Developmental and research paper

A dynamic forecast of changes in the population according to births and deaths

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Povzetek

Staranje prebivalstva je pojav, ki ga zaznavamo v večini evropskih držav, in je posledica sočasnega podaljševanja življenjske dobe ter dolgotrajnega postopnega zniževanja rodnosti. Vpliv spremenjene starostne strukture populacije pričakujemo na številnih področjih življenja in sicer od zdravstva, socialnega skrbstva in šolstva, do področij, ki neposredno vplivajo na gospodarsko rast in strukturo, potrebe na področju stanovanjske, prostorske in regionalne politike, ter obseg virov financiranja pomembnih delovnih področij v državi. Spremembe, kot posledica staranja prebivalstva, ne bodo enakomerno porazdeljene po celotnem slovenskem prostoru, temveč bodo heterogene tako po obsegu, strukturi kot tudi intenziteti. V razvojno-raziskovalni nalogi predstavljamo dinamični model napovedovanja rodnosti v Sloveniji, ki temelji na statističnih podatkih in upošteva verjetnost umrljivosti in neto migracije.

Abstract

Population aging is a phenomenon observed in most European countries, occurring because of increasing life expectancy and decreasing fertility. Changes are thus expected in numerous areas of life, from health and social care, education, to those that affect the economic growth and structure, to those affecting housing, environmental and regional policies, and the extent of funding sources for critical governmental sectors. Expected changes will not be uniform across the entire Slovenian area, but heterogeneous in terms of scope, structure and intensity. Herein a statistical model of fertility, considering the probability of dying and net migrations is presented.

Key words:

Demography, aging, working population

Introduction

Europeans regard health as one of the greatest values. This is demonstrated by domestic research, e.g. Slovenia's vision, as well as OECD research. Since health is not self-evident, both individuals and society must strive for it. As part of the complex process represented by the pursuit of health, we will present some views on the health of the population of Slovenia and its vitality in the period from 2017 to the year 2100.

Purpose and objectives

According to data from the Statistical Office of the European Union (hereinafter Eurostat), in many European countries more than a third of the necessary funds for health care are provided at national level. Similarly, many other areas, e.g. science, education, local development, infrastructure, etc. Are financed by the state. The number of resources for financing the aforementioned departments depends on the situation in the economy. The latter, however, strongly depends on the composition of the population, especially on the potential share of the active population. Therefore, demographic changes have a strong impact on factors such as: i) the number of working-age individuals, ii) economic growth, iii) the extent of financing sources, iv) the growth of expenditures for social protection and health care, v) needs in the field of housing, spatial and regional policy. The trend of population aging, which is present in developed and underdeveloped countries, is a long-term process associated with a simultaneous long-term gradual decrease in the birth rate and an increase in life expectancy. Demographic aging of the population creates pressure on the proportion of young, active residents to create sufficient economic potential and resources to provide for all residents, or to support important state departments. Due to the decrease in the share of the active population, the inflow of funds into the state treasury will also decrease. Nevertheless, it will be necessary to cover the growing costs of health and social care, while investments in the fields of education, infrastructure, science and development have not yet been considered.

Currently, EUROPOP forecasts are used for medium- and long-term forecasts of demographic changes in the Republic of Slovenia (hereafter RS), which include many scenarios of population change. EUROPOP forecasts are based on default assumptions about births, deaths and migration at the national or regional level. Population projections assume partial convergence, which means that socio-economic differences between countries within the European Union (hereafter EU) will decrease over time, meaning that countries will become more similar in demographic characteristics over time. Projections according to EUROPOP assume that the birth rate in the RS will increase, which is not in accordance with the current observed dynamics of births in the RS.

The purpose of the research article is to study the phenomenon of demographic aging in the territory of the RS, as well as all potential impacts in the areas of spending national funds to ensure the care of residents (mainly in the area of health and long-term care, education, housing issues and economic stability).

The main objective is to determine the extent of inter-regional differences in the needs of health and long-term care, education and housing stock, which will occur due to demographic aging and internal migration:

- Review and evaluation of publicly available statistical data on the number and composition of the population, as well as the rate of birth, death and migration,

- Development of a methodology for forecasting the number and composition of the population in the RS, based on publicly available statistical data,

- Prediction of indicators of demographic aging of the population (e.g. dependency ratio of the elderly, aging index, etc.),

- Evaluation of the impact of demographic aging on productivity to ensure the current standard of living.

Demographics

Since demographic aging is associated with a decline in the proportion of young people, representing demographic potential, it is not surprising that population aging also leads to a decrease in the number of inhabitants. According to forecasts, the European population is expected to grow until 2025, after which it will slowly begin to decline. By the year 2100, the population of Europe is expected to decrease by 30-40 million. The general forecast shows that the population aging process will be more intense in Slovenia than in other EU member states. According to the EUROPOP2013 population projection, which takes into account birth rates, mortality and net migration, the share of children and youth in Slovenia is expected to remain the same until 2050, while the share of people over 65 is expected to increase significantly. The anticipated demographic changes will thus have a significant impact on the share of working-age individuals and on the old-age dependency of the elderly. Demographic aging projections in Slovenia show that the greatest increase in the aging index will occur between 2020 and 2040.

In order to solve the deepening demographic crisis, where the entire population will be provided for by the working generation, whose share will decline, it is necessary to resolve the birth rate problem. The demographic aging and the decline in the proportion of young people can only be stopped by encouraging the birth rate. Internal measures based on extending working life, increasing productivity and promoting innovation and new technologies are important for the transitional period when the effects of measures to increase the birth rate will not yet be noticeable.

Incidence of disease

Physiologically, aging is associated with an increasing prevalence and incidence of chronic conditions and diseases, with multi-morbidity becoming the most common chronic condition. Research shows that in developed countries, 25% of adults have at least two chronic conditions, and more than half of those over the age of 65 have three or more chronic conditions. Multi-morbidity is an important factor that has a decisive influence on unfavourable treatment outcomes and is associated with an increased healthcare cost. Patients with multi-morbidity die earlier, are more frequently hospitalised, usually receive more drugs and have a worse quality of life (Marengoni, Angleman, Melis et al. 2011; Fortin, Soubhi, Hudon et al., 2007). Currently, in the EU, approximately 80% of the health budget is allocated to the treatment of chronic diseases. Already in 2008, non-communicable diseases accounted for an estimated 86% of the disease burden in developed countries. Forecasts for the year 2030 show that most of the burden of disease in developed countries will be non-communicable diseases, mainly chronic conditions and degenerative diseases. Here, epidemiologists predict that the proportion of mortality and disability due to cardiovascular diseases, cancer and diabetes will increase by the largest proportion compared to infectious and parasitic diseases (WHO, 2011). Although infectious diseases will still account for a large share of the disease burden in developing countries, the share of non-communicable diseases will increase to more than 50% in low-income countries and territories, and to more than 75% in middle-income countries and territories (WHO, 2011). In the population over 60 years of age, according to estimates, as much as 87% of the disease burden will be represented by non-communicable diseases (WHO, 2011). At the same time, it should be noted that other factors will also have a decisive role in increased share of people with chronic diseases, e.g. better diagnostic procedures and screening programs, lifestyle and exposure to environmental risk factors, and general circumstances in society that affect health and the use of health services.

More than 10 years ago, many countries devoted a lot of transparency to the demographic aging. Many countries have prepared national plans for development based on forecasts of changes in the population composition, especially in the fields predicted to be affected most by the demographic crisis. One of these areas is certainly healthcare, as in the future radical changes in the demand for specialist areas of medicine, as well as medical equipment and infrastructure are expected. In Slovenia, the deepening of

the health crisis has been observed for years. The crisis initially manifested in long waiting times for health visits, and with the emergence of the new Coronavirus disease, a high degree of disorganization and inefficiency of the health system became apparent. Since Slovenia is politically, economically and socially integrated into the EU, a direct comparison with other countries would enable an assessment of the situation in Slovenia. However, due to the lack of publicly available data, a direct comparison is not possible. Since aging is a general phenomenon that is perceived in all countries of the world, the impact of aging in other EU countries may be shown, based on the demographic forecast based on the base scenario of Eurostat. Thus, based on the characteristics of Slovenia, its age structure and the performance of the health system, we can create a relative comparison for the entire EU.

Monitoring the effects of measures, whether changed methods of treatment, the organization of healthcare, education and personnel development, the impact of investments, etc., on increased productivity, quality of life, general satisfaction, increase in the birth rate, or the impact of the above on the improvement of the demographic structure, transforms the initial static model into a dynamic one. In general, we are observing a complex system, which is characterized by the fact that the elements of the system act on each other and react mutually. Thus, with a model that enables the visualization of the consequences of theoretical scenarios and their effects in the areas described above, we can monitor the effects of measures and quantification of the entire system. The results show the challenges that Slovenia is currently facing in the effort to realize the Vision of Slovenia 2050.

Methodology

A dynamic fertility model

Fertility forecasts are important in designing, adopting and monitoring the effectiveness of measures promoting fertility. By forecasting the mortality rate of the population, it is possible to estimate the economic deficit for provision of the population and the economic pressure on the working population. The latter forecasts are important in the design, adoption and monitoring of the effectiveness of internal measures to increase the work efficiency of the population for a time when the effects of the increase in the birth rate will not yet be noticeable.

The total number of live births in a given year is the sum of all age-dependent fertility rates of women of reproductive age and represents the area under the curve that describes the distribution of births depending on the age of the mother. When developing the methodology, it was considered relevant the birth forecast is based exclusively on publicly available statistical data collected in Slovenia. Before starting the analysis, all publicly available data that could contribute to the accuracy and quality of the research, over the longest possible period, was collected. Due to the lack and non-uniformity of data on official statistical websites, the basic statistical analysis the time period between 1981 and 2019 was selected. For the mentioned period, we collected data on the population of the RS, according to gender and age, the number of live births, age-dependent female fertility and the total fertility rate.

The dynamic prediction of births and changes in the number of the population is based on the use of collected statistical data, whereby we used this data to predict the number of births of boys and girls. To calculate the birth rate, we used the distribution of age-dependent birth rates for women from 2019. We applied age-dependent birth rates to the number of women (according to their age) of reproductive age in the following year. The dynamic model is thus based on a matrix (100 x 100) designed for each sex, in which the number of born boys and girls moves diagonally over time (i.e. old). Based on considering the probability of death (in year n) and net migration in year n, the number of girls born in year n+1 is determined, thereby dynamically creating a new stock of mothers who, according to the default data on the fertility trend, give birth to new children in Slovenia. With the dynamic model, we can detect changes in the birth rate that occur due to past birth trends in Slovenia. In order to balance the statistical model for predicting population change over time, we also included mortality in the model. In the aging of the population, considered mortality according to the age of the population, which

is based on data obtained from Eurostat (EROPOP2019). Given that the EUROPOP2019 projections are much more optimistic than forecasts based on statistical data, we have adjusted the mortality calculation. Due to advances in science and technology, life expectancy can be expected to increase over time, which means that the probability of dying at a given age will most likely change over time. The number of deaths by age and gender was calculated from the number of living persons in a given calendar year, at a given age, which was determined from the matrix described above. To calculate the number of deaths at a given age, we used the probabilities of death according to age according to EUROPOP 2019. Data on net migration for Slovenia, which we included in the forecast model, were obtained from Eurostat (EUROPOP2019).

The design of a dynamic birth forecasting model enables the assessment of the impact of changes in policy (e.g. stimulation of the promotion of childbearing before the age of 25), on the final number of the population and important socio-economic indicators.

Review of statistics on factors affecting fertility

Size of households

The display of the dynamics changes of household sizes in the RS can indicate trends in changing birth rates. According to the data collected during the population censuses, the size of the household in Slovenia decreased by more than 20% between 1981 and 2018. The average number of children in all families (i.e. the total number of families with and without children) in Slovenia is generally declining slightly. In regions with a lower level of urbanization, worse labour market conditions, etc., the decline in the number of children in all families is more obvious.

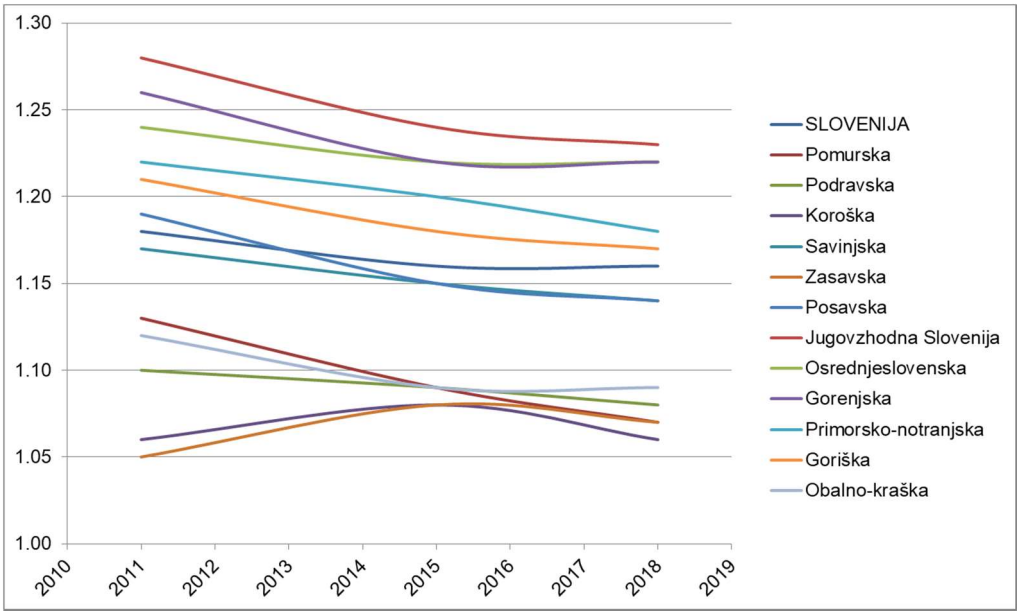


Figure 1: Average number of children in relation to the total number of families with and without children, by region.

The families in the Southeast region, followed by the Gorenjska, Osrednjeslovenska, Primorje-Notranjska and Goriška regions have the highest number of children. Average number of children in all families in Slovenia, is approximately 1.17 children per family. The smallest number of children in all families is in the Carinthia and Zasavska regions.

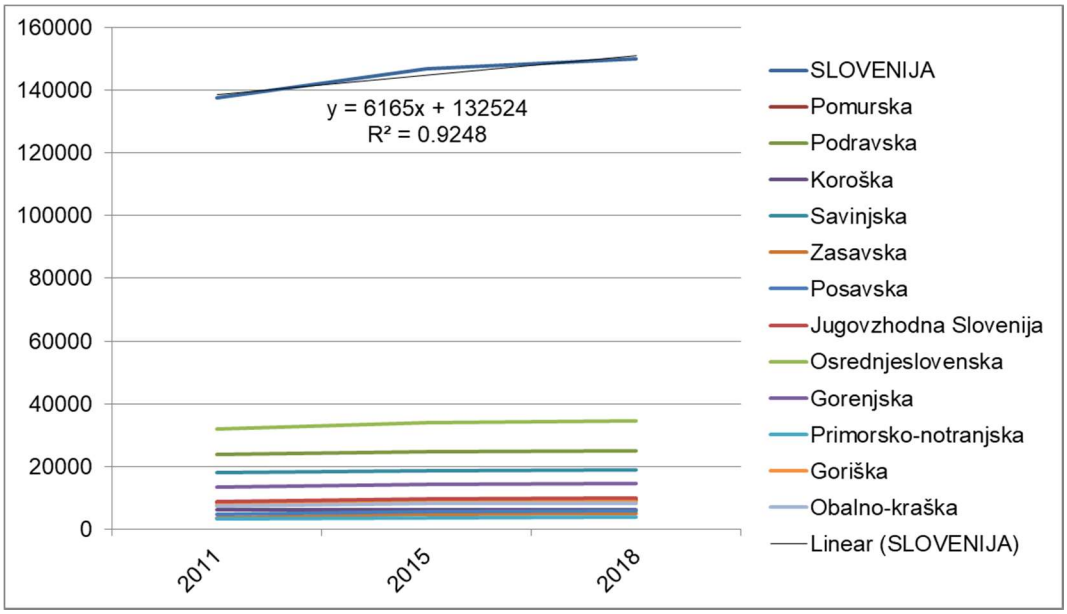


Figure 2: Display of the number of families without children in Slovenia, by region.

Moreover, the data indicate that the number of childless families in Slovenia is increasing. The fewest families without children are in the Primorje-Notranjska, Goriška and Posavina regions, while the largest number of families without children are in the Central Slovenian region.

In Carinthia, Pomurska and Posavina regions, the average number of children per family with children is decreasing. This means that, on average, women choose to have a smaller number of consecutive births. Given that the economic stability of young people is mainly influenced by the urbanization of the environment, which also depends on the presence of industry and service activities, the availability and number of vacancies, the mentioned regions are the least promising for young families. Therefore, it is not surprising that in recent years most young people or young families have moved from exposed regions.

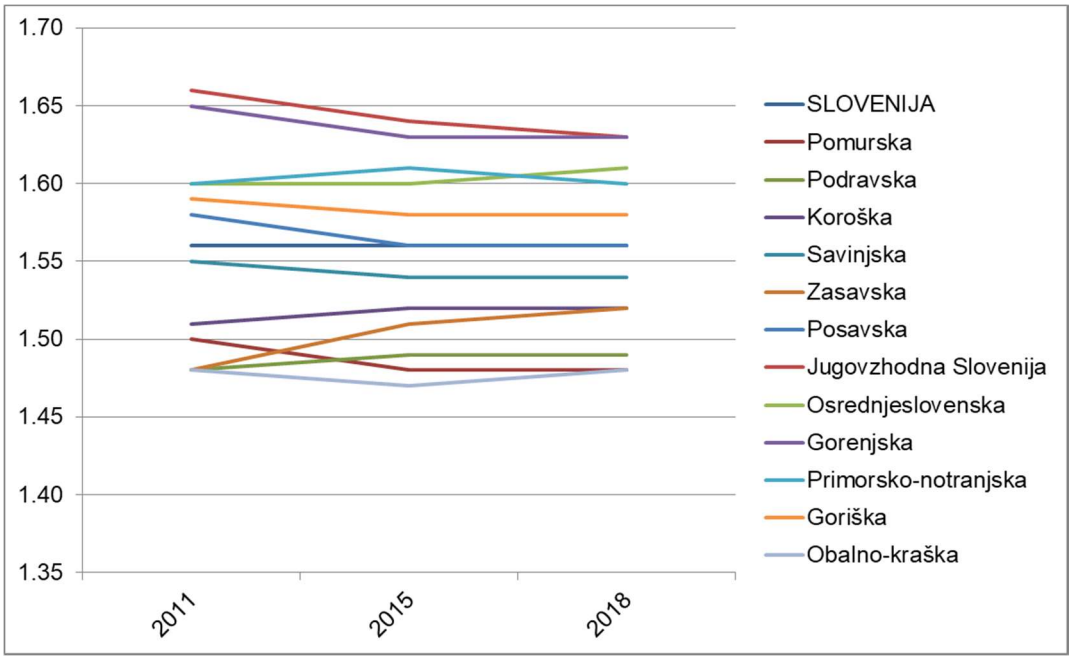


Figure 3:Display of the number of children per total number of families with children, by region.

Birth rate trend in Europe

According to Eurostat data, a decline in the birth rate has been observed in the wider area of the EU since 2008. According to 2003 data from the United Nations Population Division (DESA), the total fertility rate (hereafter CSR) needed to replace the current population is 2.1 children per woman of reproductive age. Since CSR is highly dependent on maternal and infant mortality rates, replacement CSR is higher in developing countries. In reality, however, the level of CSR required to maintain the population is higher, as it is necessary to take into account the higher probability of the birth of boys, as well as the probability of the premature death of a woman during childbearing age. To maintain the world's population, each woman of reproductive age would have to give birth to 2.33 children (Espenshade, Guzman & Westoff, 2003).

The age at which women decide to become mothers is of decisive importance for CSR. The older the mother's age at the first child, the less likely a woman will decide to have further pregnancies. The findings of Faddy and colleagues show that a woman's fertility declines with age. The period of optimal fertility is only until the early thirties, after which female fertility begins to decline significantly (Faddy et al, 1992). Although advances in medicine, especially with the technique of In Vitro fertilisation (IVF), allow women to become pregnant at an age of poor fertility, the probability of success of this procedure also decreases with age. After the age of 37, the probability of successful implantation of a fertilized egg and a healthy pregnancy significantly decreases, while at the same time the probability of a stillborn child increases (FIVNAT, 1993).

