



## Research Article

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# Human Capital at the Regional Level: Population Forecast Insights into Latvia from a Long-Term Perspective

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## Abstract

To remain prosperous and competitive, modern regions must meet the challenge of becoming smart and sustainable, and human capital has a key role in this context. Depopulation increases risks of human capital availability and emigration is a primary reason. Regions that are experiencing a decreased population must develop strategic sustainable regional development policies that consider scientifically based population forecasts. The youth population characterises regional potential for long-term human capital availability. First, children represent a region's future employees and entrepreneurs. Second, children require availability of educational services at regional level, which promotes regional vitality. Third, the youth population indirectly demonstrates a region's socio-economic attractiveness for living and working. This study employs the system dynamic method to forecast different population change scenarios at the regional level in Latvia. The results reveal a declining, long-term population tendency for working age and youth populations in Latvian regions. Overall, Latvian regions will remain extremely homogeneous in the long term, with minor differences in the short term. In conclusion, despite regional disparities in terms of quality of life with some leading examples, all regions will experience high emigration loss. Regional social, economic and environmental characteristics demonstrate a need to assess population change trends in a complex manner. This study provides data for understanding short- and long-term perspectives that must be addressed through sustainable regional development policies.

**Keywords:** human capital, youth population, working-age population, out-migration, regional socio-economic and environmental conditions, sustainable regional development, system dynamics

## 1. Introduction

Human capital as an essential factor for advancing productivity and economic growth that is associated with individuals' knowledge and skills (Angrist et al., 2021). Researchers explain human capital effects on income differences through regional education quality (Angrist et al., 2021). For example, universal primary education is considered crucial for human capital development and improvement in residents' well-being (Richards, 2023). In other words, examining and predicting regional human capital potential by assessing current youth populations is a viable approach.

Previous research predicts population changes by focusing on demographic and migration issues to explain future socio-economic trajectories (Amcoff & Westholm, 2007). Population decline due to migration and declining fertility is experienced across countries in contemporary times (Siskova et al., 2023). Siskova, Kuhn, Prettnner and Prskawetz (2023) conclude that declining fertility may be partially compensated through higher investments in health and education of a smaller number of children, which means higher investment in human capital.

Depopulation challenges regional development in advanced and emerging economies (Urbanek et al., 2023). To remain prosperous and competitive, regions must meet challenges to remain 'smart' (Makkonen & Inkinen, 2023) and 'sustainable' (Pelse et al., 2018). Human capital is essential for advancing smart and sustainable regional development. The quality and availability of human capital are at the centre of debates on regional development (Kristapsons, 2019). According to the forecasts, many European countries will experience population decline from a long-term perspective (Eurostat, 2023, 2021). As a result, the question of human capital availability and quality is a popular scientific debate (Siskova et al., 2023). For example, Latvia has high emigration rates (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al., 2020, p. 19, 21) and the lowest birth rates in the past 100 years (Official statistics portal; Official statistics of Latvia, n/d).

This study focuses on predicting human capital availability at the regional level from a long-term perspective, forecasting population changes due to emigration and youth population at regional level in Latvia. Our novel approach reveals the potential of human capital availability at the regional level, indirectly indicating the socio-economic attractiveness of regions for human capital development. The research findings contribute to scientific literature devoted to regional development in Latvia and the importance of early forecasting for characterising human capital development potential at regional levels. Practical application of the insights gained will be useful for developing regional economic strategies that consider long-term population changes.

Human capital development requires quality education and lifelong learning activities. Regions that can ensure the required amount and quality of educational services will benefit from emigration due to their attractiveness for living and working. In this context, the regional youth population requires certain educational services. The availability of quality educational institutions supports and promotes local communities' vitality, increases regions' attractiveness for families with children and has the potential for advancing human capital development. Additionally, quality educational services may be considered a predictor of the attractiveness of regional socio-economic conditions for population growth and the future availability of human capital. These considerations motivated the authors to use youth population forecasting to characterise long-term projections of human capital at the regional level. Moreover, literature on regional development and human capital demonstrates a gap in formulating methods to examine the contribution of youth populations to regional development in modern conditions.

The remainder of this paper is organised into five sections. Section 2 presents the scientific background for our research, the data used and the methods applied. Section 3 details the research results on population forecasts at the regional level in Latvia. Section 4 elaborates a discussion of the research results in the context of regions' socio-economic background, and section 5 concludes the paper.

## 2. Scientific Background, Data and Methods

### 2.1 Scientific background

*Factors affecting regional development.* Depopulation, shrinkage, low population density and ageing are contemporary issues that challenge regional development, particularly outside of economic centres (Paniagua, 2008; Makkonen & Inkinen, 2023; López-Penabad et al., 2022). Studies that consider risks and potential development approaches examine regional attractiveness for living and working and attracting childbearing-age inhabitants (López-Penabad et al., 2022; Štāle et al., 2016; Apsite-Berina et al., 2019).

Complex economic, demographic, social and environmental factors are crucial for regional development (López-Penabad et al., 2022; Ferguson & Catney, 2023). An additional factor is the sense of belonging to a rural area and understanding of what the rural lifestyle means (Ferguson & Catney, 2023). When researchers analyse these factors in the context of population change, the results and factors' significance differ depending on the regions under study. For example, Merino and Prats (2020) conclude that economic circumstances of income level and the structure of economic activities are crucial for population growth. The same research determines that public societal infrastructure is a less remarkable concern (Merino & Prats, 2020). Previous studies also indicate that distance to economic centres may hinder regional development (López-Penabad et al., 2022). According to López-Penabad, Iglesias-Casal and Rey-Ares (2022), environmental factors stimulate regional development.

Overall, researchers conclude that population size and predicted changes can provide an understanding to develop potentially better approaches for regional development in rural territories. For example, Alonso-Carrillo, Pérez-Morote, Núñez-Chicharro, and Pontones-Rosa (2023) indicate that inhabitants of small towns consider infrastructure quality a risk for rural depopulation, whereas inhabitants of medium-sized and large towns cite the rural environment and inattentiveness to agriculture. Jato-Espino and Mayor-Vitoria (2023) found out that depopulation could be reduced when expanding the areas suitable for agriculture.

Income inequality seriously affects regional quality of life and may stimulate depopulation (Štāle et al., 2016). Štāle, Kamola and Kamols (2016) indicate that population size, at-risk poverty rate, education level and human capital are key factors for regional development tendencies.

