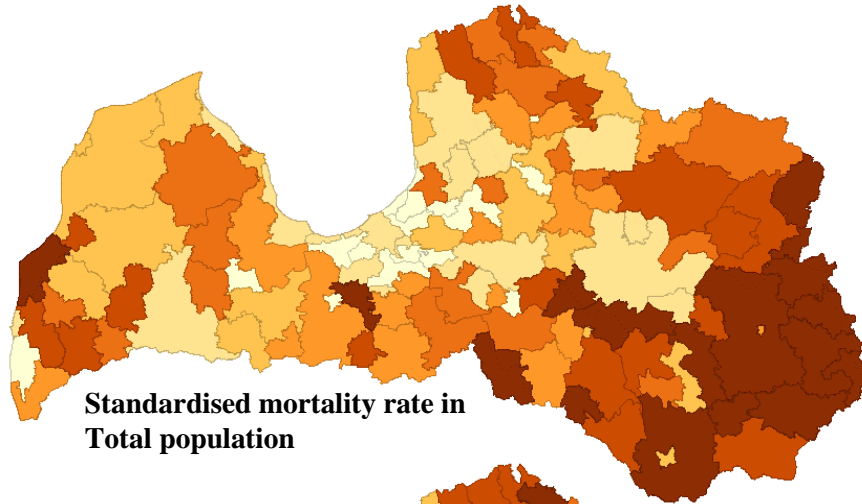
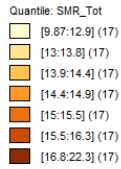
Standardised mortality ratio					
Total		Male		Female	
1,431	*	1,417	*	1,401	*
0,900		0,908		0,904	
0,989		0,944		1,002	
1,196		1,263		1,087	
1,110		1,166		1,043	
1,132		1,202		1,064	
1,075		1,063		1,074	
1,016		0,990		0,992	
1,056		0,977		1,098	
0,988		1,043		0,915	
0,814	*	0,768		0,862	
0,836		0,792		0,861	
1,037		1,037		1,041	
1,364		1,467		1,331	
1,126		1,182		1,073	
1,056		1,067		1,039	
1,035		0,969		1,053	
1,085		1,022		1,126	
1,059		1,026		1,028	
0,698	*	0,641	*	0,726	*
0,930		0,909		0,939	
0,863	*	0,841		0,888	
1,333	*	1,436		1,210	
1,292	*	1,266		1,279	*
1,007		1,042		0,993	
1,303	*	1,242	*	1,320	*
1,016		0,995		1,027	
1,004		1,075		0,897	
1,065		1,004		1,054	
0,974		0,930		0,974	
1,017		1,012		0,990	
0,833		0,679	*	0,970	
1,097		1,065		1,097	
1,126	*	1,173	*	1,078	
1,047		1,015		1,063	
0,779	*	0,677	*	0,863	
1,114		1,199		1,022	
0,865		0,854		0,880	
1,093		1,118		1,043	
1,044		1,116		0,967	
0,888		0,854		0,878	
0,888	*	0,897	*	0,886	*
1,054		1,040		1,052	
1,012		1,042		0,998	
1,116		1,051		1,125	
0,972		0,958		0,995	
1,090		1,038		1,101	
1,402	*	1,597	*	1,266	
1,037		1,083		0,973	
1,126		1,231		1,012	

Krāslavas novads	16,281	16,765	15,598
Krimuldas novads	13,351	13,705	12,601
Krustpils novads	19,184	19,497	18,172
Kuldīgas novads	14,195	14,113	13,970
Ķeguma novads	15,164	13,940	15,877
Ķekavas novads	11,730	12,075	11,337
Lielvārdes novads	13,757	14,712	12,790
Liepāja	13,562	14,537	12,879
Limbažu novads	13,339	14,139	12,238
Līgatnes novads	15,115	15,076	14,873
Līvānu novads	15,949	17,517	14,607
Lubānas novads	15,119	15,667	14,185
Ludzas novads	17,061	19,327	15,165
Madonas novads	13,778	14,647	12,928
Mazsalacas novads	15,192	17,520	13,429
Mālpils novads	14,676	14,738	14,420
Mārupes novads	10,354	9,961	10,771
Mērsraga novads	14,067	14,797	13,402
Naukšēnu novads	15,265	19,521	11,994
Neretas novads	18,166	17,722	17,785
Nīcas novads	12,912	12,758	12,469
Ogres novads	13,204	14,216	12,395
Olaines novads	13,163	14,286	12,502
Ozolnieku novads	19,129	16,683	21,040
Pārgaujas novads	13,104	13,472	12,428
Pāvilostas novads	18,395	17,187	18,963
Pļaviņu novads	16,788	18,012	15,611
Preiļu novads	14,240	15,604	13,154
Priekules novads	15,846	16,843	14,637
Priekuļu novads	14,191	14,342	13,904
Raunas novads	15,350	14,261	15,766
Rēzekne	14,813	15,666	14,432
Rēzeknes novads	18,667	20,092	16,926
Riebiņu novads	18,271	19,809	16,715
Rīga	13,021	13,715	12,645
Rojas novads	13,559	15,419	11,819
Ropažu novads	14,269	14,456	14,041
Rucavas novads	14,741	14,419	14,229
Rugāju novads	16,284	21,824	12,482
Rundāles novads	15,750	16,049	15,428
Rūjienas novads	15,850	18,152	13,734
Salacgrīvas novads	14,386	14,477	13,994
Salas novads	14,632	16,232	12,894
Salaspils novads	12,100	13,036	11,307
Saldus novads	13,829	13,671	13,710
Saulkrastu novads	12,117	12,566	11,505
Sējas novads	15,025	13,633	16,026
Siguldas novads	12,388	12,484	12,182
Skrīveru novads	14,450	14,025	14,350
Skrundas novads	16,037	16,800	15,072
Smiltenes novads	13,136	14,191	12,024
Stopiņu novads	13,569	13,941	13,256
Strenču novads	15,921	17,950	14,037
Talsu novads	15,324	15,909	14,536
Tērvetes novads	14,777	16,346	13,303
Tukuma novads	14,556	15,177	13,855
Vaiņodes novads	14,993	14,330	15,235
Valkas novads	14,246	16,612	12,207
Valmiera	12,286	12,720	12,065
Varakļānu novads	13,628	16,147	11,906
Vārkavas novads	15,235	15,575	14,132