The total fertility rate of none of the Member States currently reaches the level necessary to maintain the size of the population. Individual countries, e.g. Romania, Slovakia, the Czech Republic and Hungary managed to stop the downward trend in birth rates. The average age of a mother at the birth of her first child is increasing throughout the extended EU area, which also includes the Balkan countries and Turkey. It is characteristic of countries that have stopped the trend of declining total birth rates that they keep the age of the mother at the birth of the first child under 30 years of age.

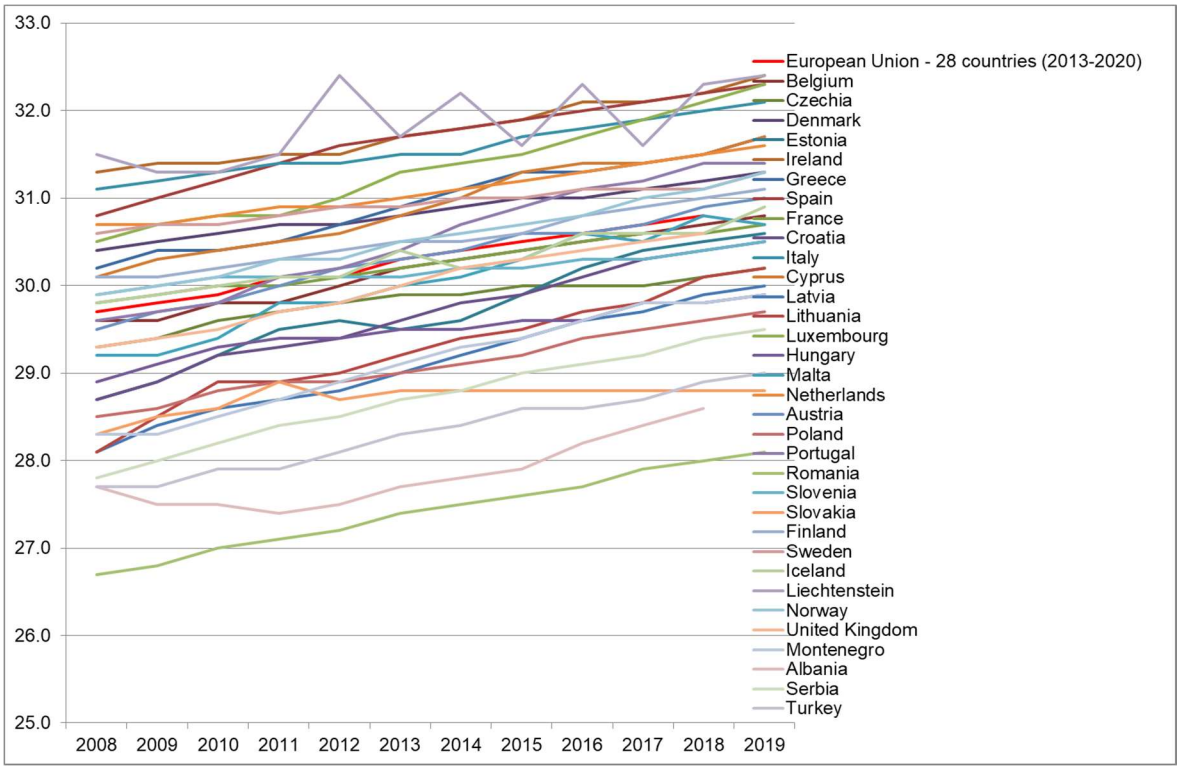


Figure 4: Maternal age per member state of European Union between 2008 and 2019.

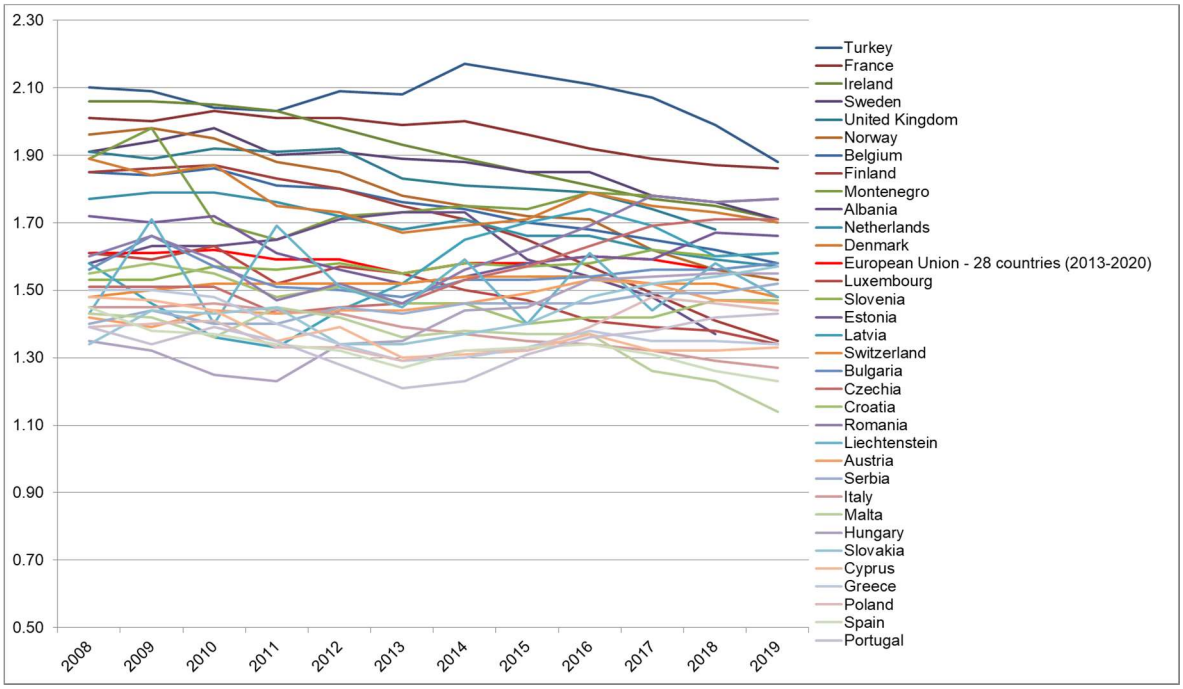


Figure 5: total birth rates per member state of European Union between 2008 and 2019.

Total birth rate

Between 1954 and 1988, an average of between 32,000 and 25,000 children were born annually in Slovenia. In 1954, a woman of reproductive age gave birth to 2.58 children on average. Until 1981, the CSR in Slovenia was higher than 2, which means that women on average gave birth to more than 2 children during their entire childbearing years. During this time, the overall birth rate in Slovenian territory still reached the level necessary for the maintenance or growth of the population. In the period before independence, the number of live births began to diminish. Between 1981 and 2003, a decline in the CSR was observed, with the lowest rate (1.20 children per woman of reproductive age) was recorded in 2003. In the period from 2004 onwards, the total birth rate increased, with the most obvious increase recorded between 2005 and 2008. In 2019, women gave birth to 1.61 children on average during their entire childbearing years. Since the turn of the millennium, the CSR has increased and currently stands at approximately 1.60 children per woman of reproductive age. The growth of the total birth rate, with a simultaneous decrease in the number of children, indicates that the proportion of women of childbearing age is decreasing.

In Slovenia, CSR certainly does not reach the level for maintaining the population. In a population where CSR is 2.0, the population is slowly declining. This means that for more than 25 years in Slovenia, we have not achieved the CSR that would allow maintaining or increasing the number of the population. The increase in the number of inhabitants in Slovenia, especially those in active years, is thus primarily the result of immigration from countries south and east of Slovenia, who immigrate for the possibility of a better standard of living.

In the article, the age-dependent birth rate from 2019 to predict the birth rate was used. This means that an unchanged CSR until the year 2100 was applied. However, CSR is more likely to change over time. If we assume that CSR changes will be the result of birth trends in the past, then we can also assume that in the future CSR will fluctuate in a similar way as the number of children born fluctuates. If we also accept the fact that the population of women of childbearing age will shrink due to demographic aging, the fluctuation of CSR will most closely resemble a damped fluctuation. Therefore, based on the assumptions, expected changes in CSR can be described using a mathematical model7. According to

the forecast, the CSR is expected to fluctuate, in line with the fluctuations in the number of girls born, but by 2100 the value would stabilize around the value of 1.5 children per woman of reproductive age.

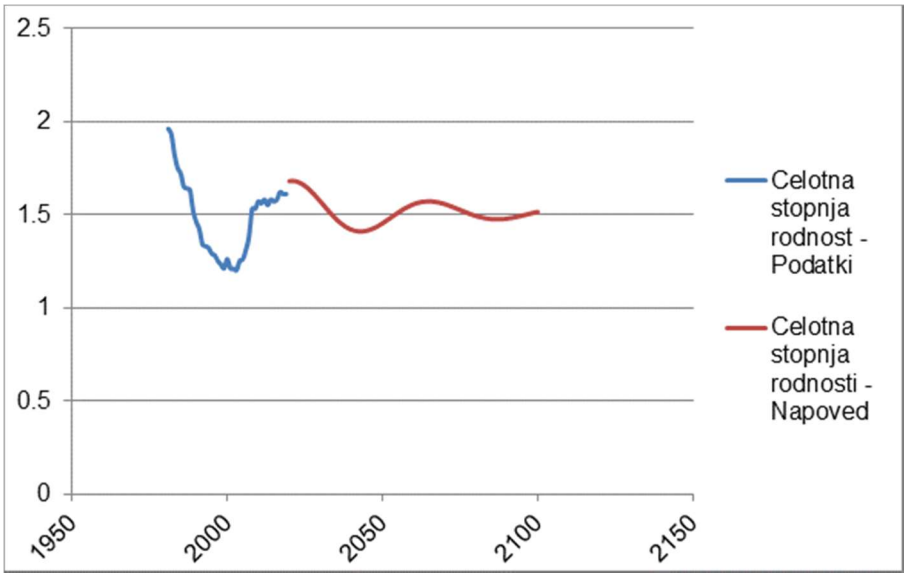


Figure 6: Total birth rate in Slovenia. The actual total birth rate is shown in blue, and in red the expected overall birth rate in Slovenia is shown.

Proportion of women who have given birth

Data on the proportion of women who have given birth for Slovenia show that among older women (age group 75 and over) more than 10% of women in their childbearing age did not give birth. The share of women in the younger generations who did not give birth in their childbearing age decreased by about 4%.

The difference suggests that advances in medicine along with new technologies (eg IVF) have almost halved the number of women who never give birth in their lifetime. The current number of women who do not give birth in their childbearing age consists of those women for whom modern approaches to infertility treatment are not successful, and those who do not decide to have a child due to other circumstances.

The share of women who gave birth to 4 or more children during their childbearing period is slowly growing in age groups over 50. This means that in the past, a larger proportion of women decided to have four or more children than in the present time. Considering that the problem of reduced birth rate cannot be solved simply by encouraging the birth rate of those women who do not have children, it is necessary to encourage women to give birth to more than one child during their childbearing period. In Slovenia, an average of 49% of mothers give birth for the first time in a calendar year. The percentage of women who give birth to their second child in a calendar year is around 37%, while only about 10% of women give birth to a third child.

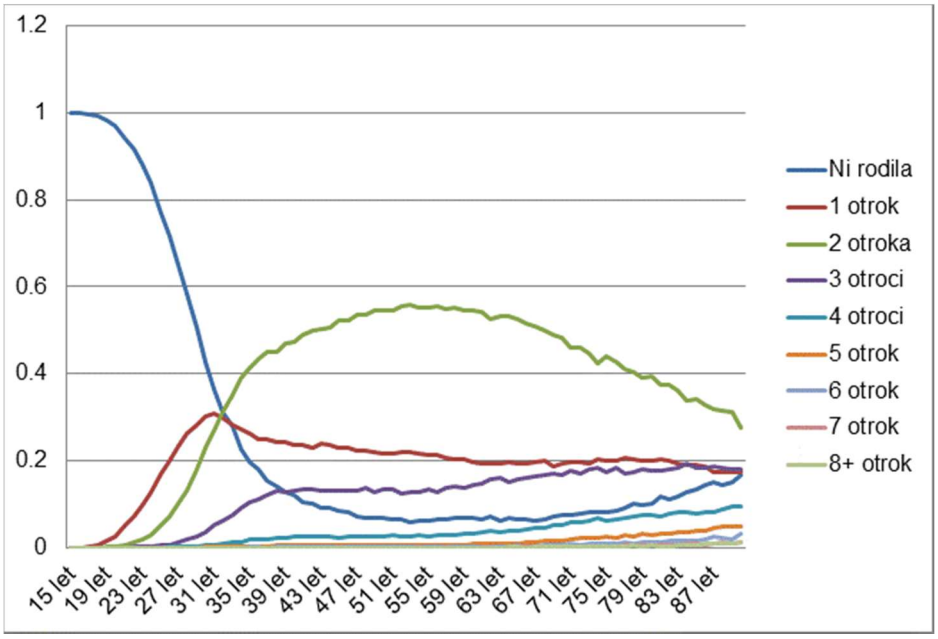


Figure 7: Share of women by age and number of children born.

UNDESA data from 2015 is more encouraging, showing an average birth rate of 2.5 children per woman of reproductive age. However, the rise in the birth rate does not reflect the true birth rate, which is highly heterogeneous and dependent on regional factors (UNDESA, 2015; UNDESA, 2017).

Data on the birth rate in Slovenia show that the birth trend has changed significantly in the last 25 years. Statistics from 1954 show that the average age of the mother at first birth was less than 25 years. The lowest average age of the mother for the birth of all children was recorded in 1980, when she was 22.9 years old. Insofar as women in the past decided to have their first pregnancy at a younger age, the average age of the mother at the time of the first child has been slowly increasing since 1990. In the 1990s, women gave birth to their first child at the age of 25, and their third at the age of 28. It is also clear from the available data that the age difference between the first and second, or second and third child is also decreasing.

In 2019, the average mother was just under 30 years old at the time of her first birth. The average age of the mother for all births was 28.4 years in 1954, which is almost 3 years less than in 2019. The curves showing the change in the average age of the mother at the first birth and all births are very similar in shape. Their difference shows that the time interval during which women give birth during their reproductive period is shorter. Currently, on average, women give birth to their first child at the age of twenty-nine or thirty, and their third at the age of 34. If the age difference between the first and second, or each subsequent child, was about 3 years in the past, it has been decreasing over the last twenty-five years. This means that women who decide to have a larger number of children give birth to them with a small age difference.

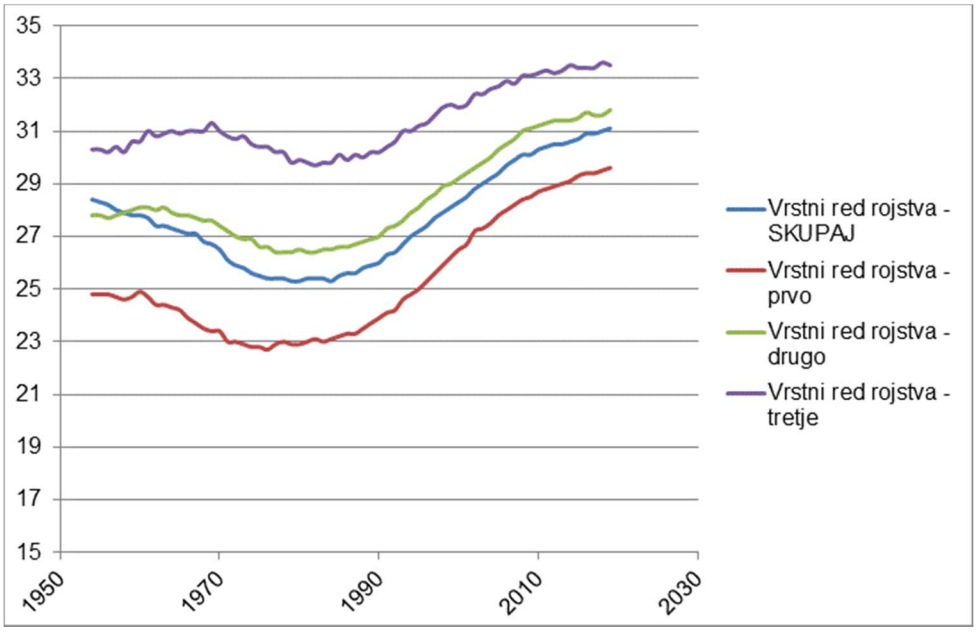


Figure 8:Age of the mother at the time of the child's birth according to the order of birth in Slovenia between 1954 and 2019.

Therefore, since women decide to have their first child later, the age interval between the births of the second and subsequent children decreases. As a result, the probability of having two or more children per woman in childbearing age also decreases due to the physiologically limited childbearing age.

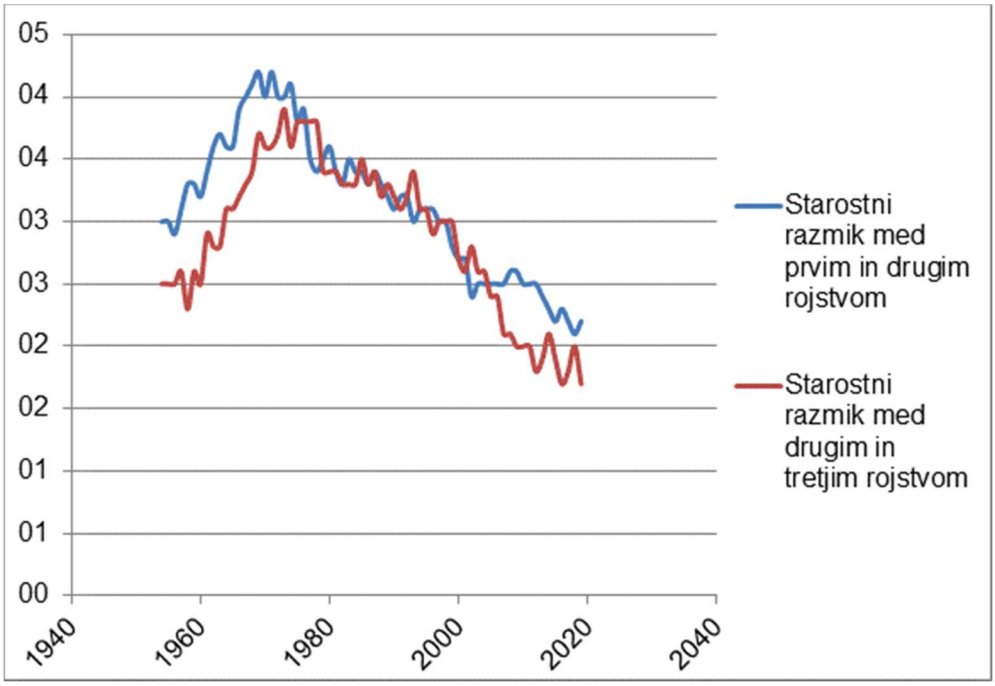


Figure 9: Age gap between first and second and second and third child.

Age-dependent fertility

The age-dependent birth rate tells how many children are born to 1,000 women at a given age. The shape of the curve, which describes the age-dependent birth rate in the entire childbearing age (14-50 years), has changed radically according to the data in Slovenia.

The peak of the age-dependent fertility distribution indicates the age at which women give birth to the largest number of children. The shift of the peak of the age-dependent birth rate to the right, in the period between 1981 and 2019, means that the average age of the mother for all births combined has increased. At the same time, the height of the age-dependent fertility peak also changed during this time, which means that the number of children that mothers give birth to on average also changed. The peak age-dependent birth rate for all births decreased after 1981, and reached its lowest value in 2001. However, from 2001 onwards, the peak age-dependent birth rate is increasing, which shows that the number of children born is also increasing 1000 women at the average age of the mother.