In the context of education, researchers highlight the role of universities and quality research activities for advancing regional development (Agasiti & Bertolotti, 2022). del Olmo-García, Domínguez-Fabián, Crecente-Romero, and del Val-Núñez (2023) contend that rural entrepreneurship is less attractive for professionals with higher education than for those with secondary educations; therefore, strategic policies must be developed to stimulate rural entrepreneurship (del Olmo-García et al., 2023). Education encourages sustainable regional development by supporting of capabilities of rural communities and ensuring educational services at all levels (Katane, 2013). In addition, quality educational services are considered significant for attracting populations to live in rural areas (Sheppard & Pemberton, 2023).

Emigration may negatively affect regional development, particularly in rural areas (López-Penabad et al., 2022; Apsite-Berina et al., 2019). Income inequality, low economic activity and insufficient public services are among the factors that stimulate regional emigration. Maintaining and increasing regional populations may occur through improved rural living and working environments (Bosworth et al., 2023) and even encourage return migration (Apsite-Berina et al., 2019). Sufficient social care and local education are key features for regional development policies to make regions attractive for living and working (Sheppard & Pemberton, 2023; López-Penabad et al., 2022). Wu, Coulter, and Dennett (2023) examine the destination choices of married migrants with children, finding that couples choose to migrate to mega cities, whereas whole multi-generational families choose less developed regions. In addition to economic factors, researchers highlight the influence of social factors on migrant families' destination choices. The choice to relocate is related to individual

interests and subjective assessments of a region's attractiveness (Elshof et al., 2017). Availability of public services is among the crucial factors, particularly for families with children and regions with weaker socio-economic conditions (Stuart et al., 2023).

Additional attention must be paid to internet connection quality given digital services and telecommuting are a new lifestyle in the emerging knowledge economy (Tammaru et al., 2023). Bosworth, Whalley, Fuzi, Merrell, Chapman, and Russell (2023) highlight the Smart Countryside concept, with an environment that support digital, knowledge-based and creative entrepreneurship. According to the authors, this approach may prevent out migration from rural areas, particularly among young and high-skilled individuals.

Contemporary researchers note a slight increase in some regional populations. Young return migrants (Apsite-Berina et al., 2019), high-income groups and displaced low-income groups (Sheppard & Pemberton, 2023) often relocate to rural areas. The tendency to migrate to rural areas was observed at the regional level during the COVID-19 pandemic in particular (Tammaru et al., 2023). As Tammaru, Kliimask, Kalm, and Zälite (2023) demonstrate families with children, high-income groups and retired people moved to rural areas to avoid densely populated places. Studies also note that newcomers' interests can encourage improvement in rural regional development quality (Sheppard & Pemberton, 2023). At the same time, capital cities and other large cities and surrounding municipalities are target destinations for unmarried return migrants (Apsite-Berina et al., 2019).

Researchers also investigate internal migration to identify the demographic and economic factors that affect regional development (López-Penabad et al., 2022). For example, López-Penabad, Iglesias-Casal and Rey-Ares (2022) indicate that female migration and work in the hospitality sector stimulate sustainable development. In terms of regional development, one study expresses hope that emerging tendencies towards migration to rural areas that began during the pandemic will improve depopulation trends (Tammaru et al., 2023). Studies also link migration in rural areas with economic cycles (Tammaru et al., 2023), indicating the significance of attractiveness of rural places for living and working and the significance of overall economic circumstances.

This literature review indicates that regions' attractiveness for living and working must be considered in the context of economic, social, environmental and health considerations to encompass the complex understanding.

*Specific regional development in Latvia.* Depopulation risks in regions in Latvia receive considerable research attention. Grinevica et al. (2016) contend that Latvia will have an insufficient population of young people by 2030 that will diminish regional economic potential. The necessity of increasing human capital participation in the domestic labour market and reducing labour emigration abroad is mentioned as a solution for maintaining regional economic competitiveness (Grinevica et al., 2016).

Rivza and Kruzmetra (2017) argue that the viability of rural areas can be ensured through employment and innovative economic activities. Studies indicate that regional development trends are monocentric in Latvia (Kreslins and Stefenberga 2016), with strong socio-economic and demographic resource concentration in the capital city region that is similar to other Baltic countries (Lang et al., 2021). According to the European Union's regional innovation strategies (RIS3) programme, economics and entrepreneurship must be cultivated in all regions to overcome monocentric regional development. Rivza and Kruzmetra (2017) find no direct causality between economic growth and population density in rural areas in Latvia, indicating that every territory has economic potential. The authors conclude that quality local governance and innovative activities significantly improve regional performance.

Latvia has high regional disparities. Judrupa (2021) demonstrates that the Riga capital city region is the most competitive based on the Regional Competitiveness Index, and Latgale is in last place. The gap in the level of well-being and economic competitiveness between these two regions is high. A possible solution for more balanced regional development is grounded in promoting sustainable competitiveness through targeted strategies (Judrupa, 2021). One issue that must be

addressed in such development strategies concerns emigration. Labour migration is affected by socio-economic factors. In Latvia (similar to Lithuania and Estonia), researchers (Vasilevska et al., 2016) indicate that international labour migration represents human capital export with low value added and investments in individuals' joint capital. Comparative studies, including Latvia (Pouliakas et al., 2014) conclude that remote regions experience 'brain-drain' due to skilled workforce out-migration. For example, migration within Latvia towards second tier cities is evaluated more positively in terms of attracting youth, families with small children and people of working age (Feldmane, Krisjane, 2016).

Considering that human capital has a significant impact on economic development (Štāle et al., 2016), regional development strategies must address the socio-economic factors that stimulate emigration. Studies pay special attention to declining population trends in Latvia (Krisjane et al., 2023), which are attributed to emigration for socio-economic reasons and low fertility rates. Increased population rates are only observed in suburbs of the capital city region, including in-migration from cities and rural areas (Krisjane et al., 2023). Socio-economic and demographic issues in regions generate simultaneous decrease in youth populations and increased elderly populations (Krisjane et al., 2023).