1,151	*	1,122	1,157
0,944		0,917	0,935
1,356	*	1,305	1,348
1,003		0,944	1,037
1,072		0,933	1,178
0,829	*	0,808	0,841
0,972		0,985	0,949
0,959		0,973	0,956
0,943		0,946	0,908
1,068		1,009	1,104
1,127		1,172	1,084
1,069		1,048	1,052
1,206	*	1,293	1,125
0,974		0,980	0,959
1,074		1,172	0,996
1,037		0,986	1,070
0,732	*	0,667	0,799
0,994		0,990	0,994
1,079		1,306	0,890
1,284		1,186	1,320
0,913		0,854	0,925
0,933		0,951	0,920
0,930		0,956	0,928
1,352	*	1,116	1,561
0,926		0,902	0,922
1,300		1,150	1,407
1,187		1,205	1,158
1,006		1,044	0,976
1,120		1,127	1,086
1,003		0,960	1,032
1,085		0,954	1,170
1,047		1,048	1,071
1,319	*	1,345	1,256
1,291	*	1,326	1,240
0,920	*	0,918	0,938
0,958		1,032	0,877
1,009		0,967	1,042
1,042		0,965	1,056
1,151		1,460	0,926
1,113		1,074	1,145
1,120		1,215	1,019
1,017		0,969	1,038
1,034		1,086	0,957
0,855	*	0,872	0,839
0,977		0,915	1,017
0,856		0,841	0,854
1,062		0,912	1,189
0,876	*	0,835	0,904
1,021		0,939	1,065
1,133		1,124	1,118
0,928		0,950	0,892
0,959		0,933	0,984
1,125		1,201	1,041
1,083		1,065	1,079
1,044		1,094	0,987
1,029		1,016	1,028
1,060		0,959	1,130
1,007		1,112	0,906
0,868	*	0,851	0,895
0,963		1,081	0,883
1,077		1,042	1,049

Vecpiebalgas nov.	14,744	15,364	13,645
Vecumnieku nov.	15,349	16,449	13,874
Ventspils	14,434	14,730	14,272
Ventspils novads	13,873	13,551	13,466
Viesītes novads	14,882	14,394	14,936
Vījakas novads	17,269	21,570	14,472
Vījānu novads	16,209	18,582	13,777
Zilupes novads	22,252	26,672	18,855

	1,042		1,028		1,012
	1,085		1,101		1,029
	1,020		0,986		1,059
	0,981		0,907		0,999
	1,052		0,963		1,108
	1,221		1,444	*	1,074
	1,146		1,244		1,022
	1,573	*	1,785	*	1,399



**Population data recalculation for Latvian local administrative units from 1959 onwards**  
*Iedzīvotāju skaita pārrēķins Latvijas lokālajās administratīvajās vienībās sākot ar 1959. gadu*