In the time period between 1981 and 2019, which we chose as the reference period, the shape of the age-dependent birth rate also changed. This means that the birth trend changed during this period. At the beginning of the reference period, age-dependent fertility had the form of a positively uneven distribution. This means that most of the data points (i.e. births) are centred to the left of the curve and the right tail is longer. Since the mass of births was accumulated to the left of the average age of the mother, in the past women therefore gave birth younger. In recent years, the age-dependent birth rate has become much more symmetrical, meaning that the mean, median and mode of age-dependent birth rates have similar values, i.e. most children, women are born around the calculated average age of the mother for all births.

The change in the age-dependent birth rate indicates a higher average age at which mothers give birth, and a decrease in the time interval in which women give birth. As a result, the probability of having two or more children per woman in childbearing age decreases due to the physiologically limited childbearing age.

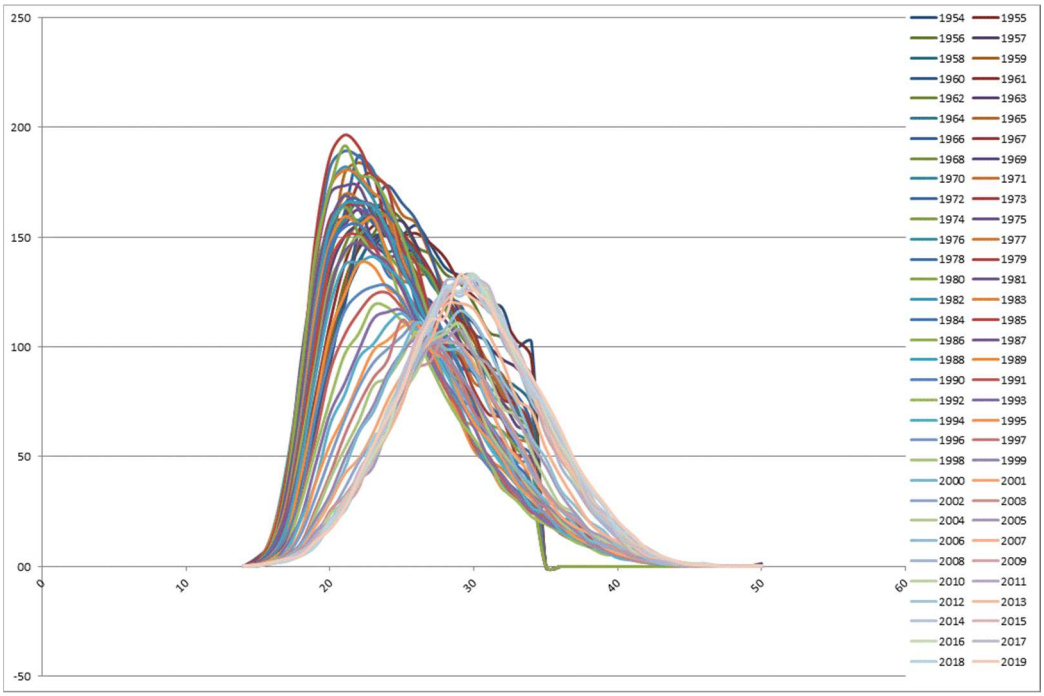


Figure 10: Age-dependent birth rate in Slovenia between 1954 and 2019.

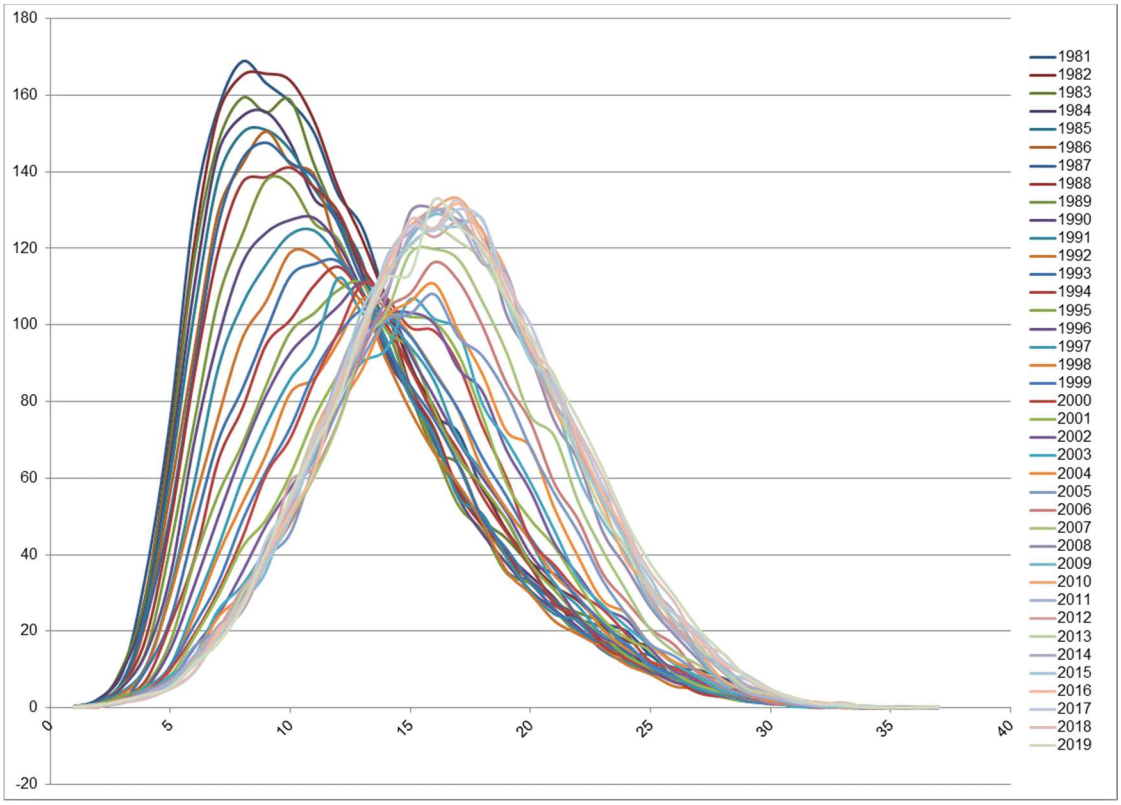


Figure 11: Age-dependent birth rate in Slovenia between 1981 and 2019.

The number of mothers

NIJZ states that more and more women decide to become mothers, but they give birth to fewer and fewer children (NIJZ, 2018). The largest share of mothers decides to have one or two children, which can also be seen from Figure 12.

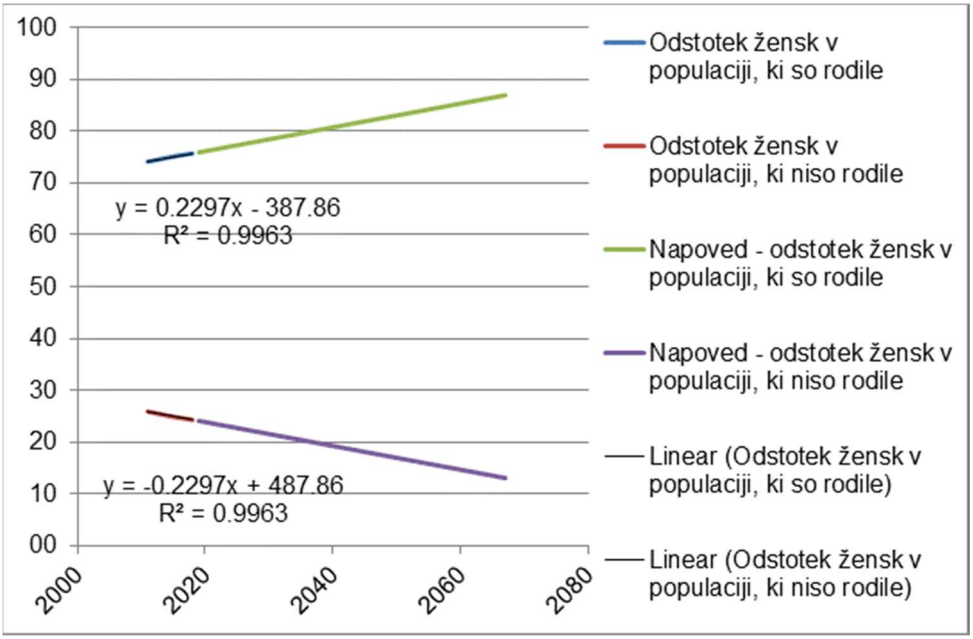


Figure 12: Linear model of the prediction of the percentage of women who will decide on motherhood in the future.

The data shows that in 2011 approximately 74.1% of all women gave birth, while in 2018 this percentage increased by just over 1.5%. According to the data, more and more women are deciding to become mothers in Slovenia, but they are giving birth later and fewer children in total.

The graph below shows the dependence of the proportion of women who decide on motherhood over time. While the number of women who choose motherhood is said to be increasing linearly over time, the number of women who do not give birth in their lifetime is decreasing linearly. Our analysis was limited by the availability of publicly available data. SORS only has recorded data from three non-consecutive years. Therefore, for a more accurate and reliable analysis, it would be necessary to obtain data for a longer period.

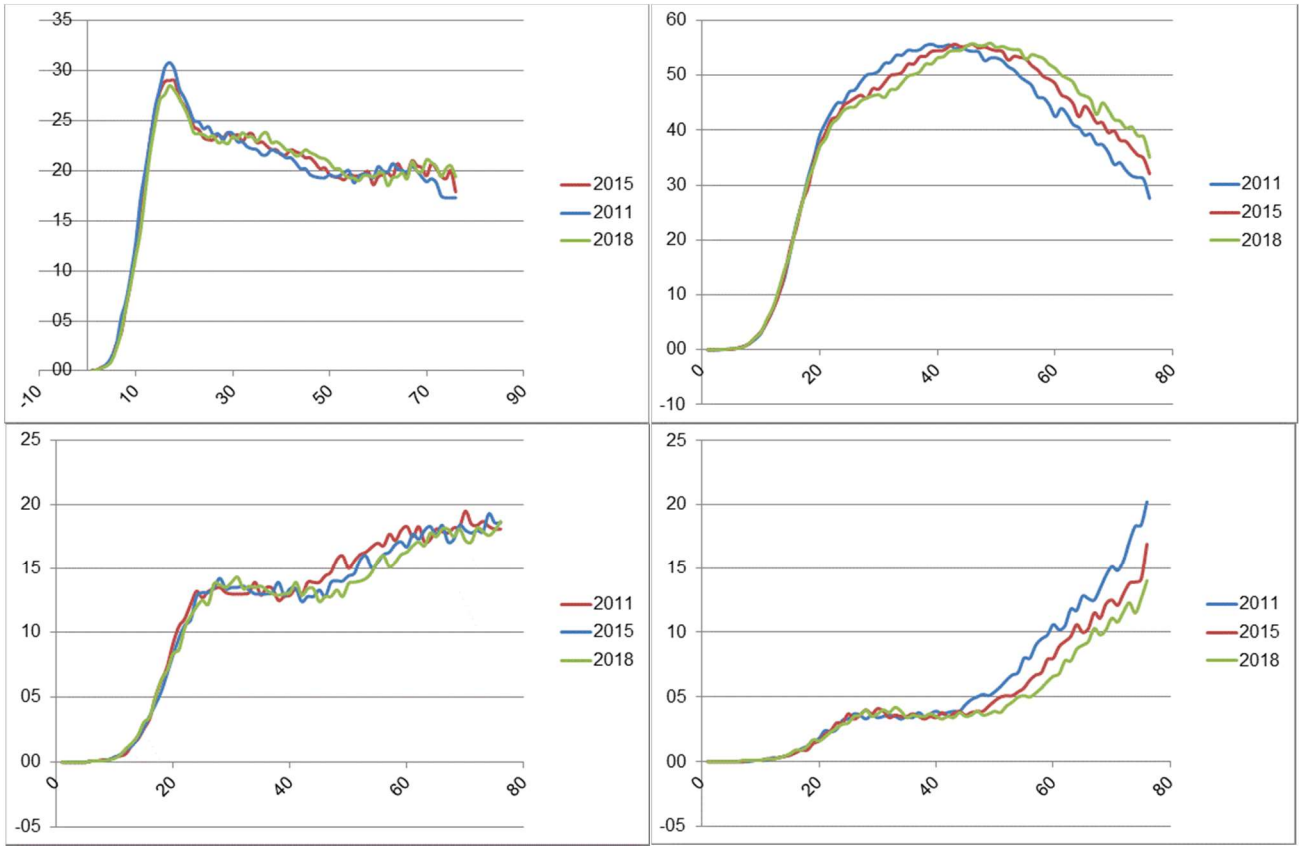


Figure 13: Share of women by age in Slovenia according to birth order. Top left - first birth, top right - second birth, bottom left – third birth, bottom right - fourth birth or higher birth.

Figure 13 shows the proportion of women in the population who gave birth to one, two, three and four or more children during their childbearing years. The biggest changes in the fertility trend can be seen in the graph showing the proportion of women who gave birth to four or more children during their childbearing years. The proportion of mothers who have four or more children in the population of younger generations of women is small and unchanged. Namely, approximately 4% of women under the age of 60 gave birth to 4 or more children during their childbearing years, with the proportion of mothers with many children increasing dramatically in older generations.

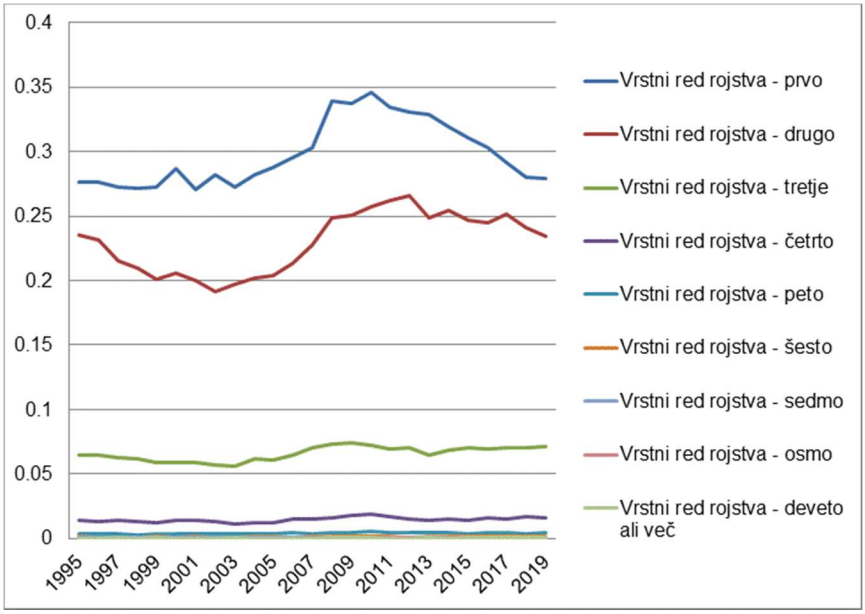


Figure 14: Share of women by order of birth in the period 1995 – 2019.

According to the data, the percentage of women of childbearing age who gave birth in a given year rose slowly from 2003 to 2009, after which growth stopped. Until 2019, there were no major changes in the number of women who decided to have a child. Figure 15 shows the number of births to mothers in a given age group in relation to education. The most children in a calendar year are born to mothers in the age group of 25-29 years who have acquired secondary professional or general education. They are followed by mothers between the ages of 30-34 who have obtained a second-level university education, i.e. master's study program or similar, and those with secondary professional or general education. However, statistics show that the number of children born to women between 25 and 34 years of age who have secondary higher education is falling. From 2012 to 2018 inclusive, the number of children born to mothers aged between 25 and 39 who had a first- or second-level university education was increasing. Women with a higher education in Slovenia therefore decide to become mothers later, after completing their education and securing a job.

In contrast to the data provided by the NIJZ, the analysis showed that in Slovenia, an unchanging number of women decide to have children, but they give birth to fewer children in their childbearing years.

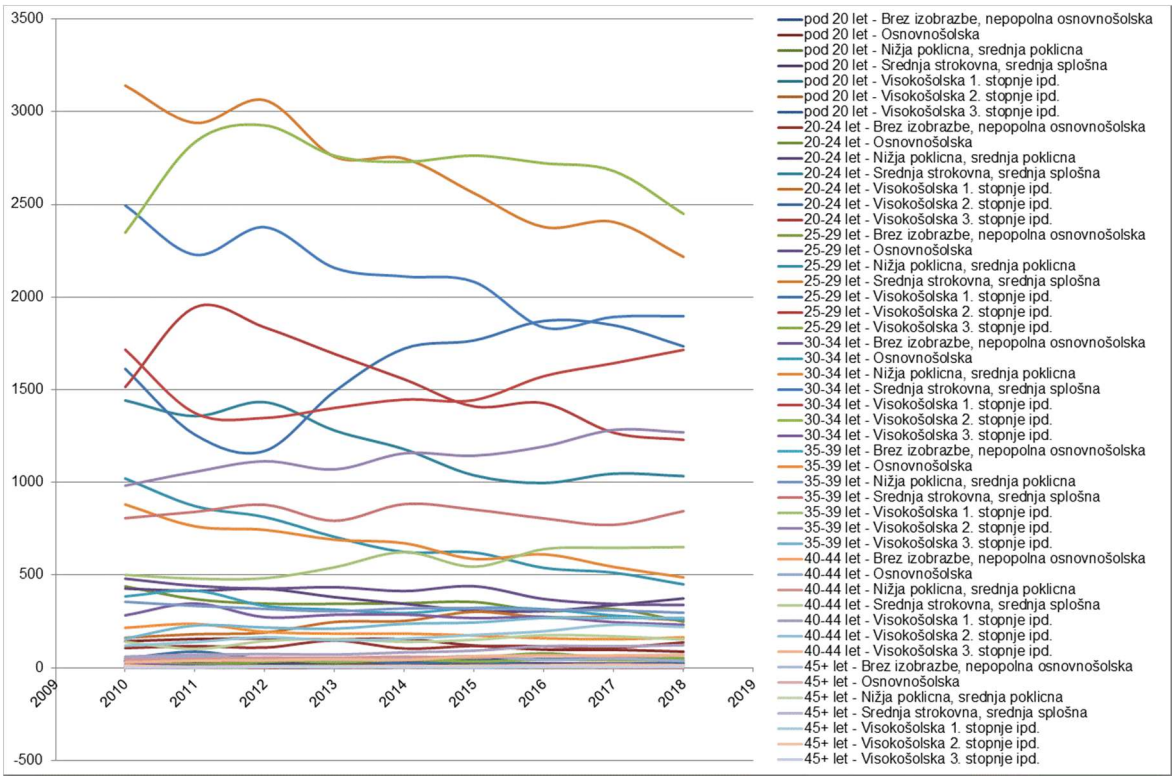


Figure 15: Number of children born to women in age group by education.

Dying

In order to maintain and renew the population, it is important that birth and death rates are balanced. When the death rate significantly exceeds the birth rate, the population begins to decline. With the demographic aging, the proportion of the elderly people is increasing. Although the general health of the elderly population is increasing due to advances in medicine and the general improvement of living conditions in recent years, mortality in the population over 65 is still much higher than in the younger active population. With age, the incidence of chronic and other diseases increases, while at the same time the body and health become more and more fragile.

The graph below shows the age at which we reach the maximum mortality as a function of time. The increased probability of death in the elderly is also confirmed by the graph of the number of deaths depending on age. The highest mortality is observed in newborns and in the population over 60 years. In general, the age at which we reach the peak of mortality increases with time, which is confirmed by the fact that life expectancy is increasing.