Cuadrado-Roura (2023) indicates possible risks to regions' sustainable development and economic activity due to imbalanced demographic structure. A particularly unfavourable circumstance is the Latgale region, where an overall long-term population decline has occurred (Krisjane et al., 2023). Researchers investigating population change record similar tendencies for elderly populations to increase in metropolitan and non-metropolitan areas, while youth populations only increase in metropolitan areas (Krisjane et al., 2023).

Population imbalances and decreasing trends in youth populations must be addressed in regional development policies to avoid human capital shortages, now and in the future. Notably, this phenomenon is not exclusive to regional development in Latvia. Many European countries are experiencing depopulation trends, particularly in rural areas (Cuadrado-Roura 2023; Krisjane et al., 2023). Returning migrants may contribute to regional human capital development through experience gained abroad (Apsite-Berina et al., 2019); however, return migration may also contribute to increasing regional socio-economic gaps in Latvia. Apsite-Berina et al. (2019) concluded that border and peripheral areas with low economic activity and ageing populations are not attractive to potential working age return migrants. Notably, despite declining populations and unfavourable socio-economic conditions, rural areas demonstrate elements of smart economic development (Rivza et al., 2016).

Overall, to address regional development issues, it is crucial to understand and predict population trends to support strategically targeted resource allocation and public service provision in the future (Park & Heim LaFrombois 2019).

## 2.2 Materials and methods

*The underlying foundations and precepts of system dynamics.* Developed by Jay W. Forrester in the 1950s, system dynamics is a scientific technique for dissecting, conceptualising and steering intricate systems (Forrester, 1961). Sterman describes system dynamics as an approach that augments understanding of intricate systems, emphasising that a system's dynamism stems from its structure, interconnectedness and interactions (Sterman, 2000). A foundational aspect of system dynamics is the concept of feedback loops, referring to the premise that actions within a system generate reactions that further affect ensuing actions, creating a feedback mechanism. System dynamics are predominantly influenced by feedback loop configurations. It is essential to understand that systems entail both growth-promoting (positive) and stability-seeking (negative) feedback loops (Sterman, 2000). System dynamics also introduces the concepts of stocks and flows. Stocks refer to system accumulations or state variables, while flows refer to the rates at which stocks are affected, thus portraying a system's evolving dynamics over time (Sterman, 2000). The system dynamics

methodology emphasises the principle of endogeneity, implying that a system's behaviour predominantly stems from its inherent structure rather than outside influences. This perspective focuses on the manner in which a system's architecture generates its behaviour, which sets system dynamics apart from alternative modelling approaches (Ford, 1999). Additionally, computer simulations have an essential role in system dynamics studies to probe system behaviours. In replicating various scenarios and examining policy implications, this approach provides deep insights into potential system reactions to different measures. Simulations are pivotal for rigorously authenticating system dynamics models to ensure that they realistically mirror actual systems and subsequently produce credible insights (Sterman, 2000). Sterman (2000) delineated multiple guidelines for adeptly employing system dynamics, which include designing models with a specific problem-solving intent, embedding modelling into projects from the outset, initially questioning the utility of modelling, integrating system dynamics with other analytical tools, prioritising implementation at the start of a project, championing a collaborative and iterative modelling approach, avoiding opaque modelling processes, practicing persistent validation and testing to ensure confidence in models, hastily developing a preliminary model and refining it as needed, prioritising the identification of systemic interactions over granular details, engaging experienced modellers rather than novices and recognising that implementation is an ongoing journey, beyond just one project.

Zhang et al. (2018) indicated that system dynamics is minimally employed in academic economic literature. Some scientific studies do apply system dynamics for population forecasts by combining demographic and economic considerations (Ali et al., 2020). For example, Ali et al. (2020) apply system dynamics to assess the relationship between population growth and the housing market. Other studies focus purely on demographic changes that affect economies, e.g. ageing (Vahidi Monfared & Moini, 2019). Population forecasts also are significant for predicting and planning for public resource demand (Kunte & Damani 2015; Park & Heim LaFrombois, 2019). System dynamics enables the elaboration of long-term population models (Kunte & Damani 2015). This study did not identify any scientific work devoted to population forecasts at the regional level that apply the system dynamics method; therefore, this study applies system dynamics for Latvia, system dynamics for population forecasts (Homutiņins et al., 2021). Other research on Latvia applies this method for examining technological and social considerations for energy policy planning (Feofilovs et al., 2018) and forest biotechnomic sectors using an economic model of the national economy (Azis et al., 2017).

This study applies system dynamics for long-term population change forecasts from emigration at regional level in Latvia. Scientists indicate that population forecasts in terms of migration at regional level are highly complicated (Krumins & Berzins, 2019). Regions of Latvia (Riga (with Pierīga), Latgale, Vidzeme, Zemgale, Kurzeme) at NUTS 3 level are used as a case study. Forecasts of population change are presented with particular attention to three age groups (up to six years, seven to fourteen years, fifteen to nineteen years).

We use two hypothetical scenarios from 2000 to 2022. Scenario A expects migration to remain at average values and Scenario B expects emigration to be twice as high as average current values (the highest historical emigration values). Scenario A demonstrates changes based on current emigration tendencies, and Scenario B demonstrates a potential pessimistic population change in the absence of appropriate long-term sustainable regional development policy.

We formulate projections using a simulation model grounded in the principles of system dynamics. For computational modelling, ISEE iThink v.10.0.2 software suite was employed. In mathematical terms, the foundational architecture of a conventional system dynamics simulation model consists of interconnected, non-linear, first-order differential (or integral) equations.

$$\frac{d}{dt}x(t) = f(x, p) \text{ [equation 1]}$$

where  $x$  denotes a vector representing levels (such as stocks or state variables),  $p$  indicates a collection of parameters and  $f$  is a non-linear function characterised by its vector value (Richardson,

1991, p. 145). We can efficiently simulate these systems by subdividing the simulation period into distinct intervals, each with a length of  $dt$ , and incrementally advancing the system one  $dt$  interval at a time. We determine the value of each state variable based on the preceding value and the net rate of change, as denoted by  $x(t)$  (Richardson, 1996, p. 807):

$$x(t) = x(t - dt) + dt \times x'(t - dt) \text{ [equation 2]}$$

Data from the Official statistics portal of the Official statistics of Latvia (n/d c, d, e, f, j) on Population in regions and cities by age and gender at the beginning of year 1971–2022, International long-term migrants by age and sex 2000–2022, Deaths by sex and age group in regions 2000–2023, Fertility rates (age-specific, total, gross and net reproduction rate, crude birth rate) 1965–2022, Number of births and fertility rates are used for the study's calculations. We use the following age group categories for data input: up to 4, 5–9, 10–14, 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69 and 70 and above. The statistical data used allow for population modelling introducing migration, mortality and fertility rates.