**METADATA - Processing of the dataset**

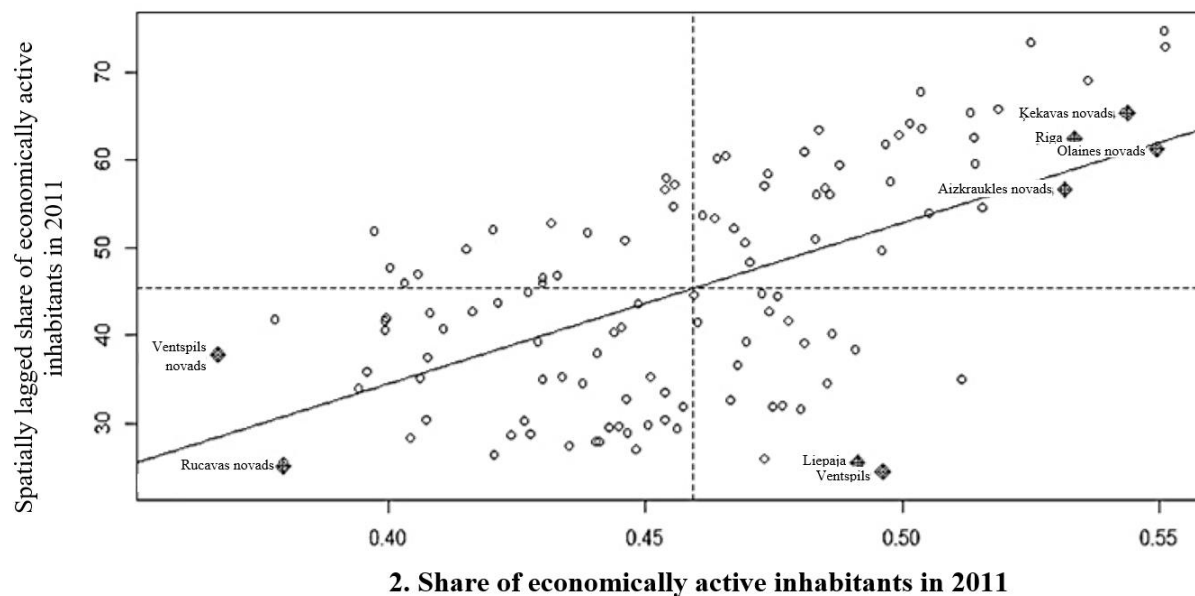
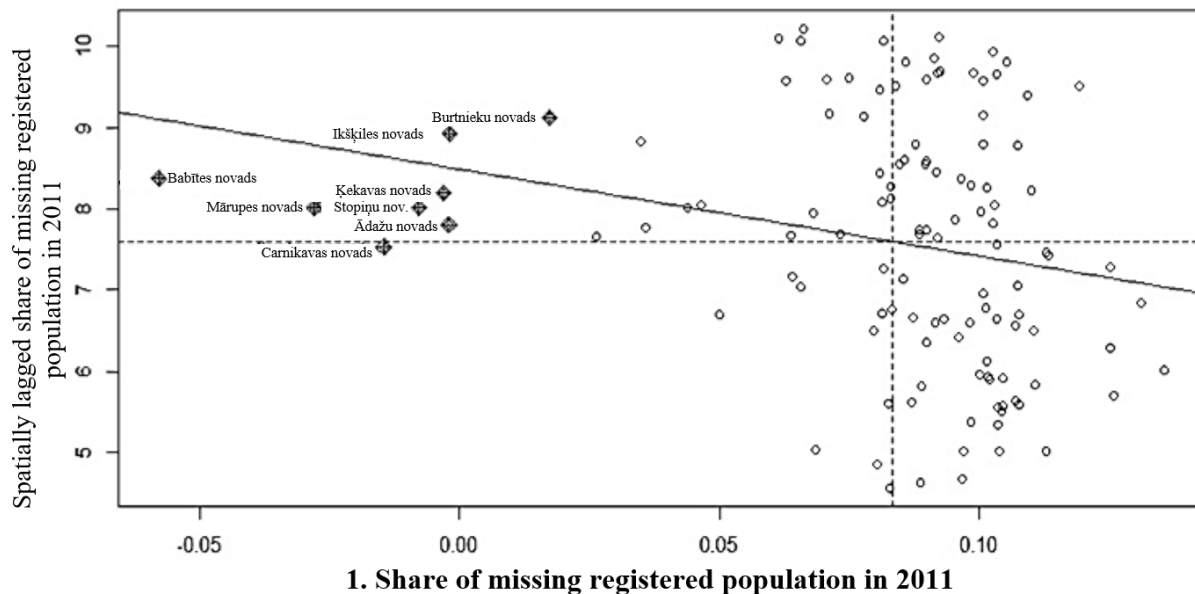
- ✓ All data have been recalculated for LAU2 units of 1 January 2012.
- ✓ Population estimates for 01.01.1961, 01.01.1971, 01.01.1981, 01.01.1991, 01.01.2001 and 01.01.2011 were interpolated from data for 15.01.1959, 15.01.1970, 17.01.1979, 15.01.1989, 31.03.2000 and 01.03.2011.
- ✓ 2012 units with recalculated data: year 2000 - 92%; years 1970, 1979 and 1989 - 95%; 1959 - 100% Considering the fact that year 2012 was defined as a base for calculations, and taking into account serious rearrangements in the administrative-territorial structure of Latvia in 1959-2011 period, a backward approach has been chosen for recalculating the population data and tracing name and boundary changes.
- ✓ 2000-2011: Due to the effects of the 2000-2009 administrative-territorial reform in Latvia, when 558 pre-reform LAUs (Parishes) were rearranged in 119 new administrative units (Novadi), population data of all units (except for the 9 Republic cities) had to be recalculated for the 2000-2011 period. As during this reform LAUs were rearranged only by merging, it was convenient to trace boundary and name changes by using information of the annexes to the Law "On the administrative-territorial reform". Unfortunately, there were no reference codes available for linking old and new LAUs, and the recalculation had to be done manually in Excel spreadsheets. As a result, an electronic list of pre-reform units (year 2000) has been created allowing to automatically sum-up the pre-reform data according to the new 119 administrative units (using SUM function and cell merging). 1989-2000: By the analogy, the aforementioned list of 558 year 2000 units was then compared and linked with the 1989 data containing 590 units. The archive data (Decisions of the High Council of the Latvian SSR on the territorial rearrangements) and historic literature have been used to determine the name and boundary changes of the units in this period, as well as to find the location and association of the extra units. It was found, that some parts of the electronic documents were corrupt and had to be updated manually from paper sources.
- ✓ 1970 - 1979 and 1979 -1989: Similar steps and methods have been used for these years. In cases, where LAUs were split over time, the population count in its parts was determined using the available historical information on the inhabitants in its towns and rural areas.
- ✓ 1959 - 1970: As only the printed documents were available for 1959, the first step was to digitize them using OCR software and manual input. Then, all of the 712 LAU names had to be translated from Russian into Latvian using historic literature and archive materials. After that, historic literature, archive data (in cases of some small villages - even church/municipal records) and experts' advises were used to trace the name and boundary changes of the LAUs and link 712 post-war rural councils, soviet workers' towns and cities with the parishes and towns of 1970, 1989, and finally - 2000.
- ✓ As a result, all population data for each census year has been traced though time and summed up to fit the 2012 nomenclature in form of a single table arranged by census years. The total number of population in the country and in its planning regions have been used as a check-sums for each year during the entire recalculation process, in order to ensure there are no missed values and/or overlapping data.