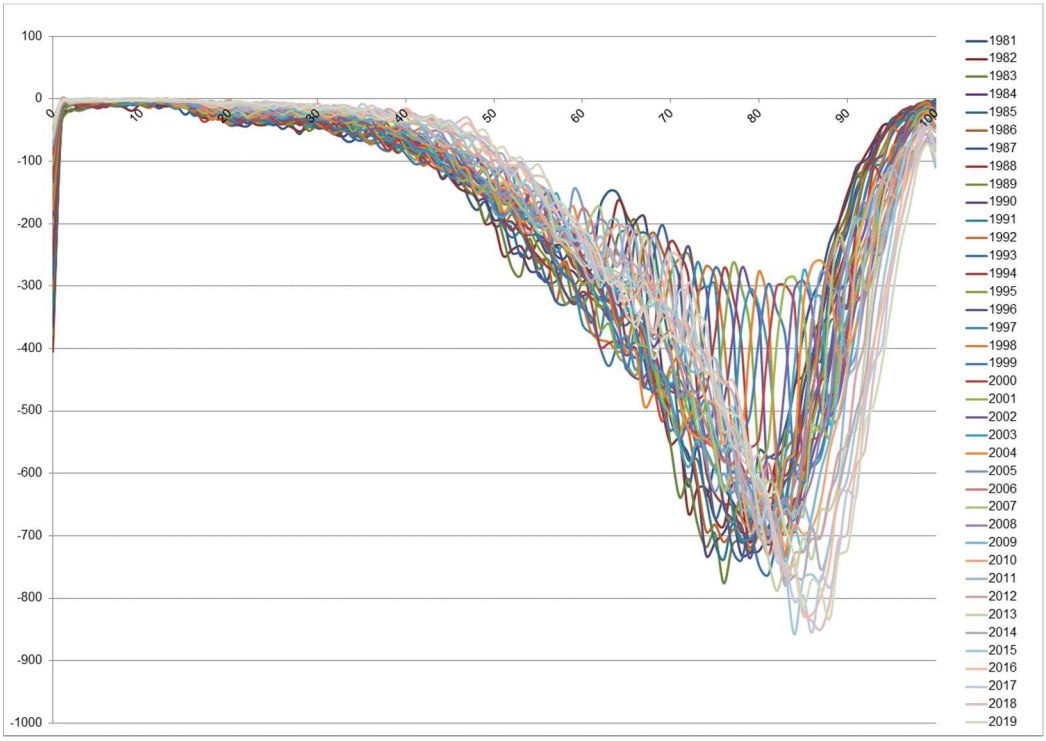


Figure 16: Probability of mortality by age between 1981 and 2019.

Migration

International relocations

The aging of the population is the result of a simultaneous increase in life expectancy and a gradual decrease in the birth rate. In the age of demographic aging, immigration is a way to increase the population of women of reproductive age, thereby improving the country's demographic potential and, in the long term, the rate of population renewal.

In the period 1995 – 2019, the population migration balance in the RS was positive. This means that more people immigrated to Slovenia from abroad than left during the same period. Due to international migration, the number of inhabitants of Slovenia increased by 118,000 in the period 1995 – 2019. In Slovenia, immigration largely depends on the structure of economic growth, as in the past it was believed that mainly younger men immigrated to Slovenia from the countries formed in the area of the former Yugoslavia, who were employed in the field of construction. Migration growth is strongly correlated with the country's economic growth. The higher the economic growth, the greater the need for labour force, and as a result the environment becomes more attractive for immigration. In Slovenia, the highest level of immigration was recorded during the period of high economic growth, while during the financial crisis, immigration fell sharply. Thus, the highest increase in migration occurred in the period before the economic crisis (2005 – 2009), when the annual increase in migration amounted to around 15 thousand inhabitants. A high increase in migration was also recorded in 2018 and 2019.

The data show that compared to men, a relatively small number of women immigrate to Slovenia. Although the largest share of women who immigrated to Slovenia between 2011 and 2019 were women up to the age of 45, only 6,820 of women between the ages of 15 and 49 immigrated to Slovenia during this period from abroad. In the same period, the total migration increase for men aged between 15 and 49 from abroad was 26,417.

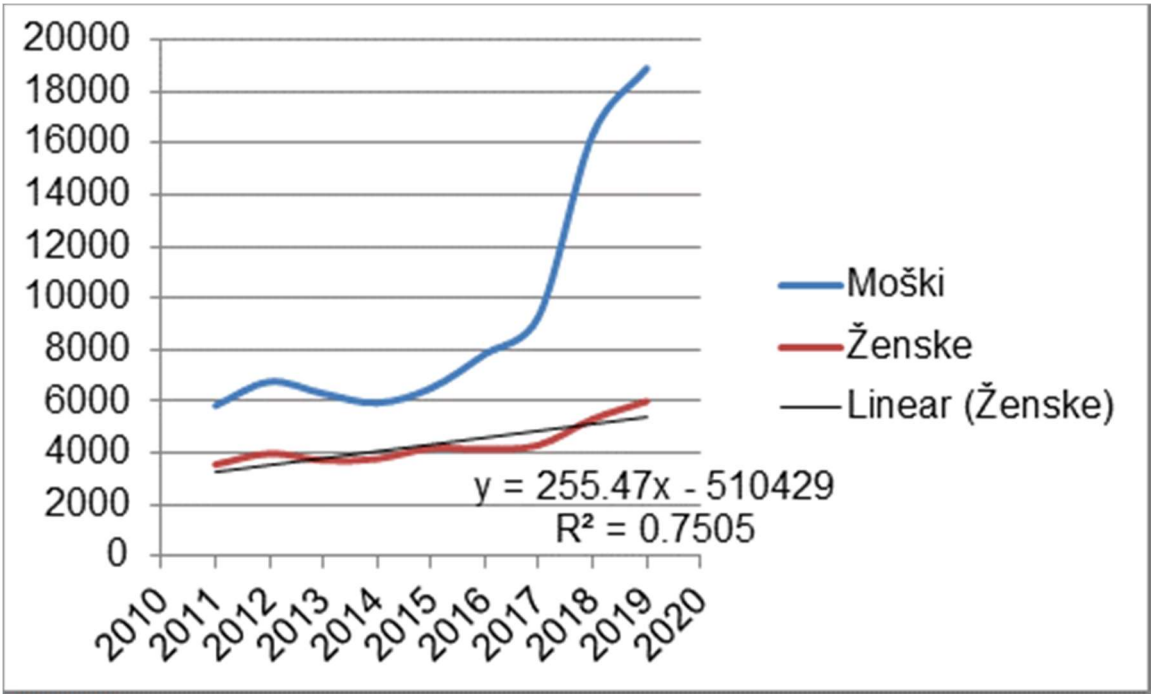


Figure 17: Trend of immigration to Slovenia between 2011 and 2019.

Interstate migration has a very strong influence on demographic changes, as the age structure of the resettled population is very specific. Younger, working-active residents migrate (both on the emigration and immigration side), either alone or with their entire family. The figure below shows the structural shares of immigration and emigrants by age group. The structure of immigrants to Slovenia is younger than the structure of emigrants, and a larger share of children who are included in the education system also immigrate.

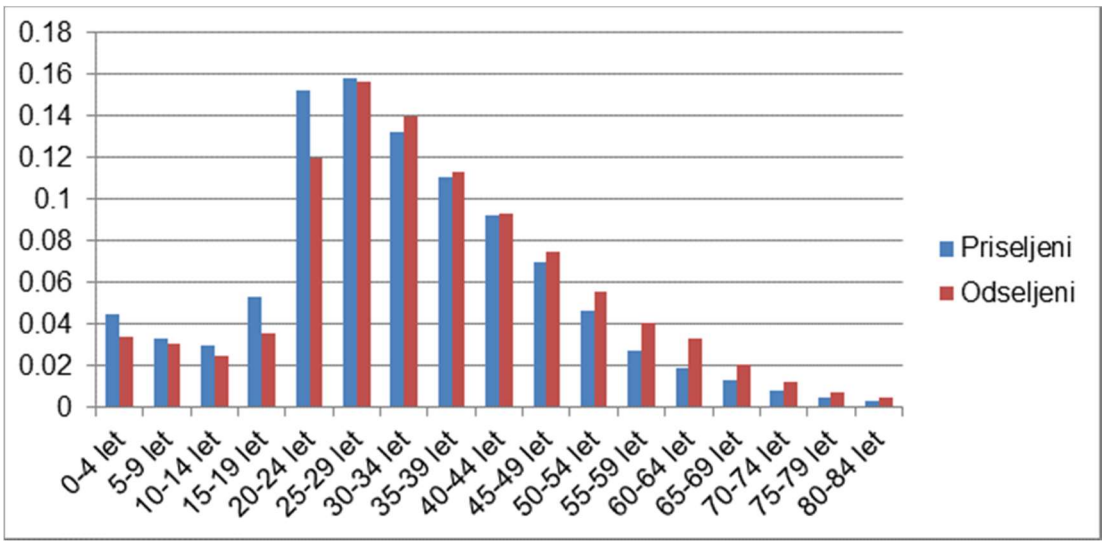


Figure 18: Age structure of international immigration and emigration at country level

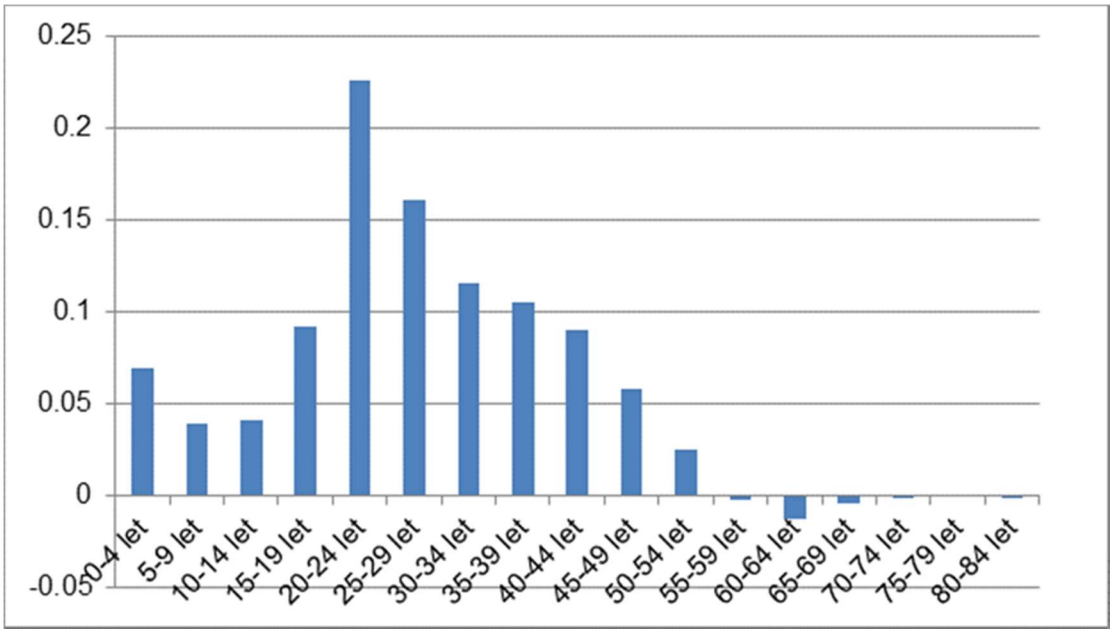


Figure 19: Age structure of inter-country migration growth at country level.

As the graphs below show, the age structure of immigrants changed in the period 2011-2019. After the financial and economic crisis, at a time of lower immigration levels, the age structure of immigrants was diverse. Since 2018, we have noticed that mainly young people between the ages of 15 and 44 are immigrating to Slovenia. Almost 75% of the increase in migration is represented by people under 35 years of age.

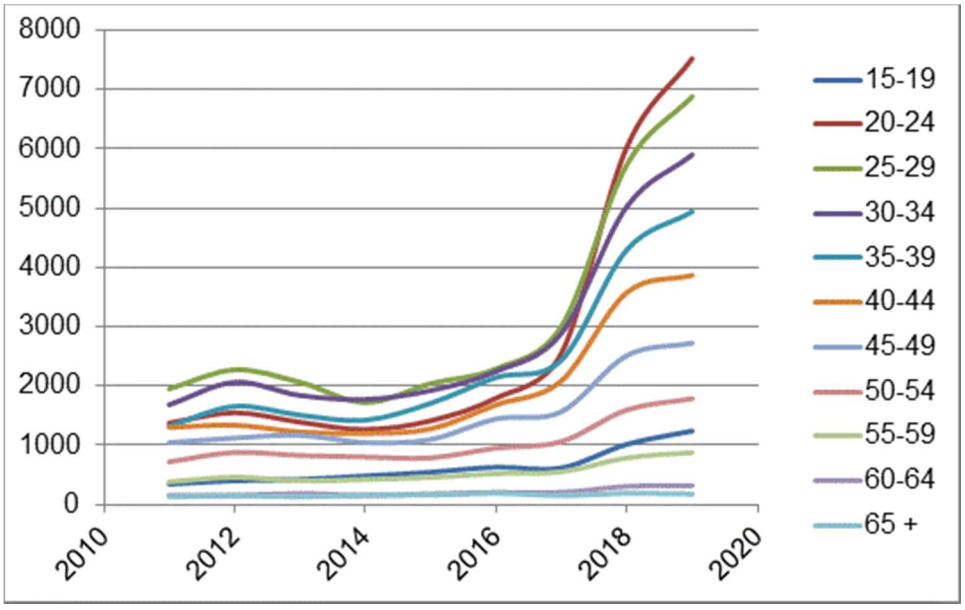


Figure 20: Number of immigrants by age group between 2011 and 2019.

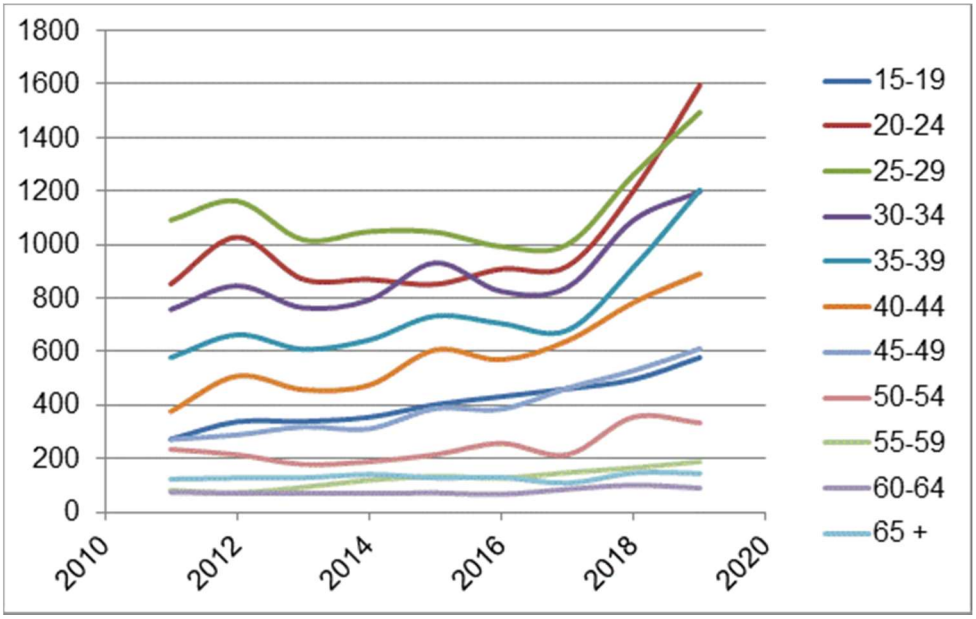


Figure 21: Composition of female immigrants by age group between 2011 and 2019.

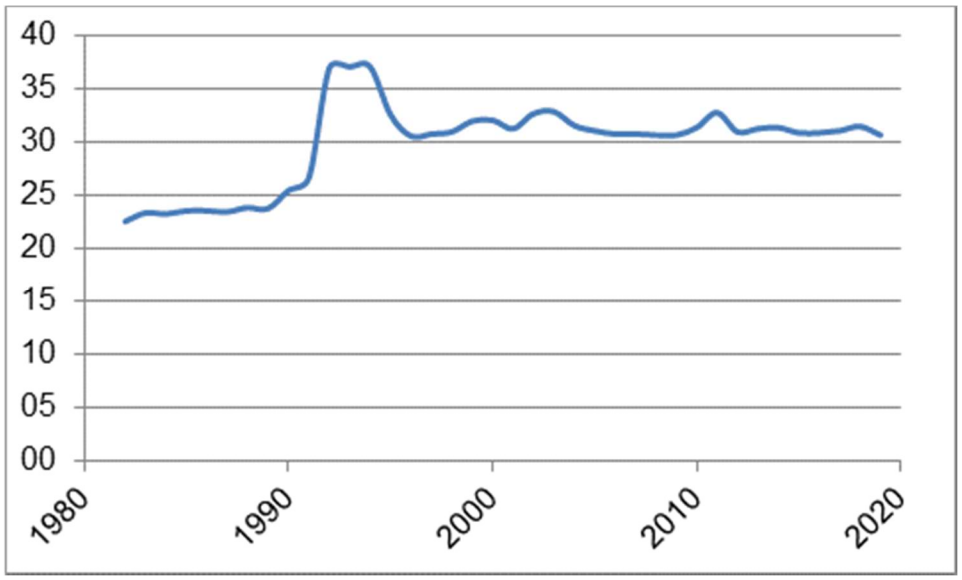


Figure 22: Average age of immigrants to Slovenia in the period between 1982 and 2019.

International migration is not evenly distributed across space. More attractive environments with greater job opportunities attract people from abroad, while environments where the economy develops more slowly lose competitiveness and, as a result, these areas become areas of emigration. At the level of Slovenian regions, the Coastal-Kraska region is the area of the largest international immigration, as the average increase in migration over the last 25 years was 4.6 per 1,000 inhabitants per year. For comparison, the Slovenian average is only 2.1 per 1,000 inhabitants per year. The Pomurska region represents the area where emigration to other countries is the strongest, as a result, the emigration increase in this region amounts to -0.7 per 1,000 inhabitants.

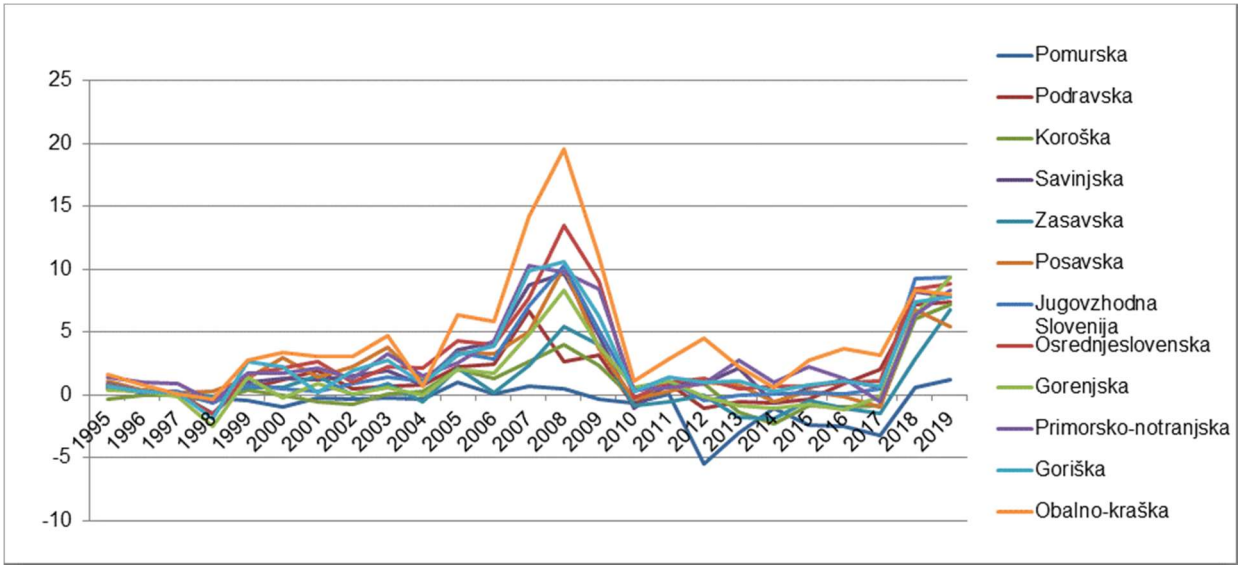


Figure 23: Migration increase with foreign countries at the level of regions.