This study forecasts population changes until 2076 applying system dynamics modelling, with a focus on emigration trends. We then examine the results based on regional socio-economic circumstances using data from the European Union Territorial Agenda 2030 (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al., 2020).

### 3. Research Results

#### 3.1 Regional profile

We next examine the main regional socio-economic and demographic profile characteristics in Latvia in recent years, which is useful for providing a baseline from which to understand long-term population forecasts. Almost a half of the population in Latvia lived in the Riga region (including the Pierīga region) in 2022 (Official statistics portal. Official statistics of Latvia, n/d b, f). The factors that primarily affect population changes include natural population growth and net migration. In 2022, the urban population is almost twice that of the rural population (Official statistics portal; Official statistics of Latvia, n/d h). Population decline was more pronounced in Latgale, followed by Kurzeme and Vidzeme (Official statistics portal; Official statistics of Latvia, n/d g). Zemgale shows a slight population increase in 2022 (Official statistics portal; Official statistics of Latvia, n/d g). Riga (including Pierīga) experienced a population increase (Official statistics portal; Official statistics of Latvia, n/d g).

In terms of working age population, the employment rate for the 15–64 age groups was relatively high in 2022 and similar across regions, at 69.5% and 69.7% for Vidzeme and Zemgale, respectively, 67.2% for Latgale and 67.6% for Kurzeme (Official statistics portal; Official statistics of Latvia, n/d a). The Riga region (including Pierīga) was the leader, with an employment rate of about 74%. The unemployment rate was the highest in Latgale (9.3%) and the lowest in Riga and Pierīga regions (Official statistics portal; Official statistics of Latvia, n/d a).

Regarding the youth population, regions were more or less homogeneous. The share of population aged 0–14 years in regions vary from 13.6% in Latgale to 16.6% in Riga and Pierīga, and similarly 16.3% in Zemgale (Official statistics portal; Official statistics of Latvia, n/d i). Vidzeme and Kurzeme are close in terms of the share of children in the population (15.6% and 15.8%, respectively).

Notably, the population over the working age (65 years and more) is slightly higher than the youth population in all regions (Official statistics portal; Official statistics of Latvia, n/d i). The share of the population over working age in Riga and Pierīga is 20.2%, 20.3% in Zemgale region, with slightly higher (but extremely close) indicators in Vidzeme and Kurzeme, at 21.7% and 21.8%, respectively. Although not far from other regions, Latgale demonstrates the highest value of 22.8%.

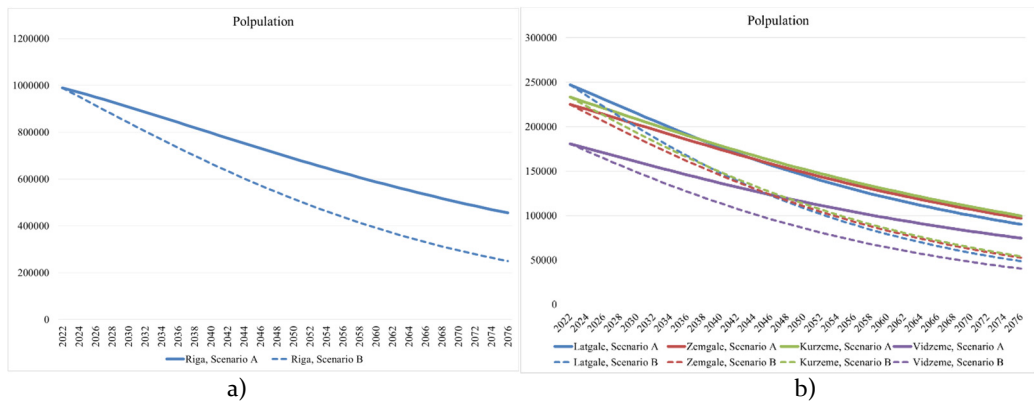
Overall, as previous research indicates, labour market differences are significant and Latgale has the least efficient labour market (Krasnopjorovs, 2023). Riga is the absolute leader in terms of economic development and potential, which subsequently weakens the ability of other regions to

narrow the gap in income level between the capital city region and rural areas. According to the Financial Times, in 2023, Riga was evaluated as one of the more desirable small regions in terms of human capital and lifestyle (Latvijas Vēstnesis, 2023).

In conclusion, the statistical data reveal that the proportion of the population over working age is higher than the youth population in all regions, which may worsen future circumstances of human capital availability at the regional level. Additionally, regional differences and economic potential indicate a need to address potential human capital shortage through sustainable regional development policies. A detailed consideration of possible long-term changes is necessary for informing the strategic qualitative elaboration of regional development policies.

### 3.2 Population change forecasting results

From a long-term perspective, populations are expected to decrease in many European countries (Eurostat 2023, 2021). Therefore, population change forecasting provides useful insights for elaborating timely regional development policies to strategically target specific issues at the regional level. Differentiated scenarios of population change are needed for more precise solutions.



**Figure 1:** Population change scenarios due to emigration until 2076 in regions in Latvia (unit: 1,000)  
**Source:** Authors' calculations

Population change demonstrates a declining tendency in all regions according to both scenarios (Figure 1, Appendix). For Scenario B with the highest emigration rates, population decline is particularly accelerated and pronounced. This indicates the urgent necessity of addressing emigration issues through sustainable regional development policies. A significant aspect of overall population change relates to the youth population. Table 1 presents long-term youth population forecasts at the regional level according to scenarios A and B. Table 1 illustrates changes for two periods—until 2030, with time included for development strategies at national and regional levels, and until 2076, presenting a long-term perspective for the next 55 years. Comparing the short- and long-term changes strongly demonstrates depopulation risks and possible shortage of human capital in regions.