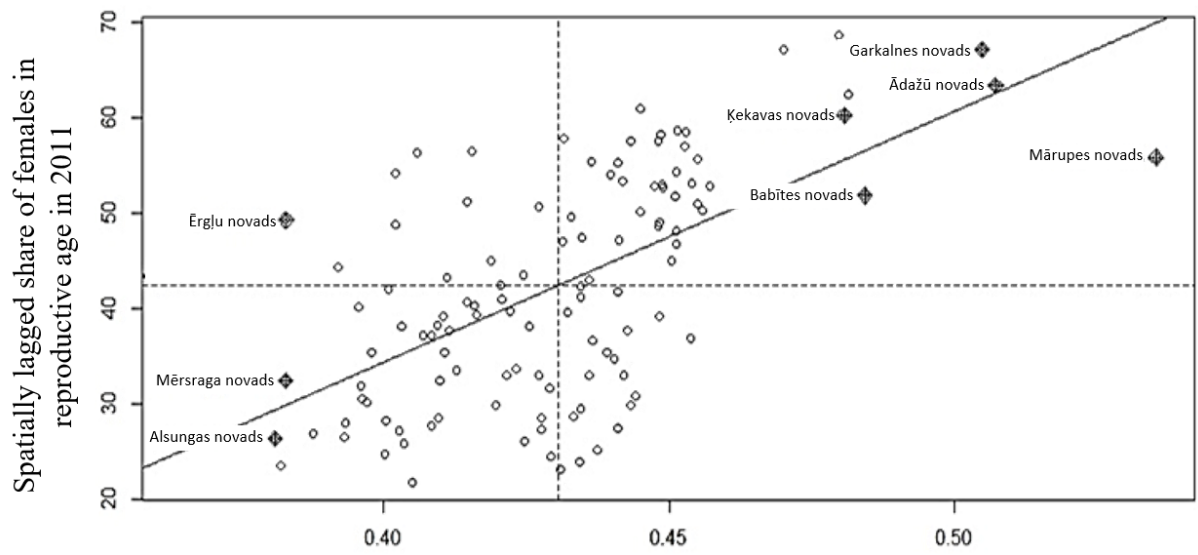
LAU_LABEL	POP_1959	POP_1970	POP_1979	POP_1989	POP_2000	POP_2011
Daugavpils	65386	100651	115742	124910	115265	93312
Jelgava	35969	54500	67333	74105	63652	59511
Jēkabpils	7449	22221	26000	30865	27871	24635
Jūrmala	35887	47957	53498	60600	55718	50840
Liepāja	71006	93981	107921	114486	89448	76731
Rēzekne	20728	29474	35620	42477	39233	32328
Rīga	583417	729003	828485	910455	764329	658640
Valmiera	11964	20642	24958	29190	27752	25130
Ventspils	27160	40939	47994	50646	43928	38750
Aglonas novads	11184	8776	7720	6547	5479	3930
Aizkraukles novads	1293	6042	8119	11286	10425	8984
Aizputes novads	12988	13684	12966	12838	11878	9265
Aknīstes novads	5127	4746	4217	3647	3790	2967
Alojas novads	8032	8141	7891	7365	7153	5316
Alsungas novads	2247	2740	2275	2190	2076	1470
Alūksnes novads	26391	25196	23978	25205	21340	17177
Amatas novads	9603	8330	7290	6782	6960	5667
Apes novads	6081	6072	5509	5524	5082	3834
Auces novads	12277	11218	10493	10330	9684	7345
Ādažu novads	3477	3855	6396	8514	6920	10027
Babītes novads	4214	5191	5577	6791	6621	9408
Baldones novads	4007	4399	4741	5217	4913	5478
Baltinavas novads	4424	3333	2578	1881	1688	1177
Balvu novads	19642	20897	19304	18993	17631	14154
Bauskas novads	25871	28876	28234	32133	30468	25561
Beverīnas novads	5626	4916	4134	3834	3757	3260
Brocēnu novads	7864	8556	8219	8649	7812	6233
Burtnieku novads	10319	9410	8733	8380	9378	8307
Carnikavas novads	1200	2104	3491	4042	4593	6712
Cesvaines novads	5040	3734	3598	3591	3480	2802
Cēsu novads	13905	19213	21078	22689	20327	18246
Ciblas novads	10895	8473	6578	5714	4009	2875
Dagdas novads	20897	16963	14322	12932	11221	8286
Daugavpils novads	41253	38631	36256	34621	32116	25127
Dobeles novads	22694	26272	27981	29346	25763	22216
Dundagas novads	8286	6632	5657	5335	5444	4228
Durbes novads	8135	5404	4565	4499	4057	3048
Engures novads	7462	6793	6864	7821	7507	7575
Ērgļu novads	5307	4761	4543	4604	4168	3193
Garkalnes novads	1781	6372	3218	2949	3382	7768
Grobiņas novads	9814	9738	10333	11089	10410	9345
Gulbenes novads	35649	31148	29797	29930	28194	22794
Iecavas novads	6686	5393	9359	9768	9367	9059
Ikšķiles novads	3585	4958	4990	5902	6232	8798
Ilūkstes novads	15097	13112	12311	11637	10642	7994
Inčukalna novads	3807	6327	6237	8082	7914	7935
Jaunjelgavas novads	9395	8679	7346	7132	6765	5797