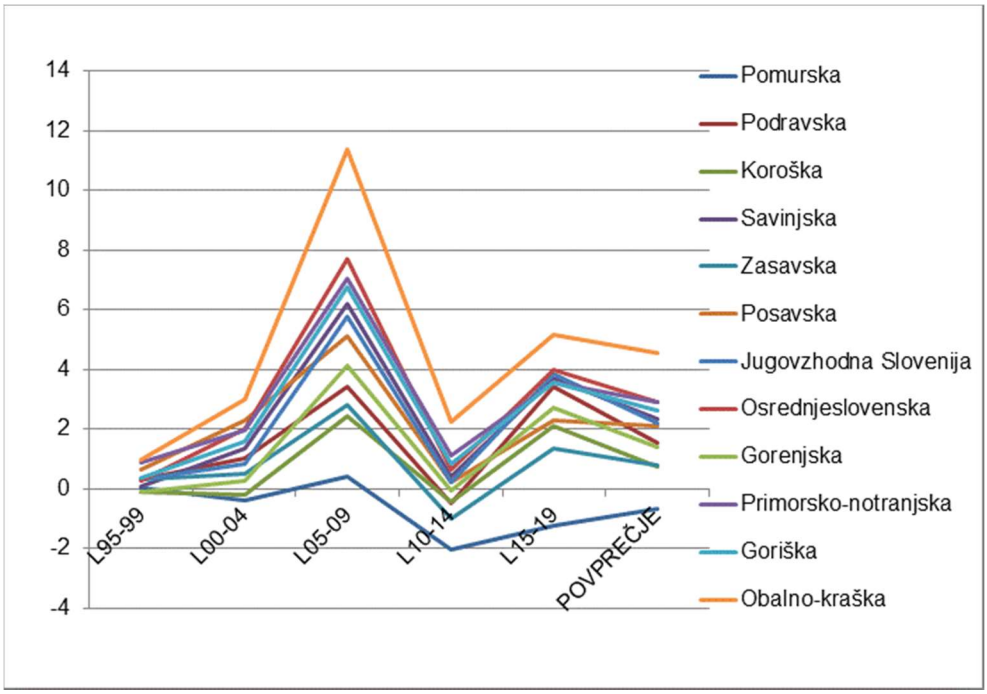


Figure 24: Migration growth with foreign countries at the country level (5-year averages).

The analysis of the 5-year average increase in migration from abroad at the national level shows that the increase in migration from abroad started to increase in 2000, with the highest level of immigration recorded between 2005 and 2009.

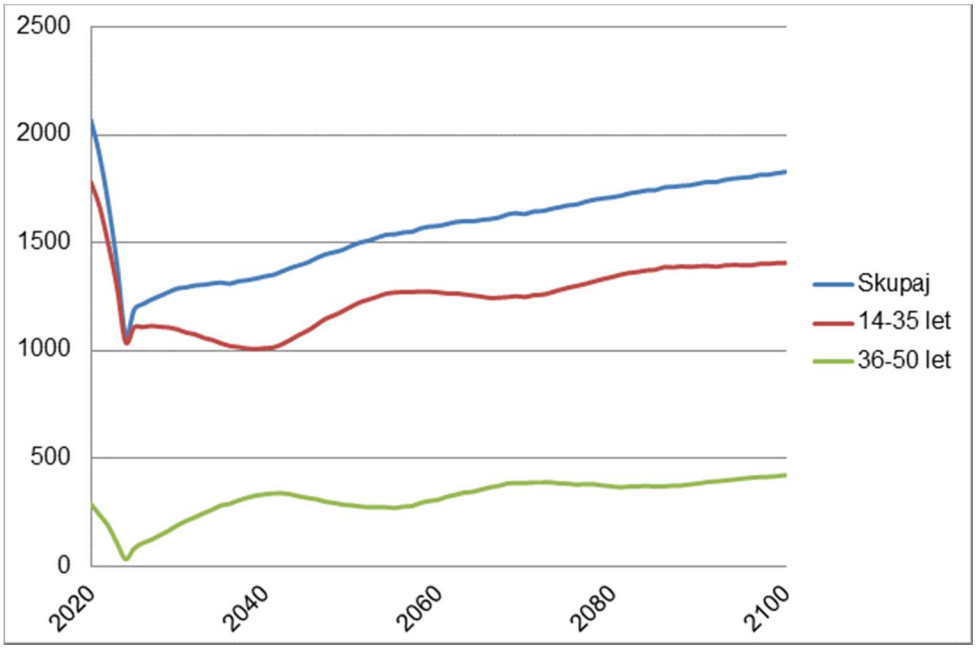


Figure 25: Prediction of the trend of female immigration to Slovenia according to Europop 2019, by age group.

Based on the data on the number of immigrant women in Slovenia between 2011 and 2019, we can conclude that the number will increase. However, the global pandemic has largely curtailed all travel, and consequently had the same negative impact on international migration as well. During the

pandemic, many immigrants decided to return to their country of origin, or they postponed moving from their country of origin.

In addition to the impact on the movement of people, the pandemic will also have consequences on the economy, especially in industries that employ women who immigrate to Slovenia. According to data from 2011, foreigners in Slovenia are employed mainly in the field of construction (61%), in the logistics-transportation, trade and tourism-catering sector (14%), and in the basic processing of raw materials and materials (17%). The graph below shows the number of women who immigrated to Slovenia between 2011 and 2019, according to their education. The largest share of immigrant women is represented by persons with a primary school education, although the share of those with a secondary school education has been increasing since 2017. Although the largest share of male immigrants is employed in the fields of construction and manufacturing industry (e.g. metal industry, etc.), women are employed mainly in the field of tourism and catering, as well as in the care and health sector. Therefore, the coronavirus disease pandemic could have long-term consequences for available jobs, especially in the field of tourism and hospitality, and thus also affect the immigration of women. A smaller volume of inter-state migration will have consequences in the field of birth rates in Slovenia.

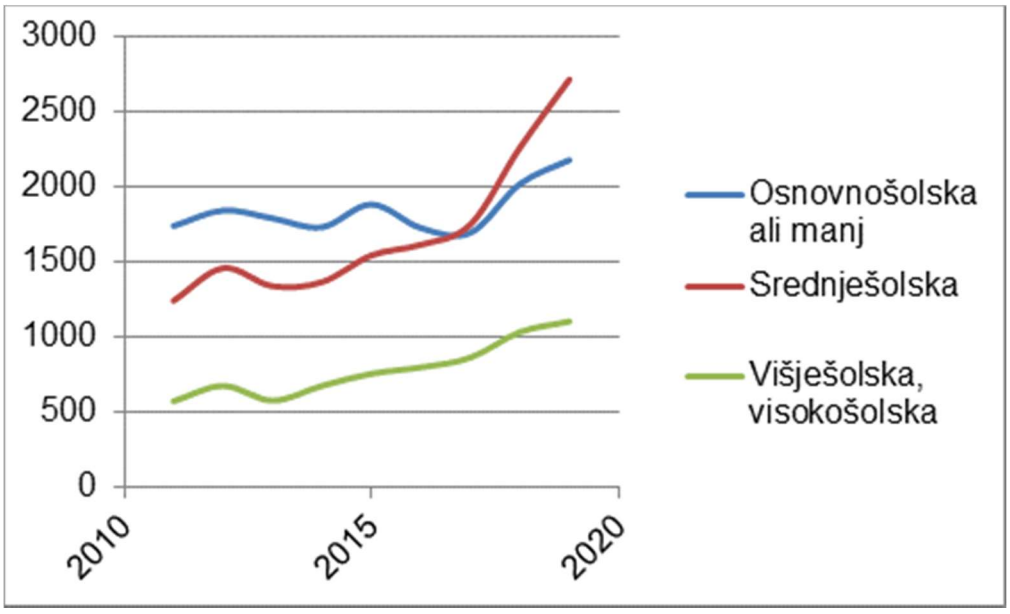


Figure 26: The number of women immigrating to Slovenia between 2011 and 2019, according to the education obtained.

Eurostat's base scenario introduces the concept of active population as an expression of the economic potential of individual countries, relative to the entire population. A comparison of the number of the population by European countries shows that the population of working age may decrease, despite the overall increase in the population in each country. Due to the reduced size of the working-age population, there is also a reduction in the country's potential economic power.

Vitality of the population as a category is understood as an improved quality of life due to a different lifestyle, even in later years, or as an improvement in the quality of life and an extension of the active age due to the progress of medicine (which is reflected in the ability to work). The vitality of the population represents the ratio between the time of the year when we can work and the time when we are unable to work due to illness or injury.

If vitality is assumed as social consumption, the performance of the population represents active residents in the creation of new value and their average age as an indicator of its change. The performance of the population is therefore understood as the working capacity of the population in the

active age, reduced by absence from work due to illness or injury. Performance is, therefore, a function of working conditions and the efficiency of the health system.

Since the vitality of the population depends on healthcare at the level of the individual, as well as the health care system, the latter also introduces a criterion for health care into the model. By introducing performance, the economic potential and the share of available resources for providing for the population are defined. Both categories are a function of the size of the age groups of the population and their state of health and are also reflected in the various needs that form the environment or conditions for the life and functioning of the population. The following shows the impact of changes in vitality and performance in Slovenia on healthcare, the housing stock, the demand for kindergartens and the needs for school locations and capacities.

The impact of migration on long-term demographic change

Migration flows between countries are the main reason for the increase in the population of several European countries. The driving force behind immigration is the expected better life, which is also reflected in the greater emigration of the population in countries east and south of Europe.

Although the number will increase in the future in most European countries, less than half of European countries show (assuming current productivity) productivity gains. This means that the problem of the necessary economic development to ensure the means of subsistence will become even more acute. Countries in which the performance will decrease will have to meet the increase in the needs of the population due to aging and the shrinking share of the active population through additional measures, e.g. extension of working life, increased productivity, innovation, new technologies, etc.

Demography of Slovenia

The base scenario of demographic development according to Eurostat 2015 initially shows a slight increase in the population until 2025, and then a slight decrease in the total number of inhabitants of Slovenia in 2067. At the same time, the structure of the population is changing significantly, especially in terms of the ratio between elderly and active residents, and it is evident also a greater difference between the elderly population by gender. A look at the spatial distribution shows a preservation or even increase in the number of residents along the highway intersection with simultaneous aging, while the remaining areas are aging and emptying at the same time.

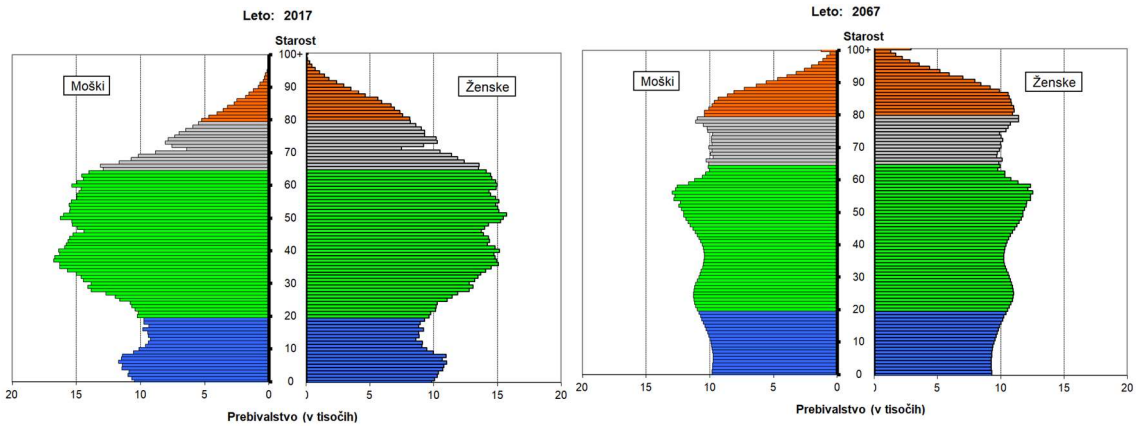


Figure 27: Age pyramids by gender for the years 2017 and 2067 (Eurostat's base scenario and inter-municipal migrations in the past period are taken into account).

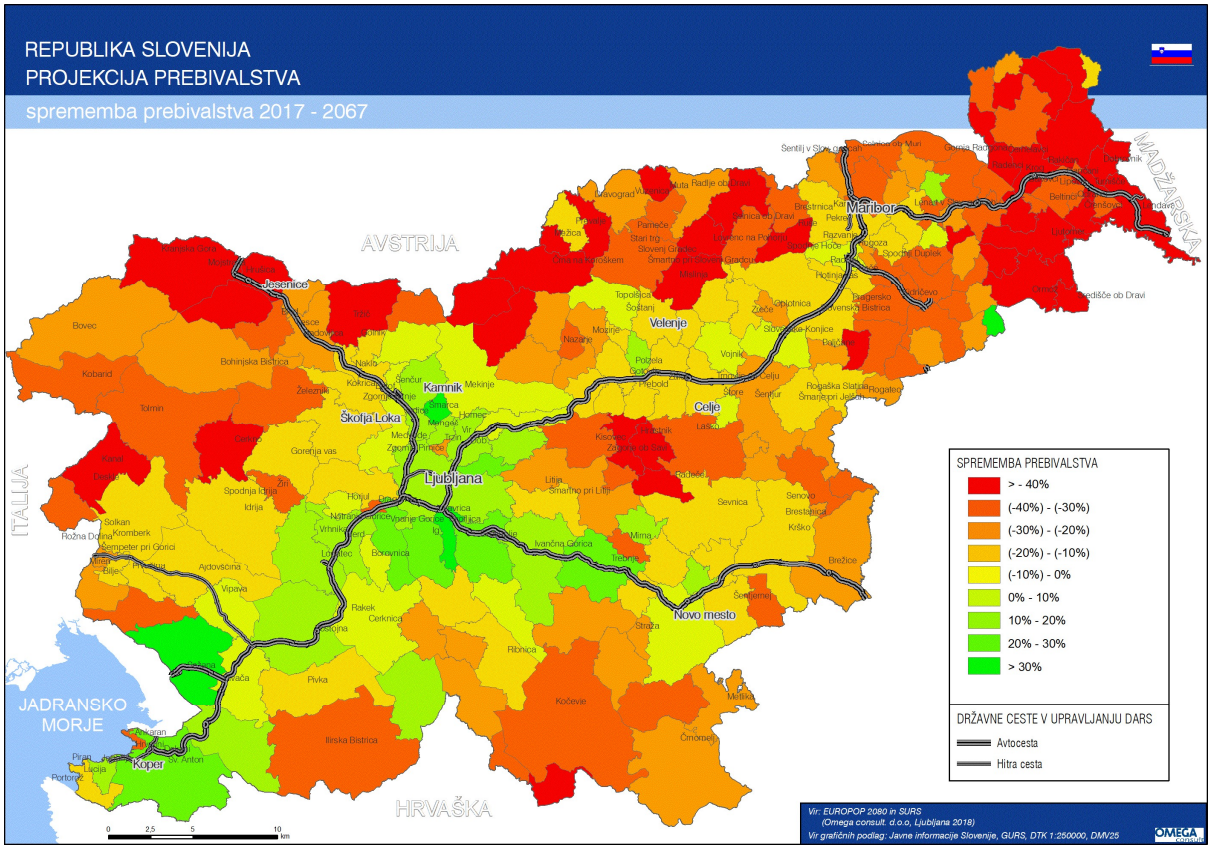


Figure 28: Increase and decrease in the number of inhabitants by municipality in the period 2017 – 2067.

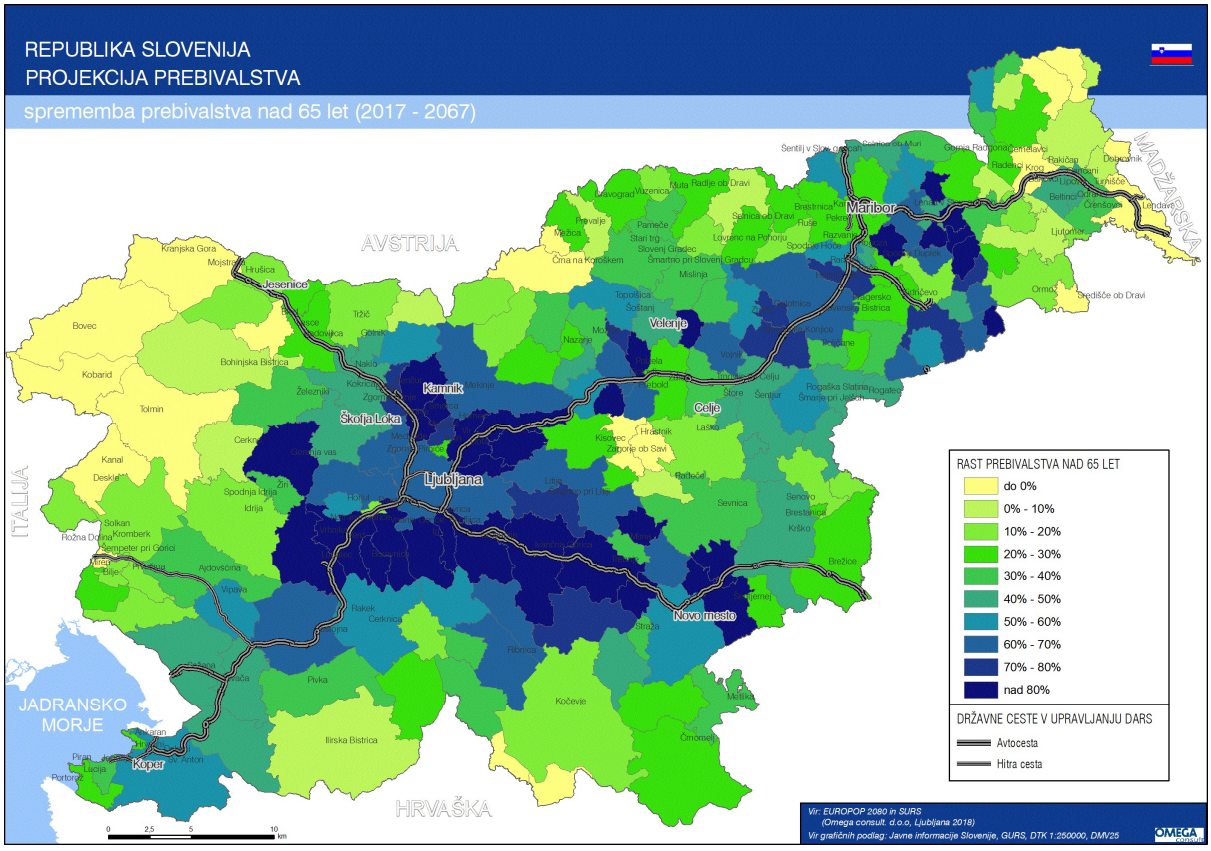


Figure 29: Growth of the population over 65 by municipality in the period 2017 – 2067.

The consequences of demographic changes are also reflected in a different pattern of illness in the population, leading to changed needs for health services. The starting point for the analysis is the state of health in 2017 (last published incidence statistics, NIJZ), which is compared with the target year 2067. The difference between the incidences shows what demands the healthcare system in Slovenia will face in the future.

Model of birth and death

Birth and death

The number of inhabitants in a population is determined by two processes - births and deaths. At the same time as these two processes, there is also the process of aging of the population. Longer life expectancy is directly related to advances in medicine and better living conditions.

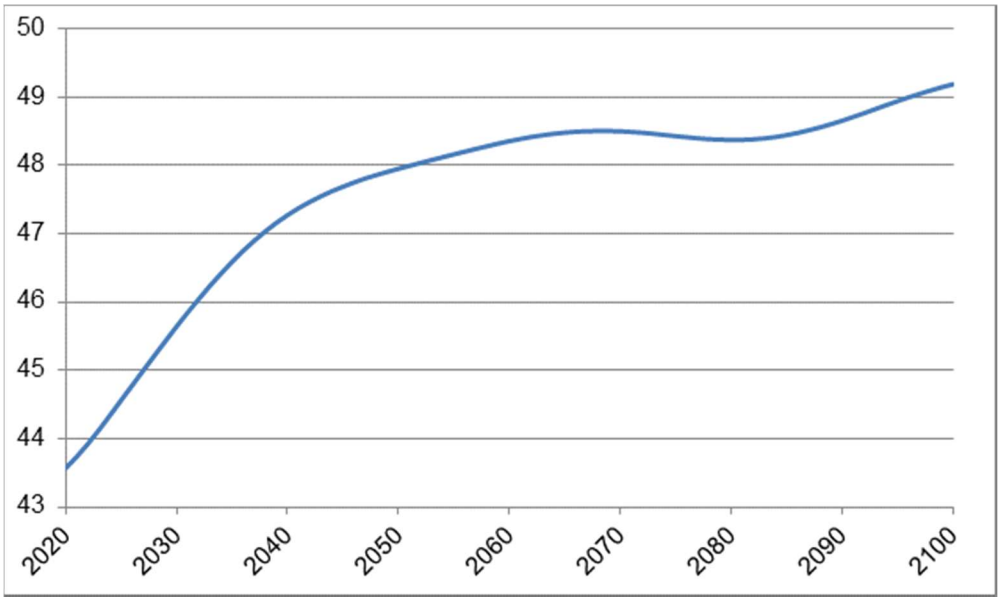


Figure 30: Display of the increase in the average age of the population of the Republic of Slovenia, according to a statistical model for predicting changes in the number and composition of the population.