**Table 1:** Youth population changes in Latvian regions due to emigration (2022–2076; unit: %).

Regions	Scenario A	Scenario B	Scenario A	Scenario B	Scenario A	Scenario B
	Changes from 2022–2030, %					
	Teens 15 to 19		Kids 7 to 14		Kids up to 6	
Riga	+7.64	+0.4	-10.54	-16.34	-16.48	-23.58
Latgale	-8.36	-14.6	-16.74	-22.15	-9.72	-17.50
Zemgale	-2.30	-8.92	-13.59	-19.21	-18.39	-25.36
Kurzeme	-5.88	-12.28	-14.30	-19.87	-16.31	-23.49
Vidzeme	-1.89	-8.53	-12.24	-17.95	-18.38	-25.39
Changes from 2022–2076, %						
Riga	-49.46	-72.55	-60.13	-78.75	-60.69	-79.84
Latgale	-57.89	-77.22	-61.44	-79.52	-56.88	-77.97
Zemgale	-55.57	-75.93	-61.36	-79.45	-60.65	-79.87
Kurzeme	-56.79	-76.61	-60.86	-79.20	-59.37	-79.22
Vidzeme	-54.75	-75.48	-60.48	-78.98	-60.63	-79.86

**Source:** Authors' calculations.

Our calculations demonstrate that the population is expected to decrease for all youth age groups in all regions (teens in Riga until 2030 are the only exception). Overall, regions are very homogeneous in the long-term, with minor differences in the short term. The decline is extremely alarming due to considerably high change rates in all regions for both scenarios considered; however, the change rates differ significantly per scenario. We next describe the possible changes for the year 2030 representing the short-term forecast and time included for regional and national development strategies (Saeima of the Republic of Latvia, 2010) and the year 2076 (long-term forecast following 50 years) in detail.

*Changes until 2030 (Scenario A).* The 'Scenario A' uses average emigration values from 2000 to 2022, demonstrating changes based on current emigration tendencies.

The child population up to six years of age is expected to decrease. The highest and similar change rates are observed for Zemgale and Vidzeme (-18.39% and -18.38%, respectively). Riga and Kurzeme have slightly lower similar change rates, although they are also high (-16.48% and -16.31%, respectively). Latgale has a considerably lower change rate of -9.72%. According to our forecasts, decreases in absolute values in the child population up to six years of age in 2030 varies from 1348 in Latgale to 2937 in Zemgale and 12049 in Riga region (the region, where one-third of the nation's population resides).

The child population from seven to fourteen years of age is also expected to decrease, with rates that are slightly lower than the previous age group in all regions except Latgale. The lowest decrease (-10.54%) is expected in Riga, and the highest (-16.74%) in Latgale. Vidzeme, Zemgale and Kurzeme present similar decrease rates of -12.24%, -13.59% and -14.30, respectively. In absolute values, decreases in the child population from seven to fourteen years of age in 2030 varies from 1923 in Vidzeme to 3301 in Latgale and 9649 in Riga. Notably, the youth population from seven to fourteen years of age is higher in all regions than those up to six years of age.

The teen population from 15 to 19 years of age is expected to decrease more slowly than the other age groups, although it will also decline significantly. The only exception until 2030 is Riga, which will experience significant increase in population for this age group (+7.64%). Decrease rates for Vidzeme and Zemgale are relatively low (-1.89% and -2.30%, respectively) compared with rates for the previous age groups. Teen populations in Kurzeme and Latgale will decrease by -5.88% and -8.36, respectively. In absolute values, decreases in the teen population from 15 to 19 years in 2030 vary from 171 in Vidzeme to 996 in Latgale. Riga is expected to experience an increase to 3631 teens. It is noteworthy that the teen population is lower than for other age groups.

*Changes until 2030 (Scenario B).* For Scenario B, emigration is twice as high as average current

values (the highest historic emigration values). This scenario is intentionally pessimistic to demonstrate possible population changes in the case of no appropriate long-term sustainable regional development policy.

In Scenario B, the child population up to six years of age is expected to decrease more rapidly. The highest decrease rates are observed for the same regions as Scenario A. Although, Latgale demonstrates the largest difference between two scenarios across regions ( $-9.72\%$  for Scenario A and  $-17.50\%$  for Scenario B). As Latgale's decrease rate for Scenario A is almost twice as high as high as other regions, Scenario B is particularly unfavourable for Latgale. However, despite such rapid change, Latgale also demonstrates the lowest decrease rate for Scenario B across regions. Overall, the child population up to six years of age is expected to decrease in all regions from  $-23.49\%$  (Kurzeme) to  $-25.39\%$  (Vidzeme). In absolute values, this means population decrease from 3150 persons in Kurzeme to 3750 persons in Vidzeme in 2030. For Riga, the decrease in absolute values means 17235 persons in 2030.

Forecasts of the child population from seven to fourteen years of age until 2030 also reveal extremely high change rates, although they are slightly lower than for the child population up to six years of age. Changes are similar for all regions. The fastest decrease is forecasted for Latgale ( $-22.15\%$ ). Although extremely similar to other regions, the lowest decrease is forecasted for Riga ( $-16.34\%$ ). Zemgale and Kurzeme have very close results ( $-19.21\%$  and  $-19.87\%$ , respectively). Vidzeme has the second highest decrease for this age group in Scenario B ( $-17.95\%$ ). In absolute values, changes in the child population from seven to fourteen years of age in 2030 are expected in a range from 2820 in Vidzeme to 4367 in Latgale. Riga is expected to experience a decline of 14961 kids aged seven to fourteen due to emigration in 2030.

Forecasts for teens in the 2030 Scenario B also indicate unfavourable changes in population number for all regions (except Riga). However, in the case of Scenario B, differences between regions for the teen population are considerably higher. Riga is expected to experience a slight increase in the teen population in 2030 ( $+0.4\%$ ). Vidzeme and Zemgale are expected to experience a decrease in the teen population in 2030 ( $-8.53\%$  and  $-8.92\%$ , respectively). Notably, these changes are more than twice as low as other age groups according to Scenario B. Kurzeme and Latgale have higher change rates ( $-12.28\%$  and  $-14.6\%$ , respectively). In absolute values, the teen population decrease in 2030 due to emigration is expected in a range from 626 in Vidzeme to 1742 in Latgale. An increase of 191 teens is forecasted for Riga in 2030.

Considering the current populations in the three child age groups and current emigration tendencies, short-term population forecasts (until 2030) indicate the necessity of developing strategically targeted strategies to prevent high emigration.