LAU_LABEL	POP_1959	POP_1970	POP_1979	POP_1989	POP_2000	POP_2011
Jaunpiebalgas novads	4424	3770	3275	3208	3022	2390
Jaunpils novads	3358	3116	2701	3168	3130	2450
Jelgavas novads	38579	32037	30153	27413	27934	24649
Jēkabpils novads	13277	9483	7987	7185	6872	5087
Kandavas novads	12862	12235	12083	10975	10558	8885
Kārsavas novads	19548	14689	12134	10219	8575	6278
Kocēnu novads	7842	7860	7353	7463	7334	6311
Kokneses novads	5965	6211	6286	6697	6484	5445
Krāslavas novads	30081	26942	25611	25225	22794	17506
Krimuldas novads	4743	4983	5292	5861	5987	5323
Krustpils novads	21811	10687	8910	7794	7484	6086
Kuldīgas novads	27800	29759	28910	29029	29183	24850
Ķeguma novads	4908	6361	6003	5997	6418	5735
Ķekavas novads	8465	8526	12478	16037	16247	21913
Lielvārdes novads	6101	7435	9095	11938	11011	10388
Limbažu novads	21020	20778	20872	21668	20865	17781
Līgatnes novads	4742	5077	4542	4808	4505	3684
Līvānu novads	14587	14244	16627	17982	15903	12496
Lubānas novads	5531	3832	3497	3306	3200	2537
Ludzas novads	23814	21694	20764	20444	18271	14226
Madonas novads	31546	32953	31950	32995	31192	25118
Mazsalacas novads	5348	5614	4889	4908	4675	3460
Mālpils novads	3298	4130	4499	4755	4341	3626
Mārupes novads	5524	6790	8296	9426	8611	15950
Mērsraga novads	2207	2103	2283	2111	2084	1638
Naukšēnu novads	3021	3156	2795	2789	2551	1987
Neretas novads	8271	6855	5689	5268	5012	3878
Nīcas novads	4499	4714	4507	4215	3847	3579
Ogres novads	19568	28815	37717	41976	39403	36202
Olaines novads	7223	13287	18226	20545	18094	20116
Ozolnieku novads	6672	7934	8463	9877	9437	9753
Pārgaujas novads	5528	5403	4800	4460	4842	3953
Pāvilostas novads	5357	4910	4154	3864	3592	2850
Pļaviņu novads	9756	9592	8843	7542	7002	5680
Preiļu novads	12347	12143	12063	13890	13091	10696
Priekules novads	10106	10410	10416	9654	7292	5837
Priekuļu novads	6749	9292	10393	11414	10441	8365
Raunas novads	5416	4886	4747	4773	4581	3592
Rēzeknes novads	54344	49477	42503	36311	34997	28208
Riebiņu novads	13564	11753	9363	7857	7298	5536
Rojas novads	2536	4655	4501	4661	4742	3972
Ropažu novads	3230	3691	4120	6253	6058	6904
Rucavas novads	5044	3781	2831	2634	2345	1814
Rugāju novads	7001	5441	4222	3500	3203	2363
Rundāles novads	7544	6014	5636	5679	5020	3698
Rūjienas novads	7857	6830	7075	7473	6853	5577
Salacgrīvas novads	11107	11174	10591	10517	10513	8323

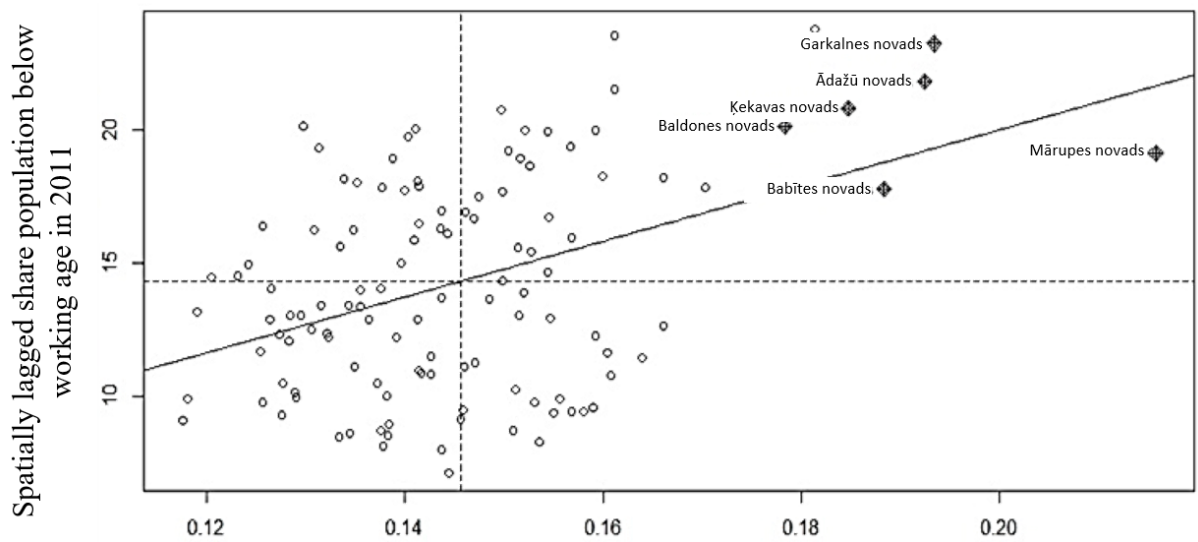
LAU_LABEL	POP_1959	POP_1970	POP_1979	POP_1989	POP_2000	POP_2011
Salas novads	3124	4798	5080	6070	4748	3796
Salaspils novads	5094	9873	18035	21899	21102	22391
Saldus novads	26161	27646	27956	30819	31104	25604
Saulkrastu novads	3237	4877	5629	5482	5523	5855
Sējas novads	1306	2535	2444	2839	2406	2293
Siguldas novads	9647	12783	14544	17151	16678	16729
Skrīveru novads	3360	3204	3224	4277	4189	3708
Skrundas novads	8955	8293	8243	9766	6910	5313
Smiltenes novads	16263	15448	15334	15867	15573	13078
Stopiņu novads	3083	10237	6289	7259	7290	10096
Strenču novads	6524	7338	6642	6752	4977	3827
Talsu novads	36692	36178	36472	37934	37544	31219
Tērvetes novads	4108	4974	4538	4715	4799	3687
Tukuma novads	27690	31254	33795	36611	33005	30614
Vaiņodes novads	5468	5875	5258	5513	3396	2613
Valkas novads	11785	13894	13252	13436	11857	9299
Varakļānu novads	8810	5934	5228	4970	4419	3560
Vārkavas novads	5232	3956	3127	3012	2785	2113
Vecpiebalgas novads	5082	5667	5176	5520	5241	4161
Vecumnieku novads	10854	11549	11120	10594	10433	8786
Ventspils novads	18746	16161	14458	15701	14620	12139
Viesītes novads	7974	6831	6317	5487	5583	4133
Viļakas novads	16847	11521	11152	9539	8102	5665
Viļānu novads	10976	9680	9135	8899	8093	6409
Zilupes novads	8288	7422	5774	5168	4270	3353