According to the statistical forecast model, the average age of the population in the RS will rise to more than 49 years. A larger proportion of elderly people in the population increases mortality, as the incidence of severe chronic and other diseases increases with age. Estimates show that by 2050, the population in Europe is expected to decrease by as much as 40 million (Kupiszewski & Kupiszewska, 2010). The demographic aging of the population also affects the ability to bear children in the population, as demographic aging also reduces the number of women of childbearing age.

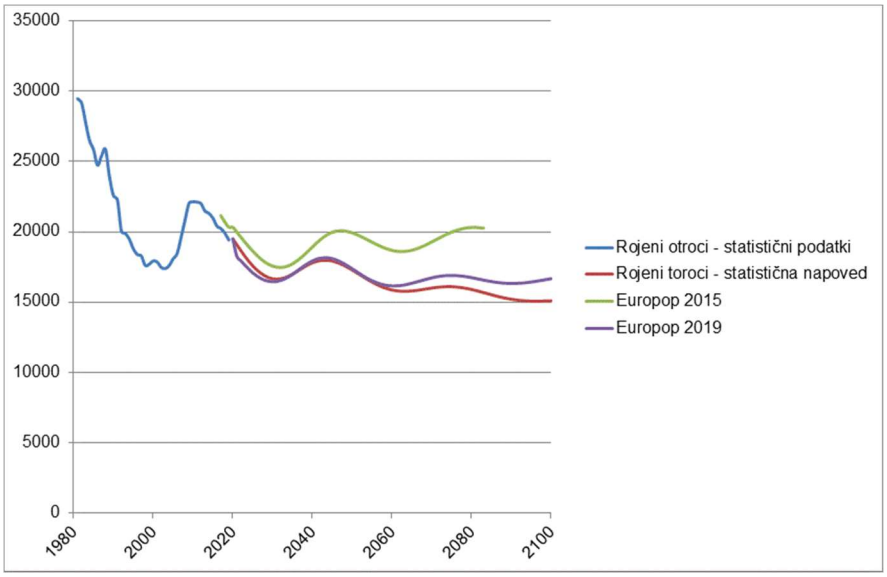


Figure 31: Number of births in Slovenia between 1981 and 2019, and projections of births between 2020 and 2100.

The statistical model for predicting births, in which we adopt the base scenario of death and immigration, shows that the number of boys and girls born will decrease during the observation period (i.e. 2020 – 2100). According to the statistical forecast, the decline in births will be greater than projected by EUROPOP. One of the assumptions on which the EUROPOP projections are based predicts the growth of CSR, which is not in accordance with the statistical data related to the dynamics of births observed in the RS over the last 20 years.

Because according to the forecasts, the number of children born decreases, the entire population in the territory of the Republic of Slovenia will also begin to decrease over time. Namely, the statistical model shows that in the year 2100, according to the base scenario of death and immigration, the population will comprise just over 1.85 million inhabitants. This means that the entire population, compared to the base year of 2019, will decrease by more than 11%. If the demographic aging of the population were to follow the scenario of basal mortality and the scenario of a low level of immigration, according to the statistical model, we can expect a reduction of the population by more than 20 percentage points.

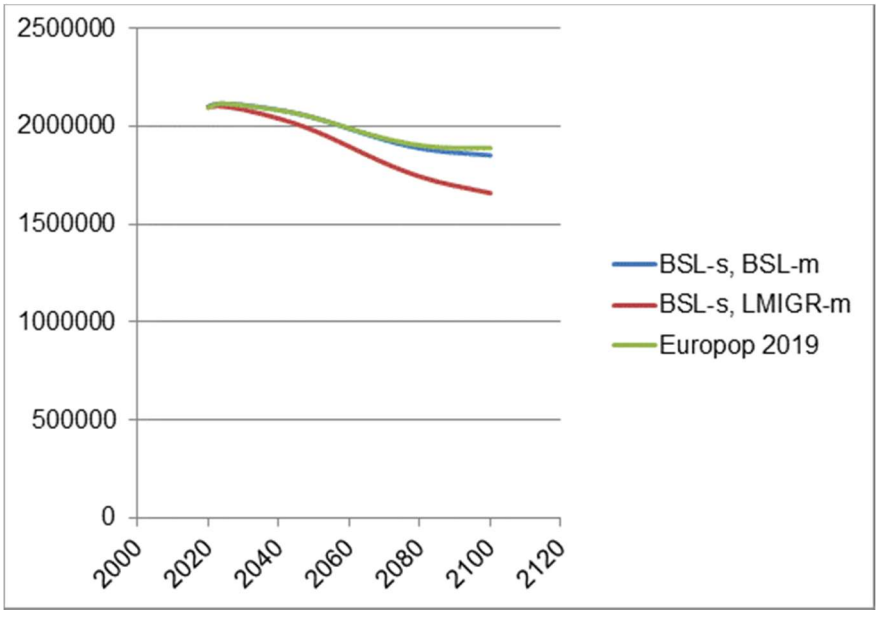


Figure 32: Illustration of the change in the size of the entire population according to a statistical model that takes into account two different immigration scenarios (base scenario - blue line and low-level immigration scenario - red line), and the projection of Europop 2019 according to the base scenario of death and immigration.

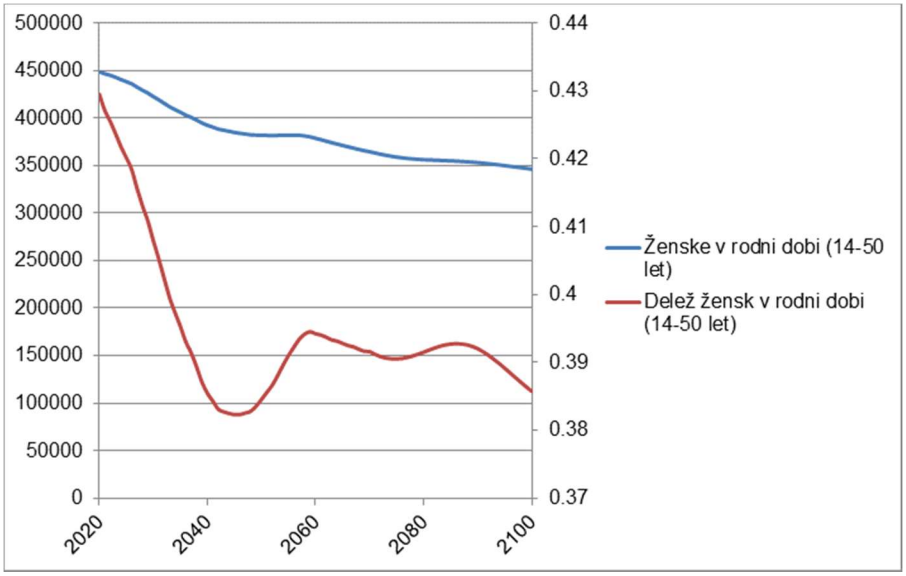


Figure 33: Display of changes in the number and share of women of reproductive age (14-50 years) over time.

The statistical model predicts that until the year 2100 the number of women of reproductive age, i.e. between 14 and 50 years of age, declining. In 2045, the share of women between the ages of 14 and 50 in the population of all women will be the smallest, namely 38%. The share of women of reproductive age will then, due to the gradual reduction of the population to 65, increase slightly, but its value will remain below 40%.

According to the statistical model, the percentage of women giving birth in a calendar year will increase by 0.002 percentage points annually. Meanwhile, EUROPOP 2015 and 2019 projections predict at least a fourfold annual increase in the ratio of births to women of reproductive age.

The figure showing the indicative model of births and deaths shows that the trend of deaths in Slovenia will not be balanced by births, so the population will decline and age.

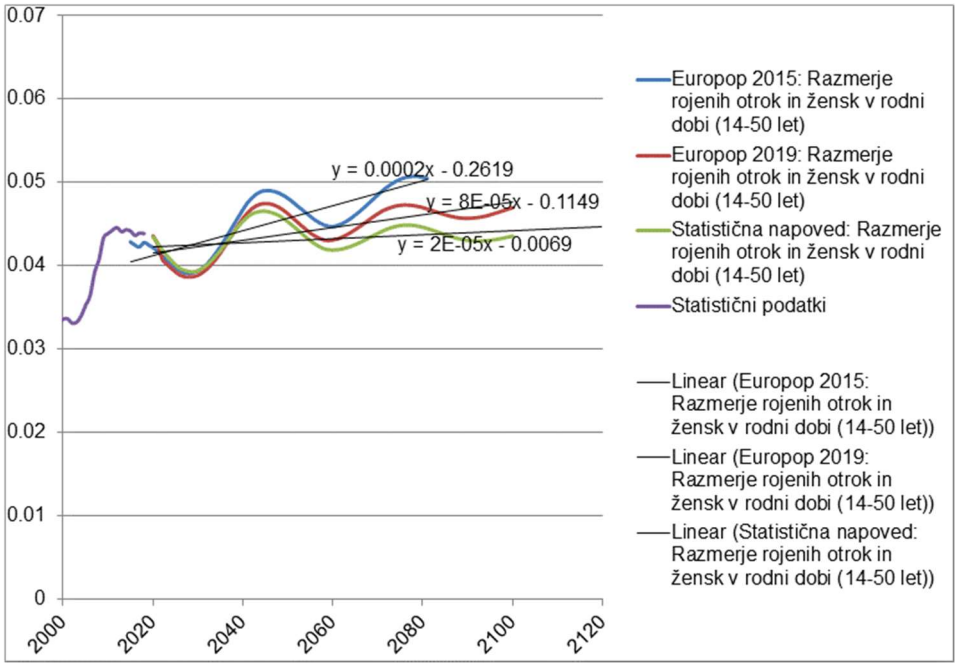


Figure 34: Relationship between the number of children born and the number of women of reproductive age (14-50 years).

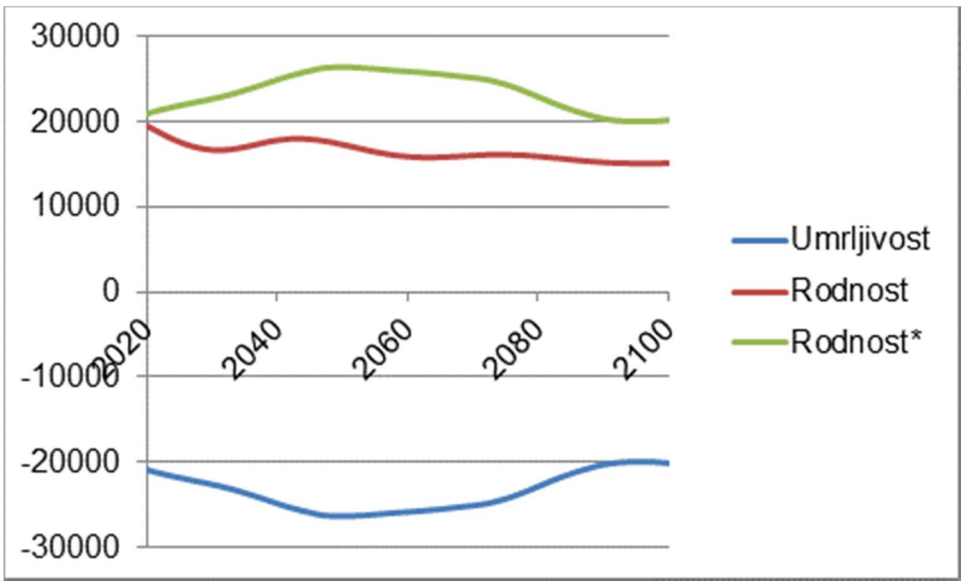


*Figure 35: Indicative model of birth and death; * the green birth curve shows the birth trend needed to equalize the death trend.*

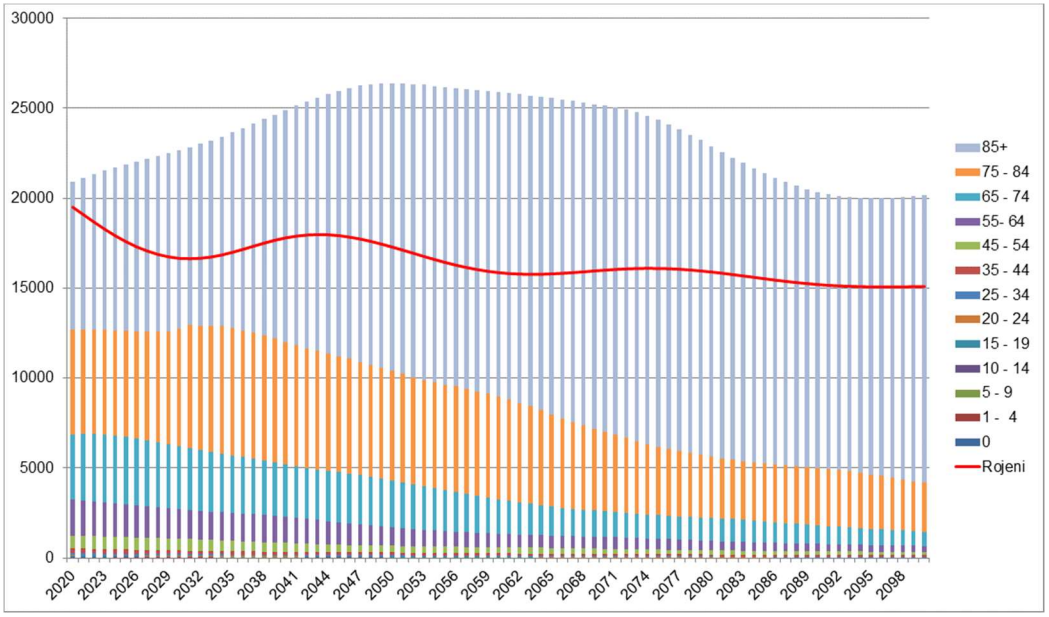


Figure 36: Number of deaths by age predicted by a statistical model of changes in the number and composition of the population.

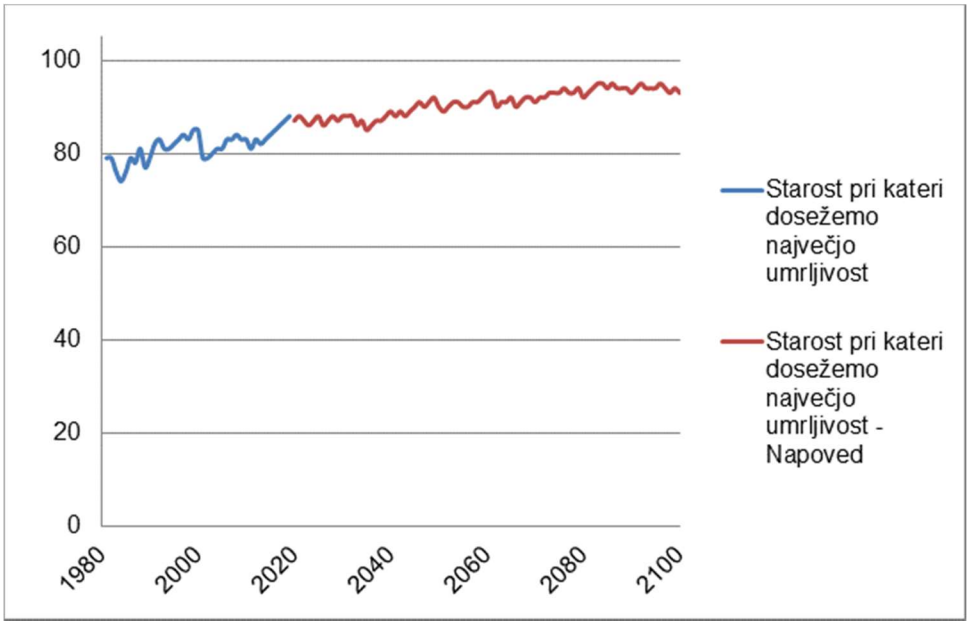


Figure 37: Change in average life expectancy based on determining the age at which the maximum mortality rate is reached.

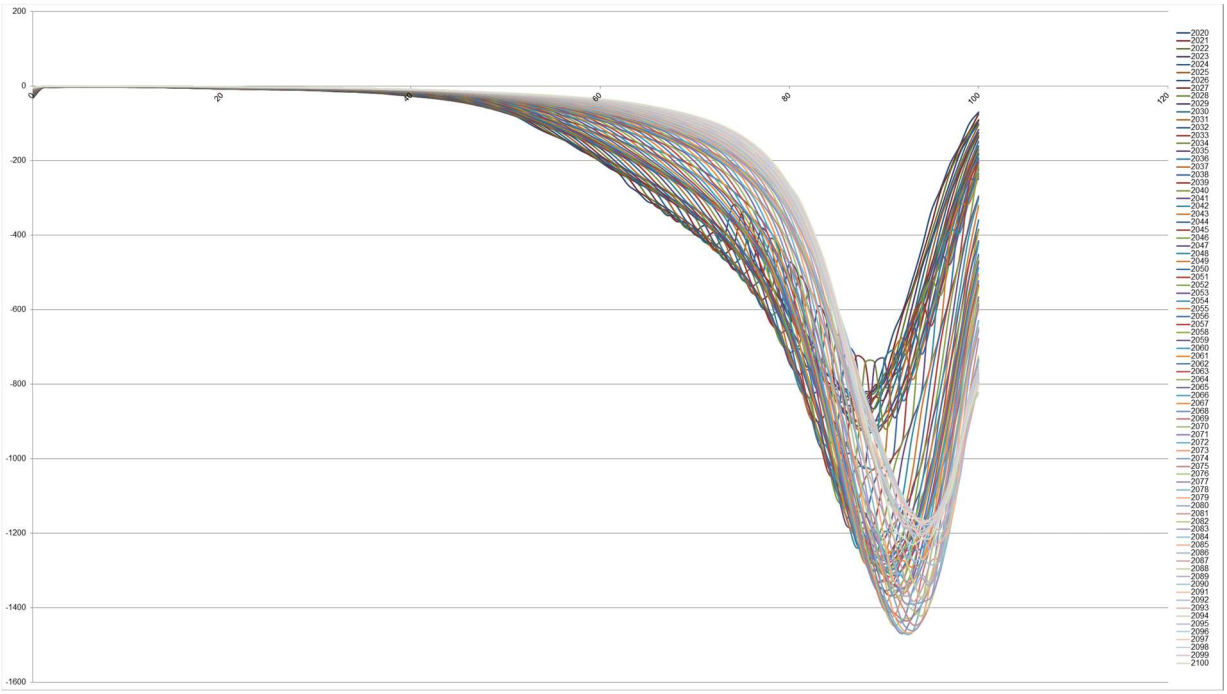


Figure 38: Age-dependent mortality rate in Slovenia between 2020 and 2100, determined by a statistical model of changes in the number and composition of the population.

With the statistical model of birth, we can also predict the number and composition of the population over time. However, when the probability of death at a given age is also included in the model, we can also determine the mortality rate according to age and gender. The analysis is based on the probability of death by sex and age, according to EUROPOP2019, which is applied to the number of living men or women at a given age (i.e. the total number of births or living, and net immigration). The figure shows the number of deaths over time, by age group. According to forecasts, the number of deaths in all age groups, except for the over-85 age group, is expected to decline. The total number of deaths per calendar year is expected to stabilize at about 20,000 by 2100.

Demographic potential

Demographic potential is an important concept in predicting changes in population structure that can be expected. Demographic potential depends on the current age and gender composition of the population and reflects past demographic events. Since the birth rate is physiologically limited by age only in women, the demographic potential depends mainly on the proportion of women of reproductive age, i.e. number of women between 14 and 50 years of age. A more favourable demographic potential is characteristic of populations with a greater number of younger women on whom CSR depends. Data on the number of women in Slovenia show that the number of women of childbearing age increased in the period between 1981 and 1997, when there were the most women of childbearing age in Slovenia.