In the long-term forecasts (until 2076), changes in the youth population due to emigration are highly unfavourable for regional development. Declines are observed in all regions with change rates exceeding  $-50\%$  and even  $-70\%$ . Notably, change rate differences for the three child age groups in the long-term become less pronounced and the overall decreases are highly similar.

Accurate and timely understanding of regional population change tendencies is useful for developing targeted sustainability policies based regional development circumstances.

*Changes until 2076 (Scenario A).* According to the forecasts and based on current emigration tendencies, population change in the three child age groups is expected to decrease significantly in all regions until 2076, and the rates of decrease for long-term change between regions differ insignificantly. For example, population decreases vary for children up to six years of age, from  $-56.88\%$  to  $-60.69\%$ . Moreover, differences in decrease rates do not reach even half of a percentage point for Riga, Zemgale and Vidzeme. These rates are extremely high, exceeding  $-60\%$ . In absolute values, the child population decrease for the age group up to six years in 2076 (compared with 2022) is expected to vary from 7886 in Latgale to 9688 in Zemgale and 44363 in Riga.

Similarly, change rates minimally differ across regions for the group from seven to fourteen years of age and are very close for all regions, exceeding  $-60\%$ . In absolute values, the population decrease due to emigration for the group from seven to fourteen years of age is expected to reach

9504 in Vidzeme, 12116 in Latgale and 55056 in Riga.

For the group from fifteen to nineteen years of age, decrease rates until 2076 are lower than those for other two age groups but also indicate highly unfavourable depopulation tendencies. Decrease rates vary from -49.46% in Riga to -57.89% in Latgale. Changes in population in absolute values are expected to vary from 6901 in Latgale to 23496 in Riga.

*Changes until 2076 (Scenario B).* Our forecasts, which are based on assuming twice as high emigration rates (the highest historic values), demonstrate significant depopulation for three youth age groups at the regional level until 2076. Decrease rates exceed even -75% and reach almost -80%. Minimal and maximal change in absolute values by age group reveal population decreases of 10810 in Latgale and 12757 in Zemgale for the group up to six years of age, 12411 in Vidzeme and 15683 in Latgale for the group from seven to fourteen years of age and 6825 in Vidzeme and 9206 in Latgale for the group from fifteen to nineteen years of age. For the capital city region, changes in absolute values are 58365 for the group up to six years of age, 72096 from seven to fourteen years of age and 34465 from fifteen to nineteen years of age.

In conclusion, our data analyses and predictions indicate that decline indicators for the youth population in Latvia will rise at the regional level (see Table 1, Appendix), which threatens the long-term availability of human capital at regional levels and requires urgent attention through strategically targeted sustainable regional development policies.

#### 4. Discussion

Human capital receives considerable attention within national development strategies. Knowledge, education and entrepreneurial competencies are prerequisites for economic growth and regional development. Latvia has been formulating a human capital development strategy, the aim of which is to coordinate human capital management to successfully adjust to future labour market needs (Ekonomikas ministrija, 2023). The strategy promoted the provision of a modern environment for human capital development according to actual labour market changes to create higher value added. The emphasis of the policy is on education (especially STEM), labour market expansion through improved mobility and housing availability, motivation and involvement of the economically inactive population, monitoring the ageing workforce, attracting qualified and skilled employees (including return migration), developing a lifelong learning culture, improving the digital skills of the working population, retraining for labour market changes and strengthening the availability of human capital and monitoring human capital (Ekonomikas ministrija, 2023).

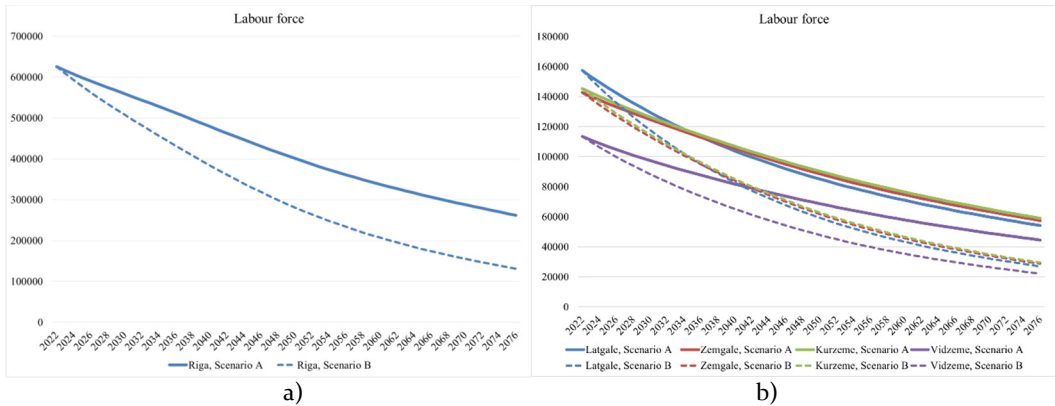
Research indicates that activating internal labour reserves is also possible (Krasnopjorovs, 2023). For example, experts from Latvijas Banka highlight youth and upper-middle-aged men that may be involved in the labour market to a greater extent (Krasnopjorovs, 2023). Insufficient popularity of vocational education and apprenticeships, low digital skills, outdated professional skills, insufficient lifelong learning and health issues are noted as obstacles for active participation in the labour market for the noted groups (Krasnopjorovs, 2023).

The Employers' Confederation of Latvia (LDDK), which is the largest association of employers' organisations in Latvia, is also participating in the process and providing insights for addressing the growing human capital shortage (LDDK, 2023). According to the employers' opinion, the primary focus of human capital development must be on labour force availability, labour force cost competitiveness and skills development (LDDK, 2023). Collaborations between the government and entrepreneurial sector intend to reach effective use of available labour force, to reduce structural mismatch in skills, to solve shortage in labour force and to improve relationships at labour market (LDDK, 2023).

In a broader approach, successful human capital management must not only focus on education and the labour market but also the health care system. According to the experts of Latvijas Banka (Krasnopjorovs, 2023), depopulation trends are highly affected by excess mortality and significant improvement in the national health care system is required.