**Moran plots of the selected demographic indicators in Latvian municipalities in 2011**  
*Morana korelogrammas Latvijas pašvaldību demogrāfiskajiem indikatoriem 2011. gadā*





**3. Share of females in reproductive age in 2011**



**4. Share of population below working age in 2011**

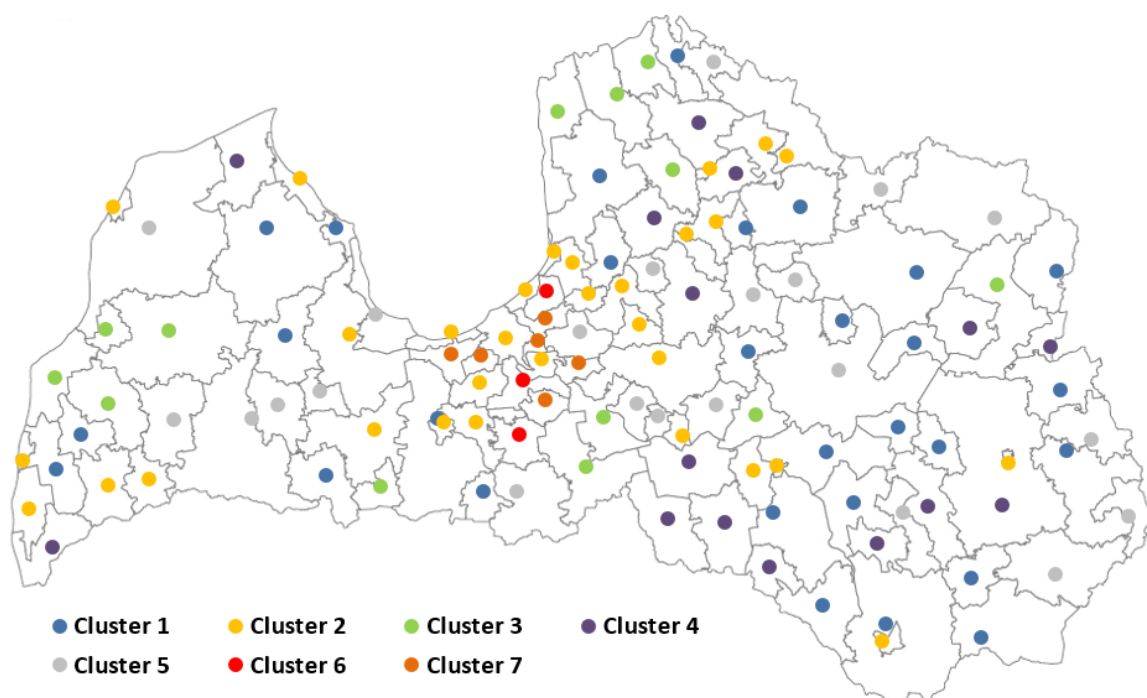
**Detailed cluster analysis of the historical population trends in modern Latvian municipalities in 1959-2011 period**

*Mūsdienu Latvijas pašvaldību teritoriju iedzīvotāju skaita dinamikas detalizēta klasteru analīze 1959.-2011. gados*