After 1997, the number of women began to decline, and it should be emphasized that the downward trend continues. Fertility forecasts, which consider fertility trends from 2019 and are based on actual statistical data on the composition of the population of Slovenia, show that the number of women of reproductive age will decline until the year 2100.

From 1997 to 2019, the share of women of childbearing age in relation to the total number of women in Slovenia also declined. In 1981, more than 52% of women in Slovenia were between 14 and 50 years old. In 38 years, the share of young women decreased by about 17%. As the graph shows, the decline in the proportion of women of childbearing age is expected to stabilize after 2020. During this period, the proportion of women of reproductive age in Slovenia will be approximately 39%.

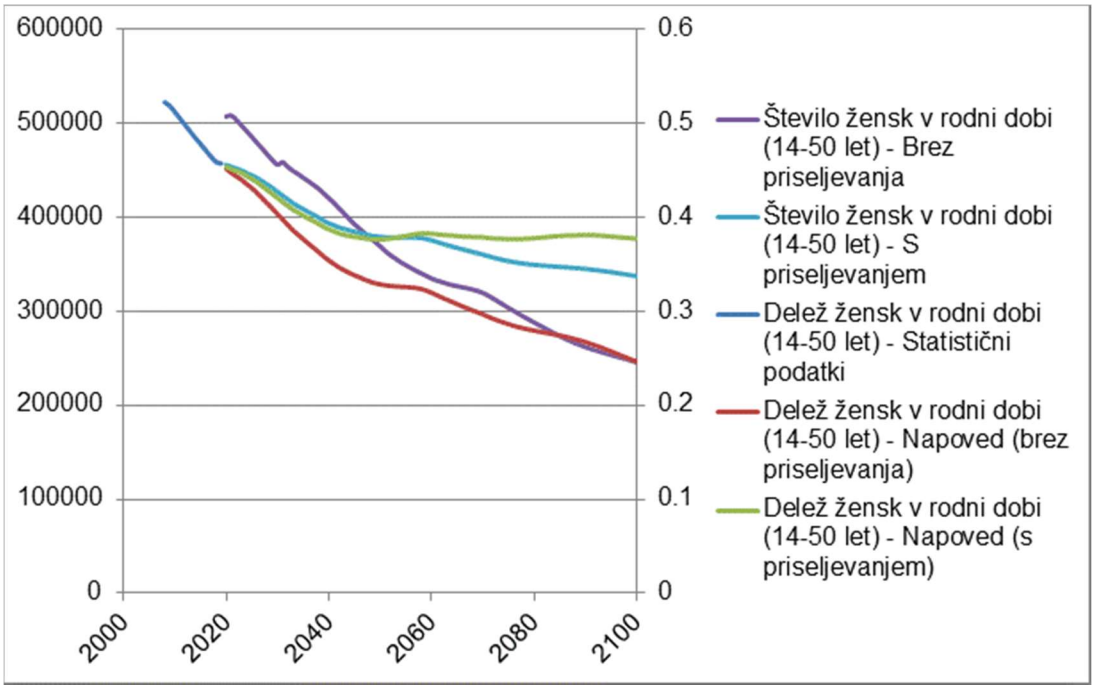


Figure 39: Forecast of the number and share of women of reproductive age (14-50 years) in Slovenia, and comparison with statistical data.

The figure shows the change in the share of women in Slovenia according to age group. Between 1981 and 2019, the share of girls aged between 0 and 14 decreased by almost 10%. Forecasts show that girls between the ages of 0 and 14 in Slovenia will represent only 13% of the total female population. The share of women over 65 has been increasing since 1981, when women over 65 represented about 11% of the female population. The proportion of women over 65 is predicted to peak in 2100, when approximately 30% of the female population will be over 65.

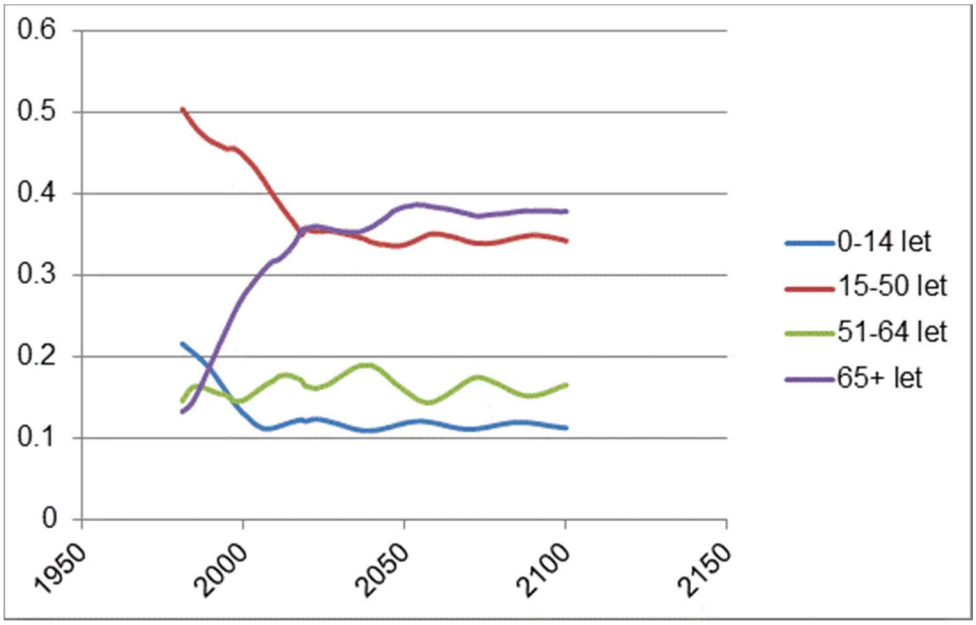


Figure 40: Display of the predicted change in the proportion of children, the working-age population and the elderly, based on a statistical model for predicting births. The figure does not consider interstate migration.

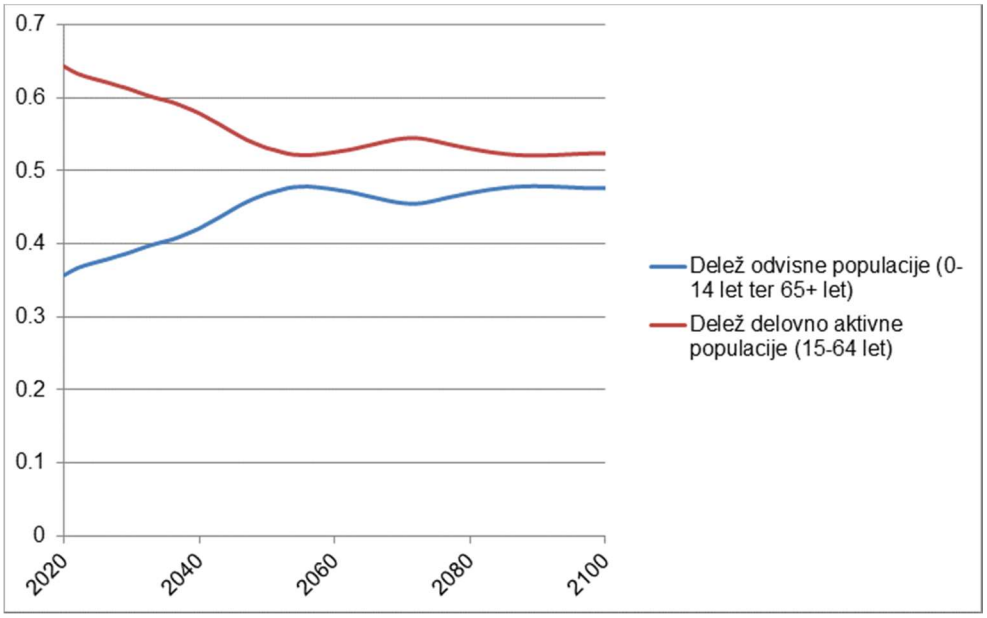


Figure 41: Predicted change in the share of the dependent (children and elderly) and working-age population, based on the statistical model of birth prediction. The display does not consider interstate migration and is based on the base scenario of dying.

The impact of inter-state migration on demographic change

Interstate migration is an important factor in predicting the effects of demographic aging, since (as we have shown) mainly young, working-age individuals or families immigrate to Slovenia. The diagram below shows the population of Slovenia according to the method by which the entire population of Slovenia was determined. The statistical model for predicting the number of births shows that if net interstate migration according to Eurostat 2019 is considered, the model predicts well the movement of the population according to data according to Europop 2019. If net migration is not considered, the model predicts that the entire population of Slovenia will in 2100 decreased sharply. A total of 16,213 people immigrated to Slovenia in 2019. If we assume that the age and gender structure of the

immigration trend from 2019 will remain unchanged until the year 2100, the statistical model of the number of children born predicts that the population in Slovenia will be much larger than the forecast according to Europop 2019. The predicted immigration trend according to Eurostat 2019, which used in our modelling, indicates a drop in immigration in 2024, followed by a renewed, but moderate, increase in migration growth. Therefore, it is not surprising that the size of the total population is much larger if we assume the unchanged trend of immigration from 2019.

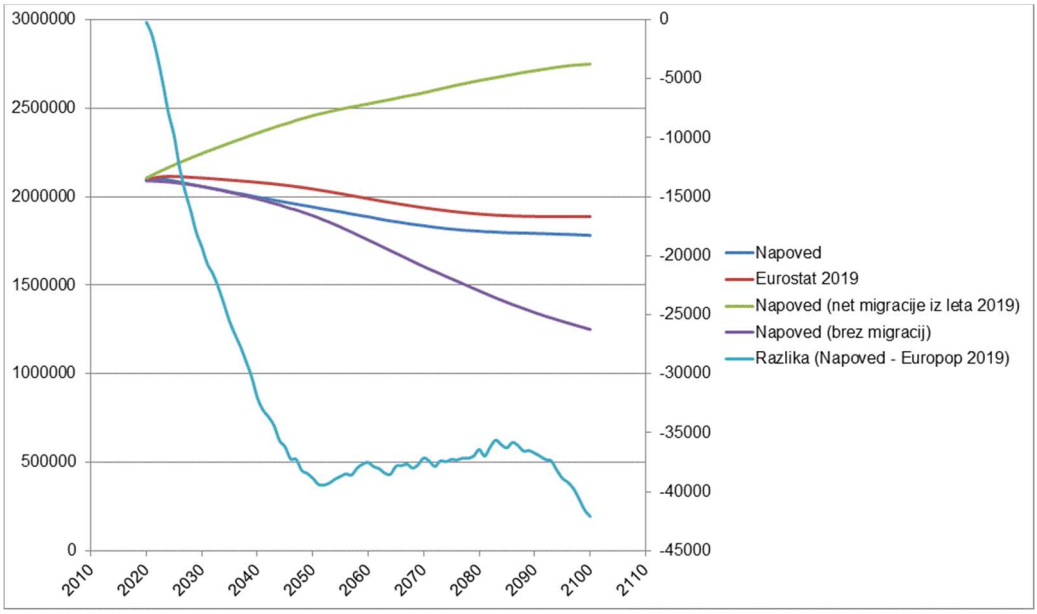


Figure 42: Changes in the number of inhabitants of Slovenia according to the projection method. The prediction method is based on the statistical determination of the number of children born, which is described in the Methodology chapter. The different number of inhabitants of Slovenia determined by the statistical model depends on the consideration of net interstate migration.

Prediction of the number of children born

The number of women in childbearing years in Slovenia has been slowly declining since 1997. The decrease in the number of young women can be attributed to demographic aging, which is one of the consequences of the low birth rate. However, the number of births and live births in Slovenia increased between 1999 and 2008. From 2008 onwards, however, we notice that the number of births has stabilized, or that the increase has slowed down. According to the model, which is based on statistical data on births in Slovenia, we expect that the number of children born will decrease in the future. Nevertheless, we will achieve local fluctuations in the birth of children, which will reflect past changes in the number of girls born.

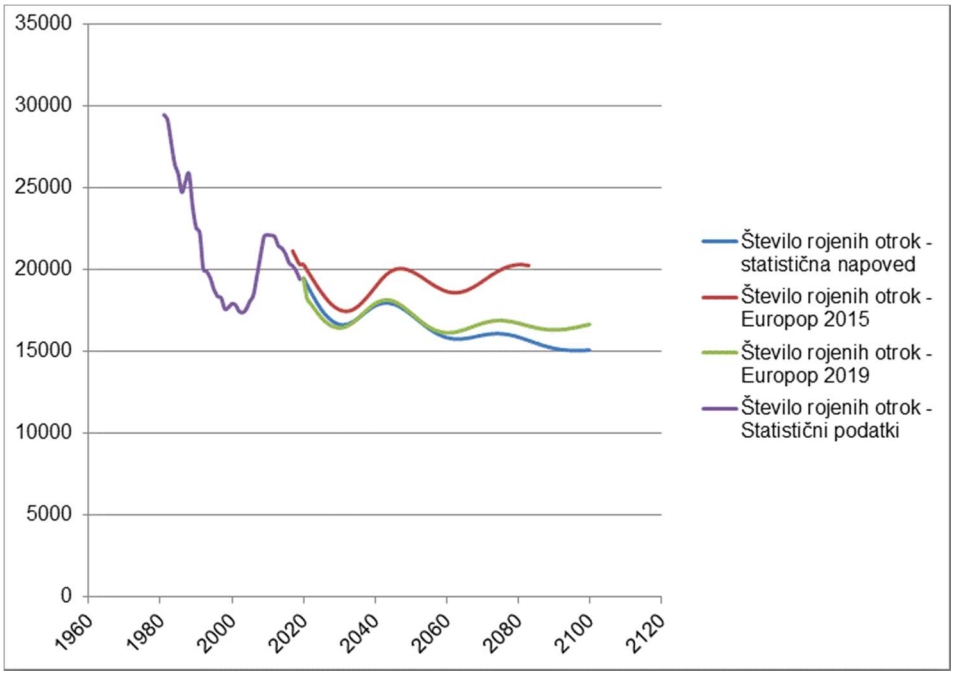


Figure 43: Children born in Slovenia. The dark blue colour shows statistical data on the number of children born in Slovenia between 1981 and 2019. The predicted number of births is shown in red deadline based on a statistical fertility model. Projections of births according to Europop 2015 and 2019 are shown in green and purple.

The graph below shows the difference in the number of births determined from data according to EUROPOP2019 and data obtained with the help of a model based on statistical analysis of data for Slovenia. A comparison with forecasts according EUROPOP2019 and forecasts based on a model based exclusively on data obtained in Slovenia (but not taking migration into account) shows that forecasts according to EUROPOP2019 are much more optimistic. In order to reach the base scenario according to EUROPOP2019, the difference in the number of births would have to be covered by young women who would immigrate to Slovenia.

Over time, the difference in the number of children born is increasing according to EUROPOP2019. Considering that the projection according to EUROPOP also includes migration flows, the difference could also be to a certain extent represented by the children of young women who will immigrate to Slovenia. The question is whether Slovenia is interesting enough for young families south and east of Slovenia to immigrate to the extent that Eurostat predicts with its projections (Figure 46).

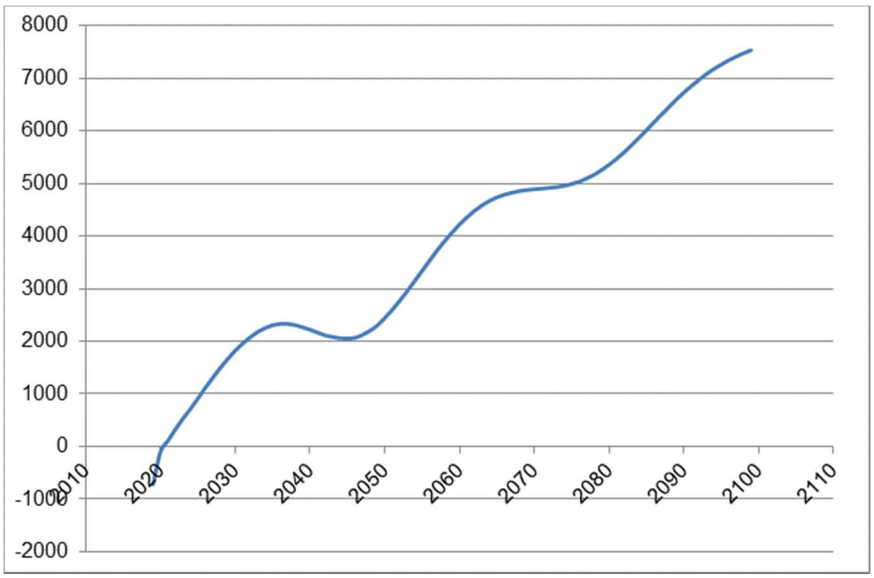


Figure 44: Forecasted migration of women between the ages of 14 and 50 to Slovenia, according to Europop 2019 data.

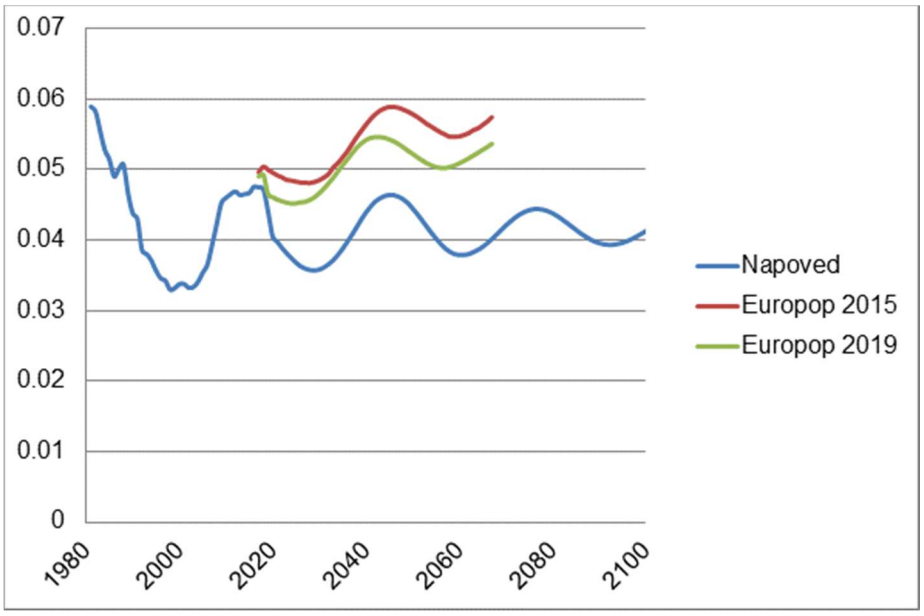


Figure 45: The relationship between the number of children born and the number of women of childbearing age (14-50 years). The forecast is shown in blue. The percentages shown in red and green are determined from data according to Europop 2015 and 2019.

An illustration of the relationship between the number of children born and the number of women of childbearing age shows that the share of women of childbearing age who give birth in a calendar year will stabilize at 4% in the future.

Net population renewal rate

The net population renewal rate for a calendar year means the average number of live birth girls that a generation of women of their reproductive age (i.e. between 14 and 50 years of age) would have given birth to, if their age-specific birth and death rates had been the same as in the observed year. Since women of reproductive age represent the population's demographic potential, it is important to be actively involved in understanding demographic aging and solving this issue.

In 1954, when statistical data on the population of Slovenia began to be collected, the net renewal rate was 1.15. The lowest net recovery rate was recorded in Slovenia between 1997 and 2005, when its value fluctuated between 0.57 and 0.60. The forecast of the net rate of population renewal shows that due to demographic aging, the population will not be renewed, or rather, the population in Slovenia will decrease.