Modern research regarding regional development focuses on human capital, education and knowledge (Pelse et al., 2018). In Latvia, human resources are considered the primary source of sustainable regional development (Apsite-Berina et al., 2019). In this context, special attention must be devoted to regional population changes. Emigration is one of the main factors that stimulate depopulation at the regional level (Rajevska & Romanovska, 2016). Additionally, Latvia experienced the lowest birth rates in the last 100 years in 2022 (Official statistics portal; Official statistics of Latvia, n/d d). Emigration and low birth rates are expected to negatively affect population change in the short- and long-term.

According to our calculations, the youth population is expected to decrease significantly in short- and long-term in all regions. Our forecasts demonstrate possible future labour force and entrepreneur shortages in the future (see Figure 2).



**Figure 2:** Scenarios of labour force change due to emigration until 2076 in regions in Latvia, thousands

**Source:** Authors' calculations

Menshikov, Vanags, and Volkova (2013) conclude that economically active residents with high physical capital choose to become labour migrants. In this context, researchers identify a comparatively low amount of cultural capital that could be transformed into human capital and subsequently into economic capital (Menshikov et al., 2013). Menshikov et al. (2013) also indicate that the social environment is a factor that encourages the decision to migrate. In the context of depopulation, return migration can significantly support regional socio-economic potential. The characteristics of returning migrants in Latvia include working age, majority unmarried and choosing to live in the capital city, other largest cities and surrounding municipalities (Apsite-Berina et al., 2019). Merino and Prats (2020) note that regions with better economic circumstances experience increasing populations.

Attractiveness for living and working is related to regional socio-economic and environmental conditions. The population change forecasts at the regional level from emigration can be used to inform sustainable regional development policies, with particular attention to emigration trends. Notably, the predicted decline is highly pronounced in all regions. Certain regional socio-economic and environmental conditions have crucial role. The data from the Atlas for the Territorial Agenda 2030 (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al., 2020) indicates some substantial regional socio-economic and environmental circumstances.

#### 4.1 Economic

A common opinion contends that economic activity and viability relies on population size and population density (Krumins et al., 2015). In Latvia, regional population density is relatively low. At the same time, regions are demonstrating goals and achieving results in smart development (Smart Rural 21 n/d).

Economic disparities and structural inadequacy are the factors that affect regional economic growth potential. Latvia's capital city region has been considerably ahead in GDP than other regions for a long period (Official statistics portal. Official statistics of Latvia, 2023). Foreign direct investment can contribute to regional development. According to data on Extra-European Foreign Direct Investments Inflows (as a percentage of GDP, 2003–2015), Kurzeme is ahead of other regions (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al., 2020, p. 53). Data on trends in 4.0 technological innovations (taxonomy of 4.0 technology inventing regions 2010–2015) characterise all regions as low tech (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al., 2020, p. 77). Data on trends in 4.0 technological transformations (main implementation of 4.0 technological transformation 2009–2016) indicate that digitalisation has occurred for traditional services in all regions (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al., 2020, p. 77). For example, enterprises in the bioeconomy industry are predominantly innovative only within their regions (Pelse et al., 2018). Pelse et al. (2018) conclude that enterprises appreciate collaborations with scientific and research institutions. According to the data on new enterprises (regional start-up rates in 2017), Kurzeme and Vidzeme are ahead of Riga, Vidzeme and Zemgale (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al, 2020, p. 35). Employment structure according to economic sectors (the proportion of employees in each sector in all employees in 2016) is similar for all regions, with the service sector dominating (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al, 2020, p. 31). The share of young people that are not employed, educated or trained in a specific vocation (according to 2019 data) is also similar in all regions (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al, 2020, p. 33).

In conclusion, some disparities in the terms of economic activity level and attractiveness for investments are observed between regions, but at the same time, all regions need improvements in the level of innovativeness and technological intensity of economic activities.

#### 4.2 Social

Overall, previous research indicates that social aspects in terms of health, education, public services and infrastructure (López-Penabad et al., 2022; Stuart et al., 2023) as well as job opportunities, unequal development and poverty (Suárez Roldan et al., 2023) are among the primary challenges for regional development.

According to the Federal Institute for Research on Building, Urban Affairs and Spatial Development et al. (2020, p. 19), population change from 2010 to 2019 in all regions in Latvia are characterised by higher migration loss over excess death rates. Annual net migration per 1000 inhabitants for the period from 2016 to 2018 was positive in Riga and negative (with high values) in other regions (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al., 2020, p. 21).

An index that indicates opportunities for a good life (Good Life Enablers Index), which includes dimensions of personal, socio-economic and ecological spheres such as housing and basic utilities, health, education, transport, digital connectivity, work, consumption, public spaces, cultural assets, green infrastructure and protected areas, presents differences between regions. Zemgale has the lowest index value and Riga is the leader (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al., 2020, p. 36). Latgale and Kurzeme are ahead of Zemgale but behind Vidzeme (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al.,

2020, p. 36). In the terms of life maintenance (personal health, personal safety, healthy economy, healthy society, healthy environment and climate change), Latgale is behind Riga, Vidzeme, Kurzeme and Zemgale (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al., 2020, p. 36). In the terms of life flourishing (self-esteem, self-actualisation, interpersonal trust/societal belonging, institutional trust/good governance and biodiversity wealth), Zemgale and Latgale are behind Kurzeme, Vidzeme and Riga (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al., 2020, p. 36). In conclusion, despite regional disparities in terms of quality of life with some leading examples, all regions experience high migration loss.

#### 4.3 Environmental

Previous studies indicate that environmental factors may drive rural development (López-Penabad et al., 2022). In the terms of regional adaptability to climate change, all regions demonstrate no/marginal vulnerability and no/marginal impact of climate change (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al., 2020, p. 58). Notably, the Baltic Sea Region is associated with positive impacts from climate change in terms of crop yields and tourism potential (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al., 2020, p. 58).

Land transitions into urban use (change of agricultural areas, forests and semi-natural areas, marshland, water areas, mining areas and dumps into urban areas, industrial, commercial and transport areas and urban green areas from 2000–2018 in m<sup>2</sup> per inhabitant) was more intensive in Riga following by Zemgale, with considerably lower rates for Vidzeme, Latgale and Kurzeme (Federal Institute for Research on Building, Urban Affairs and Spatial Development et al., 2020, p. 61). In terms of rural development, one study concludes that expanding land areas suitable for agriculture may reduce depopulation (Jato-Espino, Mayor-Vitoria 2023).