Cluster	Municipality	Population growth					
		1959-1970	1970-1979	1979-1989	1989-2000	2000-2011	1959-2011
1	Aglonas novads	-0,215	-0,120	-0,152	-0,163	-0,283	-0,649
1	Auces novads	-0,086	-0,065	-0,016	-0,063	-0,242	-0,402
1	Cesvaines novads	-0,259	-0,036	-0,002	-0,031	-0,195	-0,444
1	Daugavpils novads	-0,064	-0,061	-0,045	-0,072	-0,218	-0,391
1	Durbes novads	-0,336	-0,155	-0,014	-0,098	-0,249	-0,625
1	Ērgļu novads	-0,103	-0,046	0,013	-0,095	-0,234	-0,398
1	Grobiņas novads	-0,008	0,061	0,073	-0,061	-0,102	-0,048
1	Gulbenes novads	-0,126	-0,043	0,004	-0,058	-0,192	-0,361
1	Ilūkstes novads	-0,131	-0,061	-0,055	-0,086	-0,249	-0,470
1	Jelgavas novads	-0,170	-0,059	-0,091	0,019	-0,118	-0,361
1	Jēkabpils novads	-0,286	-0,158	-0,100	-0,044	-0,260	-0,617
1	Kandavas novads	-0,049	-0,012	-0,092	-0,038	-0,158	-0,309
1	Kārsavas novads	-0,249	-0,174	-0,158	-0,161	-0,268	-0,679
1	Krāslavas novads	-0,104	-0,049	-0,015	-0,096	-0,232	-0,418
1	Krimuldas novads	0,051	0,062	0,108	0,021	-0,111	0,122
1	Krustpils novads	-0,510	-0,166	-0,125	-0,040	-0,187	-0,721
1	Limbažu novads	-0,012	0,005	0,038	-0,037	-0,148	-0,154
1	Līvānu novads	-0,024	0,167	0,081	-0,116	-0,214	-0,143
1	Lubānas novads	-0,307	-0,087	-0,055	-0,032	-0,207	-0,541
1	Ludzas novads	-0,089	-0,043	-0,015	-0,106	-0,221	-0,403
1	Mērsraga novads	-0,047	0,086	-0,075	-0,013	-0,214	-0,258
1	Raunas novads	-0,098	-0,028	0,005	-0,040	-0,216	-0,337
1	Rundāles novads	-0,203	-0,063	0,008	-0,116	-0,263	-0,510
1	Rūjienas novads	-0,131	0,036	0,056	-0,083	-0,186	-0,290
1	Smiltenes novads	-0,050	-0,007	0,035	-0,019	-0,160	-0,196
1	Talsu novads	-0,014	0,008	0,040	-0,010	-0,168	-0,149
1	Varakļānu novads	-0,326	-0,119	-0,049	-0,111	-0,194	-0,596
1	Viļakas novads	-0,316	-0,032	-0,145	-0,151	-0,301	-0,664
1	Viļānu novads	-0,118	-0,056	-0,026	-0,091	-0,208	-0,416
<b>Total Cluster 1</b>		<b>-0,142</b>	<b>-0,041</b>	<b>-0,022</b>	<b>-0,062</b>	<b>-0,195</b>	<b>-0,392</b>
2	Aizkraukles novads	3,673	0,344	0,390	-0,076	-0,138	5,948
2	Carnikavas novads	0,753	0,659	0,158	0,136	0,461	4,593
2	Cēsu novads	0,382	0,097	0,076	-0,104	-0,102	0,312
2	Daugavpils	0,539	0,150	0,079	-0,077	-0,190	0,427
2	Dobeles novads	0,158	0,065	0,049	-0,122	-0,138	-0,021
2	Inčukalna novads	0,662	-0,014	0,296	-0,021	0,003	1,084
2	Jelgava	0,515	0,235	0,101	-0,141	-0,065	0,655
2	Jēkabpils	1,983	0,170	0,187	-0,097	-0,116	2,307
2	Jūrmala	0,336	0,116	0,133	-0,081	-0,088	0,417
2	Liepāja	0,324	0,148	0,061	-0,219	-0,142	0,081
2	Mālpils novads	0,252	0,089	0,057	-0,087	-0,165	0,099
2	Nīcas novads	0,048	-0,044	-0,065	-0,087	-0,070	-0,204
2	Ogres novads	0,473	0,309	0,113	-0,061	-0,081	0,850
2	Olaines novads	0,840	0,372	0,127	-0,119	0,112	1,785
2	Ozolnieku novads	0,189	0,067	0,167	-0,045	0,033	0,462
2	Priekules novads	0,030	0,001	-0,073	-0,245	-0,200	-0,422
2	Priekuļu novads	0,377	0,118	0,098	-0,085	-0,199	0,239
2	Rēzekne	0,422	0,209	0,193	-0,076	-0,176	0,560
2	Rīga	0,250	0,136	0,099	-0,160	-0,138	0,129