In conclusion, it is possible to highlight low-tech economic structure, dominant employment in the service sector, negative migration trends but favourable environmental conditions. Latvian regions primarily share homogeneous characteristics. Social, economic and environmental characteristics demonstrate a need to assess population change trends in a complex manner. This study provides data for understanding short- and long-term perspectives that must be addressed through sustainable development policies for rural and urban areas.

## 5. Conclusions

Depopulation is a serious challenge for regional development in developed and developing countries. To counter depopulation conditions, regions must design strategically focused sustainable regional development policies that consider scientifically based population forecasts. Forecasts that offer different scenarios are well grounded for understanding short and long-term socio-economic development trajectories. Such knowledge can correctly identify the hindering factors of regional development for targeted policies. Emigration is a hindrance to regional development, and the conditions that stimulate emigration can be socio-economic and environmental. The long-term, negative effects of emigration cause a shortage of human capital in local places that creates unfavourable socio-economic conditions and even decreases regions' attractiveness for living and working.

Human capital is essential for advancing smart and sustainable regional development. Depopulation challenges human capital availability and emigration threatens adequate regional human capital. Youth populations characterise regional potential for future human capital. First, children are future employees and entrepreneurs. Second, require quality educational services to ensure the vitality of rural territories. Third, youth population changes indirectly characterise the attractiveness of local places for living and working.

This study examines the case of Latvian regions (Riga, Latgale, Vidzeme, Zemgale and Kurzeme)

and youth population changes in three age groups (up to six years, from seven to fourteen years and from fifteen to nineteen years). Our results reveal decreasing population changes for working age and child populations in Latvian regions. Two possible scenarios for population change due to emigration are considered, including Scenario A, in which migration is expected to maintain average values based on 2000–2022, and Scenario B, in which emigration doubles the average current values.

The economic context demonstrates the necessity for improving the innovativeness and technological intensity of regional economic activities. In terms of quality of life, despite some regional disparities, all regions experience high emigration loss. Environmental regional circumstances indicate favourable conditions.

Overall, Latvian regions are extremely homogeneous in the long-term, with minor differences in the short term. Population decline, particularly the youth population, is extremely alarming due to considerably high change rates in all regions for both scenarios, although the change rates differ significantly. The findings provide valuable insights for designing and implementing appropriate regional development policies that address emigration and socio-economic challenges and promote solutions for advancing sustainable regional development.

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Appendix

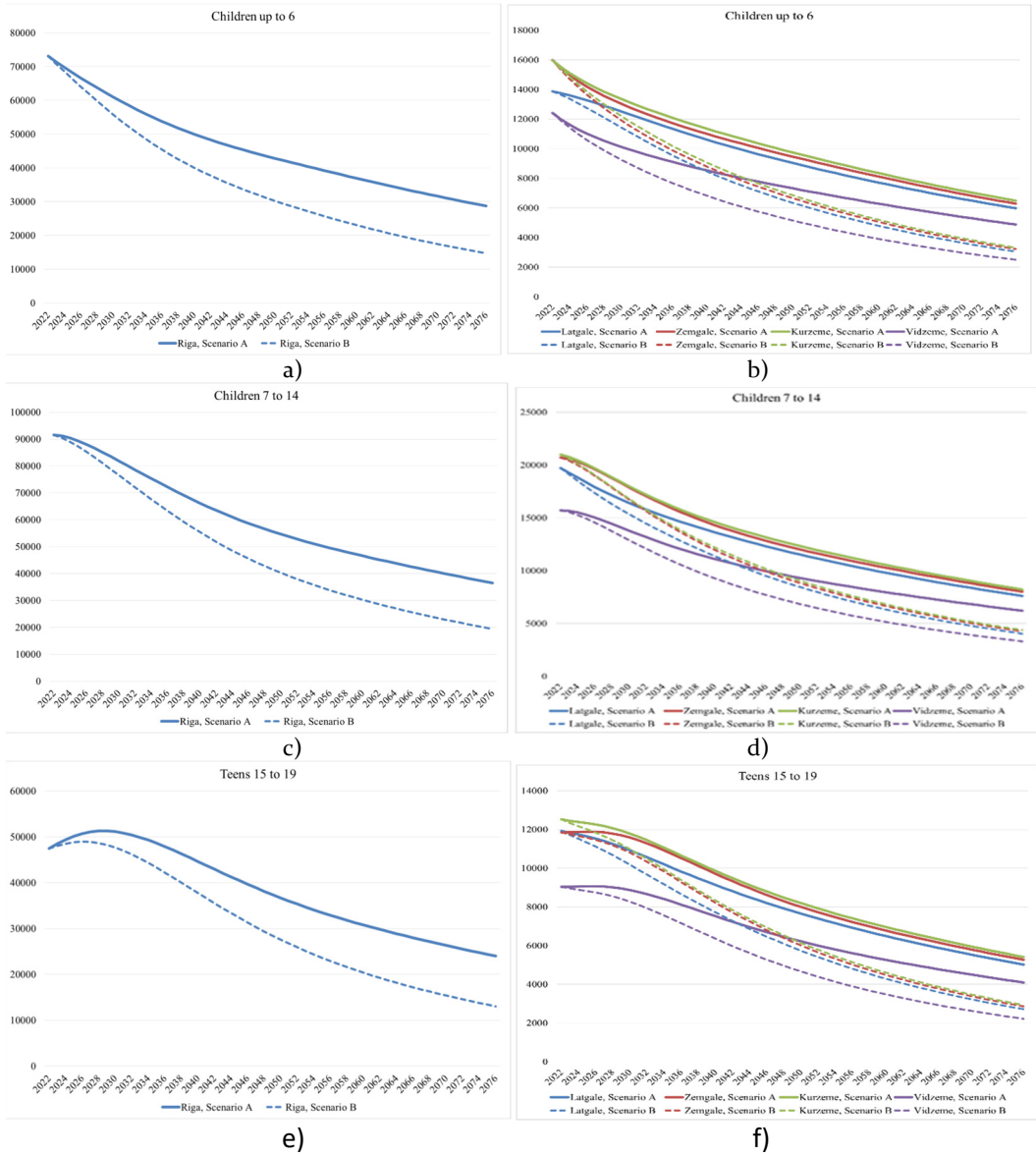


Figure 1A: Youth population changes in Latvian regions due to emigration (2022–2076; unit: 1,000)  
Source: Authors' calculations