2	Rojas novads	0,836	-0,033	0,036	0,017	-0,162	0,566
2	Salas novads	0,536	0,059	0,195	-0,218	-0,201	0,215
2	Salaspils novads	0,938	0,827	0,214	-0,036	0,061	3,396
2	Saulkrastu novads	0,507	0,154	-0,026	0,007	0,060	0,809
2	Sējas novads	0,941	-0,036	0,162	-0,153	-0,047	0,756
2	Siguldas novads	0,325	0,138	0,179	-0,028	0,003	0,734
2	Strenču novads	0,125	-0,095	0,017	-0,263	-0,231	-0,413
2	Tukuma novads	0,129	0,081	0,083	-0,098	-0,072	0,106
2	Vainodes novads	0,074	-0,105	0,048	-0,384	-0,231	-0,522
2	Valkas novads	0,179	-0,046	0,014	-0,118	-0,216	-0,211
2	Valmiera	0,725	0,209	0,170	-0,049	-0,094	1,100
2	Ventspils	0,507	0,172	0,055	-0,133	-0,118	0,427
<b>Total Cluster 2</b>		<b>0,327</b>	<b>0,147</b>	<b>0,100</b>	<b>-0,137</b>	<b>-0,123</b>	<b>0,267</b>
3	Aizputes novads	0,054	-0,052	-0,010	-0,075	-0,220	-0,287
3	Alojas novads	0,014	-0,031	-0,067	-0,029	-0,257	-0,338
3	Alsungas novads	0,219	-0,170	-0,037	-0,052	-0,292	-0,346
3	Balvu novads	0,064	-0,076	-0,016	-0,072	-0,197	-0,279
3	Kocēnu novads	0,002	-0,065	0,015	-0,017	-0,139	-0,195
3	Kuldīgas novads	0,070	-0,029	0,004	0,005	-0,148	-0,106
3	Ķeguma novads	0,296	-0,056	-0,001	0,070	-0,106	0,169
3	Mazsalacas novads	0,050	-0,129	0,004	-0,047	-0,260	-0,353
3	Pāvilostas novads	-0,083	-0,154	-0,070	-0,070	-0,207	-0,468
3	Plaviņu novads	-0,017	-0,078	-0,147	-0,072	-0,189	-0,418
3	Salacgrīvas novads	0,006	-0,052	-0,007	0,000	-0,208	-0,251
3	Tērvetes novads	0,211	-0,088	0,039	0,018	-0,232	-0,102
3	Vecumnieku novads	0,064	-0,037	-0,047	-0,015	-0,158	-0,191
<b>Total Cluster 3</b>		<b>0,056</b>	<b>-0,061</b>	<b>-0,022</b>	<b>-0,026</b>	<b>-0,186</b>	<b>-0,232</b>
4	Aknīstes novads	-0,074	-0,111	-0,135	0,039	-0,217	-0,421
4	Amatas novads	-0,133	-0,125	-0,070	0,026	-0,186	-0,410
4	Baltinavas novads	-0,247	-0,227	-0,270	-0,103	-0,303	-0,734
4	Beverīnas novads	-0,126	-0,159	-0,073	-0,020	-0,132	-0,421
4	Burtnieku novads	-0,088	-0,072	-0,040	0,119	-0,114	-0,195
4	Dundagas novads	-0,200	-0,147	-0,057	0,020	-0,223	-0,490
4	Jaunjelgavas novads	-0,076	-0,154	-0,029	-0,051	-0,143	-0,383
4	Neretas novads	-0,171	-0,170	-0,074	-0,049	-0,226	-0,531
4	Pārgaujas novads	-0,023	-0,112	-0,071	0,086	-0,184	-0,285
4	Rēzeknes novads	-0,090	-0,141	-0,146	-0,036	-0,194	-0,481
4	Riebiņu novads	-0,134	-0,203	-0,161	-0,071	-0,241	-0,592
4	Rucavas novads	-0,250	-0,251	-0,070	-0,110	-0,226	-0,640
4	Rugāju novads	-0,223	-0,224	-0,171	-0,085	-0,262	-0,662
4	Vārkavas novads	-0,244	-0,210	-0,037	-0,075	-0,241	-0,596
4	Viesītes novads	-0,143	-0,075	-0,131	0,017	-0,260	-0,482
<b>Total Cluster 4</b>		<b>-0,126</b>	<b>-0,149</b>	<b>-0,112</b>	<b>-0,016</b>	<b>-0,197</b>	<b>-0,478</b>
5	Alūksnes novads	-0,045	-0,048	0,051	-0,153	-0,195	-0,349
5	Apes novads	-0,001	-0,093	0,003	-0,080	-0,246	-0,370
5	Bauskas novads	0,116	-0,022	0,138	-0,052	-0,161	-0,012
5	Brocēnu novads	0,088	-0,039	0,052	-0,097	-0,202	-0,207
5	Cīblas novads	-0,222	-0,224	-0,131	-0,298	-0,283	-0,736
5	Dagdas novads	-0,188	-0,156	-0,097	-0,132	-0,262	-0,603
5	Engures novads	-0,090	0,010	0,139	-0,040	0,009	0,015
5	Jaunpiebalgas novads	-0,148	-0,131	-0,020	-0,058	-0,209	-0,460
5	Jaunpils novads	-0,072	-0,133	0,173	-0,012	-0,217	-0,270
5	Kokneses novads	0,041	0,012	0,065	-0,032	-0,160	-0,087
5	Lielvārdes novads	0,219	0,223	0,313	-0,078	-0,057	0,703
5	Līgatnes novads	0,071	-0,105	0,059	-0,063	-0,182	-0,223
5	Madonas novads	0,045	-0,030	0,033	-0,055	-0,195	-0,204
5	Naukšēnu novads	0,045	-0,114	-0,002	-0,085	-0,221	-0,342
5	Preiļu novads	-0,017	-0,007	0,151	-0,058	-0,183	-0,134

5	Ropažu novads	0,143	0,116	0,518	-0,031	0,140	1,137
5	Saldus novads	0,057	0,011	0,102	0,009	-0,177	-0,021
5	Skrīveru novads	-0,046	0,006	0,327	-0,021	-0,115	0,104
5	Skrundas novads	-0,074	-0,006	0,185	-0,292	-0,231	-0,407
5	Vecpiebalgas novads	0,115	-0,087	0,066	-0,051	-0,206	-0,181
5	Ventspils novads	-0,138	-0,105	0,086	-0,069	-0,170	-0,352
5	Zilupes novads	-0,104	-0,222	-0,105	-0,174	-0,215	-0,595
<b>Total Cluster 5</b>		<b>-0,016</b>	<b>-0,047</b>	<b>0,083</b>	<b>-0,079</b>	<b>-0,170</b>	<b>-0,223</b>
6	Ādažu novads	0,109	0,659	0,331	-0,187	0,449	1,884
6	Iecavas novads	-0,193	0,735	0,044	-0,041	-0,033	0,355
6	Ķekavas novads	0,007	0,464	0,285	0,013	0,349	1,589
<b>Total Cluster 6</b>		<b>-0,046</b>	<b>0,588</b>	<b>0,216</b>	<b>-0,052</b>	<b>0,260</b>	<b>1,201</b>
7	Babītes novads	0,232	0,074	0,218	-0,025	0,421	1,233
7	Baldones novads	0,098	0,078	0,100	-0,058	0,115	0,367
7	Garkalnes novads	2,578	-0,495	-0,084	0,147	1,297	3,362
7	Ikšķiles novads	0,383	0,006	0,183	0,056	0,412	1,454
7	Mārupes novads	0,229	0,222	0,136	-0,086	0,852	1,887
7	Stopiņu novads	2,320	-0,386	0,154	0,004	0,385	2,275
<b>Total Cluster 7</b>		<b>0,710</b>	<b>-0,127</b>	<b>0,134</b>	<b>-0,013</b>	<b>0,552</b>	<b>1,591</b>



**Dendrogram showing hierarchical clustering of modern Latvian municipalities by similarity of their historic population trends in 1959-2011**

*Detalizēta koka diagramma, kas attēlo mūsdienu Latvijas pašvaldību teritoriju hierarhiskās klāsteru analīzes rezultātus pēc to iedzīvotāju skaita trendu līdzības 1959.-2011. periodā*