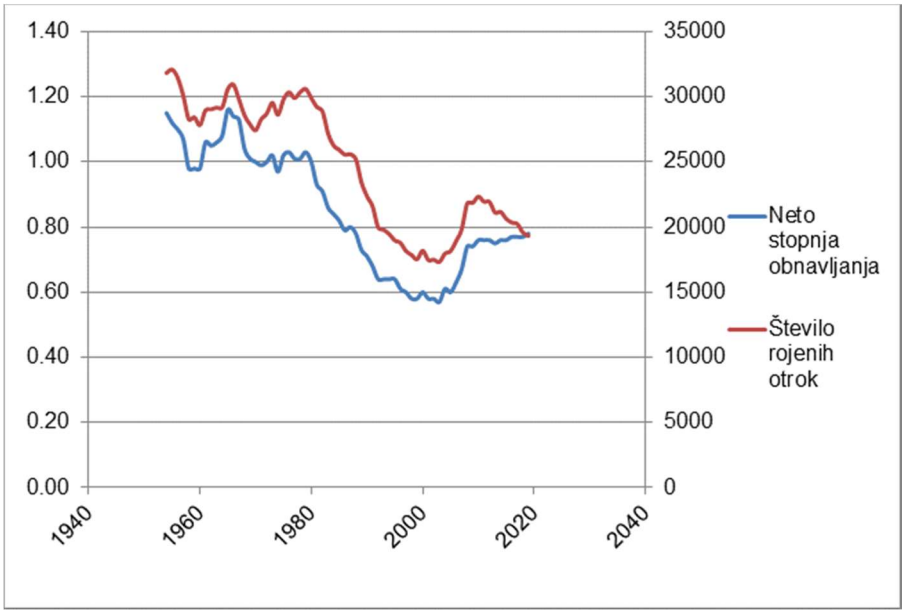


Figure 46: Net population renewal rate and number of births between 1954 and 2019.

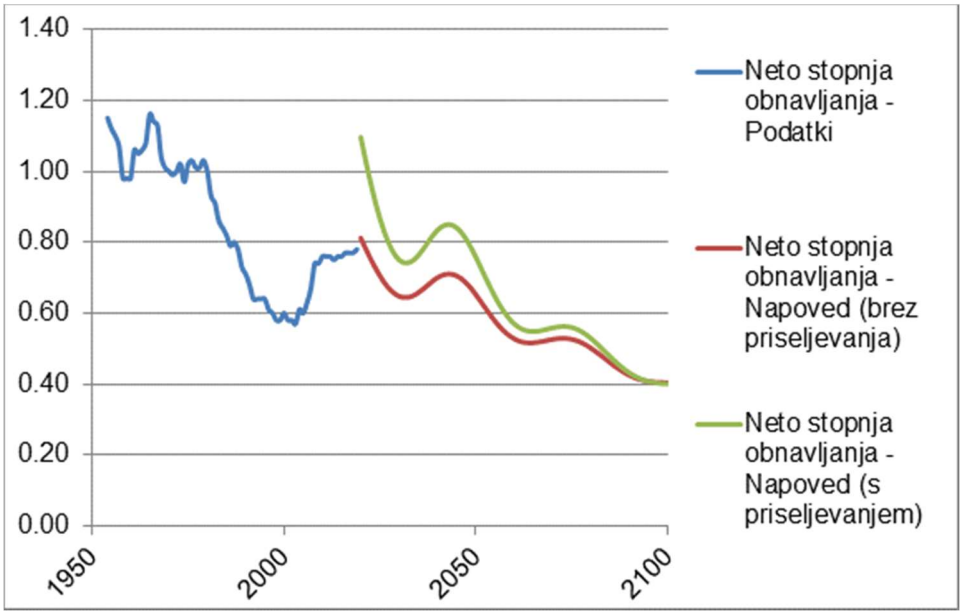


Figure 47: Estimated net rate of population renewal in Slovenia. The statistics of the net renewal rate between 1954 and 2019 are shown in blue. The green and red colours show the projected net renewal rate, without and with net migration considered.

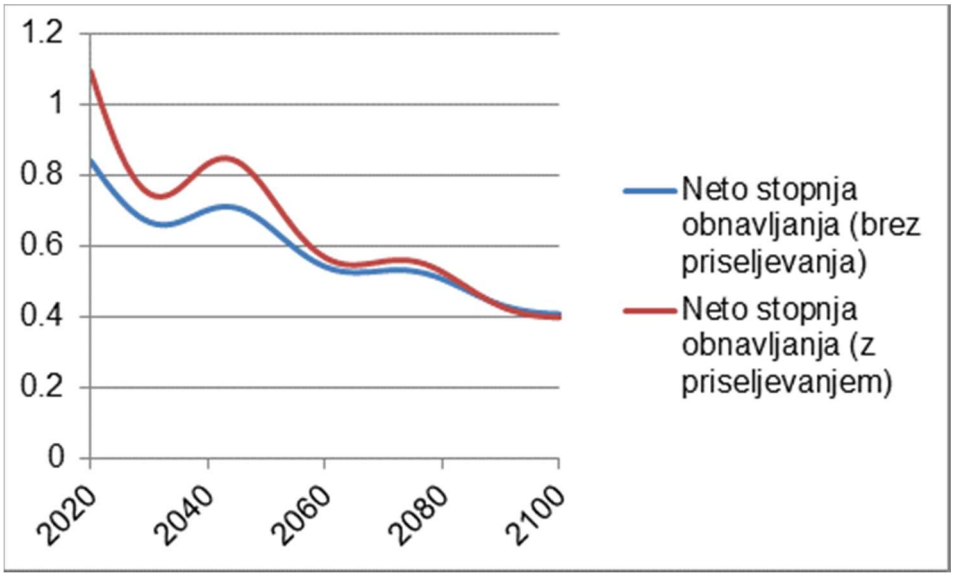


Figure 48: Projected net rate of population renewal in Slovenia between 2020 and 2100. The forecast that does not take migration into account is shown in blue, and the forecast that takes migration into account is shown in red.

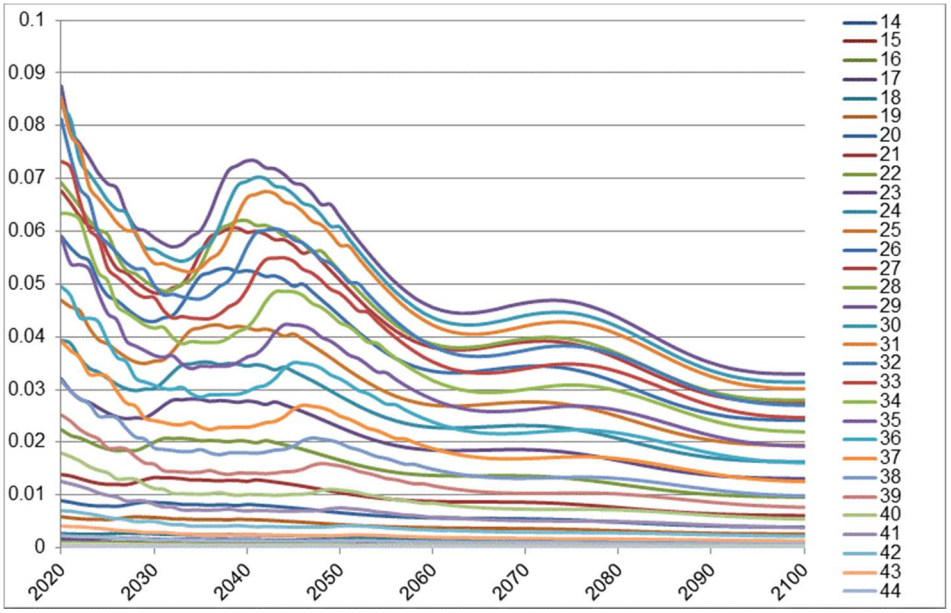
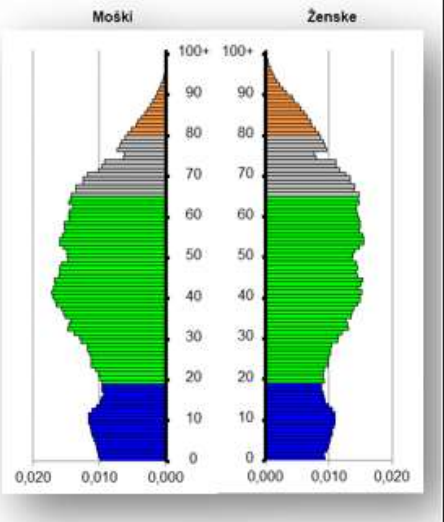
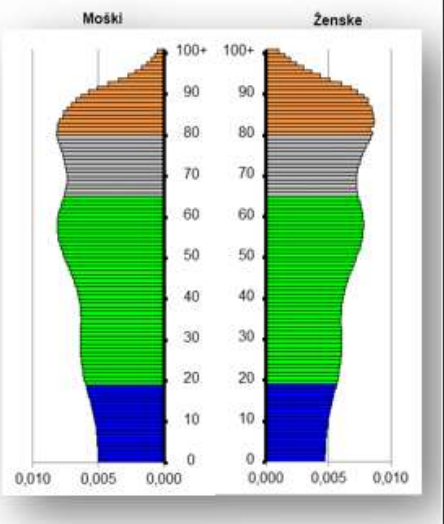
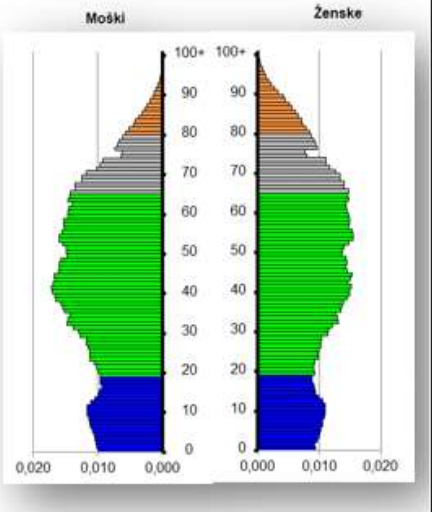
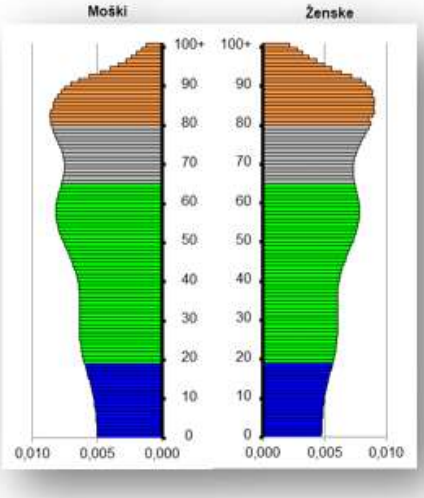
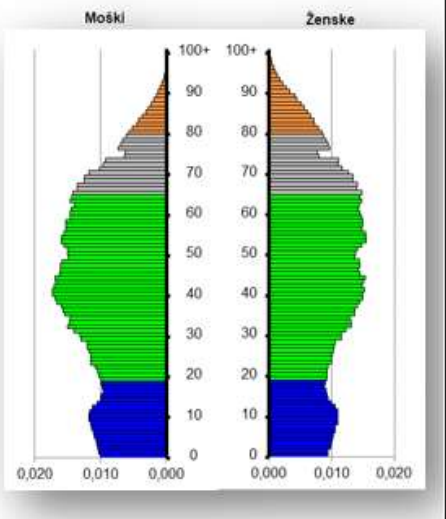
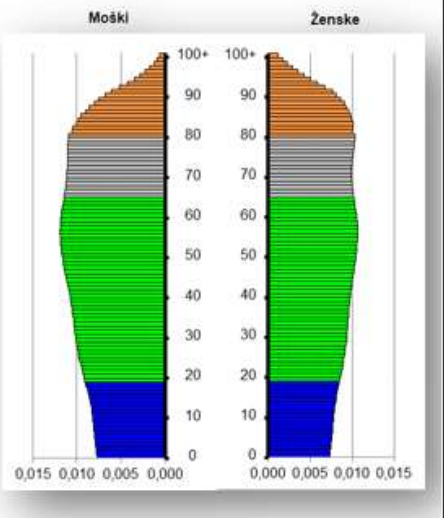
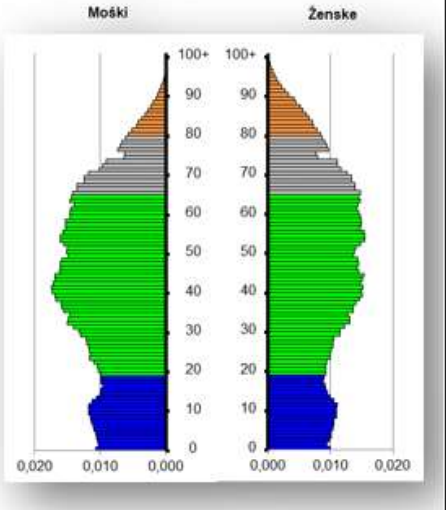
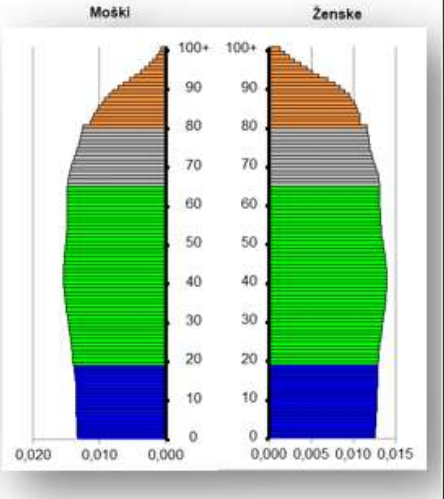
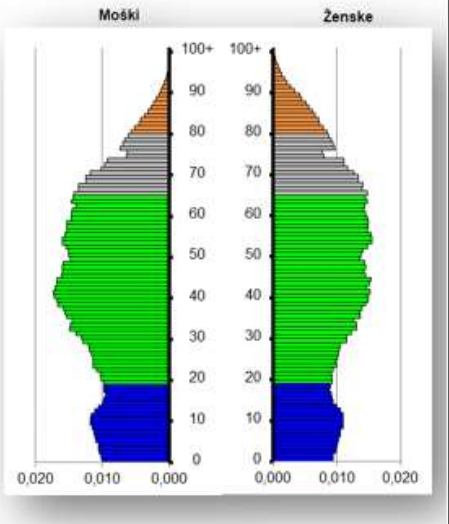
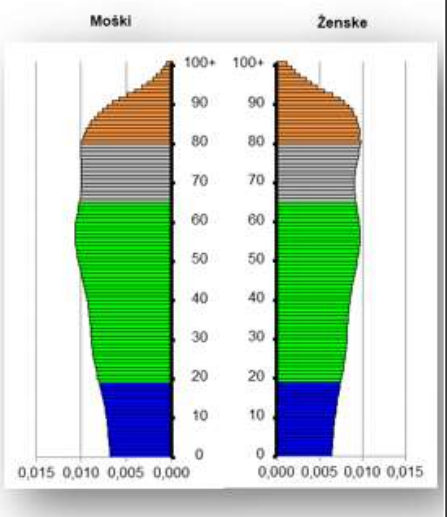
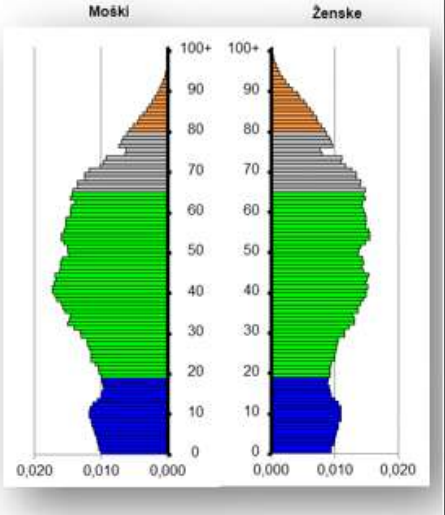
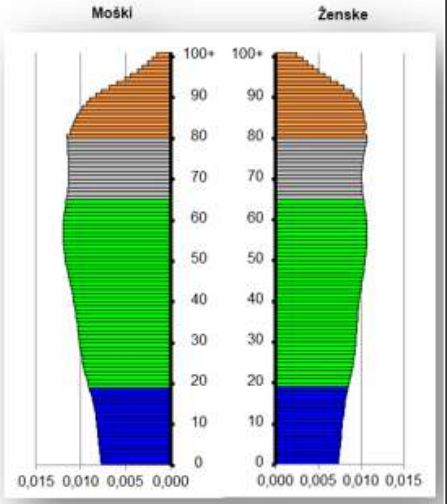


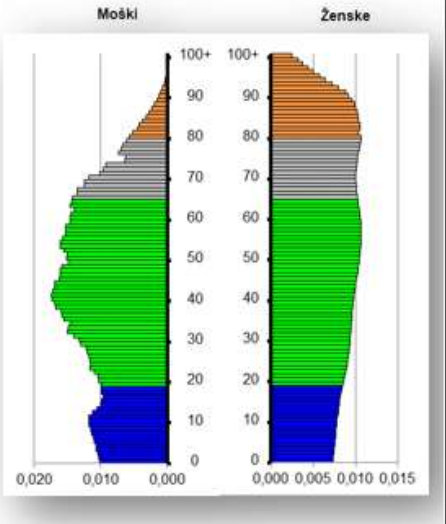
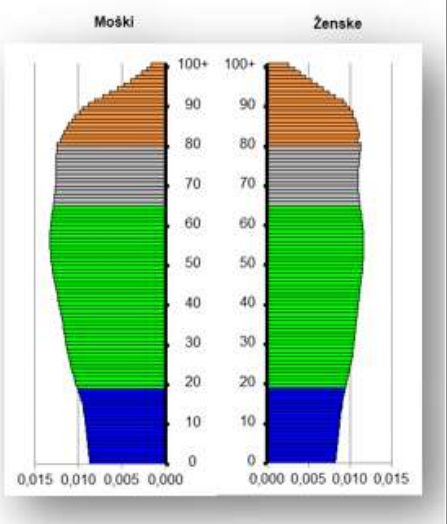
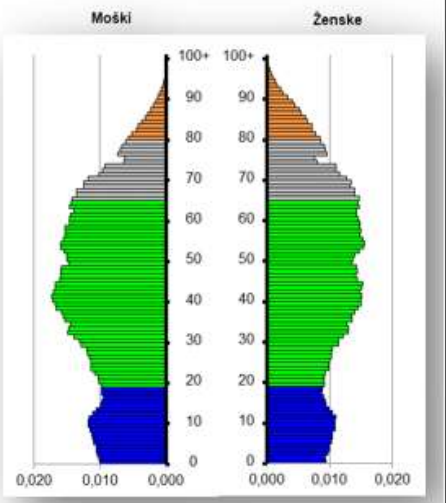
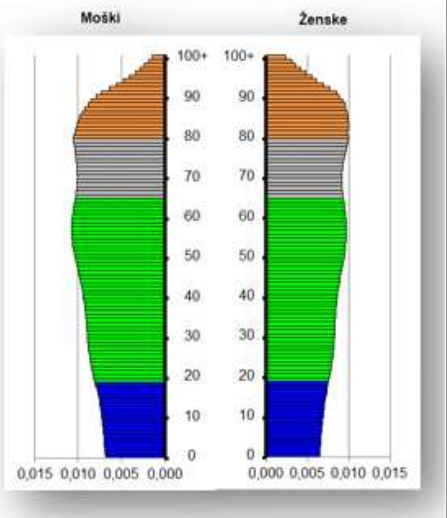
Figure 49: Recovery rate by maternal age.

Table 1: Comparison of age pyramids for different scenarios of death and immigration in Slovenia for the starting year 2020 and the target year 2100.

Scenarij/Leto	2020	2100
Smrtnost po BSL, brez priseljevanja		
Smrtnost po LMTR, brez priseljevanja		

Mortality and immigration scenario BSL		
Mortality scenario BSL, immigration scenario HMIGR		

Mortality scenario BSL, immigration scenario LMIGR		
Mortality scenario LMTR, immigration scenario BSL		

Mortality scenario LMTR, immigration scenario HMIGR		
Mortality scenarioo LMTR, immigration scenario LMIGR		

A comparison of the age pyramids, which show the structure of the population of Slovenia according to different scenarios of death and immigration, shows that the scenario of the probability of death according to age, each year, has only a small effect on the structure of the population. When the low mortality scenario (LMTR) is used to predict the population structure, the total population, in the absence of immigration, increases by only about 3.6% relative to the baseline mortality scenario.

The size of the population and the age structure of the population have the greatest influence on the volume of immigration. According to the base scenario of death and the scenario of large-scale immigration (HMIGR), the population of Slovenia will increase by 18.2% in the target year. According to the scenario of low mortality and a large volume of immigration, the abundance of the population is maintained in the target year. In all other scenario combinations, the population size in the target year 2100 decreases by about 10-35%. According to forecasts, the largest population decline in Slovenia is expected to occur if the mortality trend follows the base scenario, while the immigration trend follows the scenario of a reduced volume of immigration. In this case, the population size in the target year 2100 will be more than 20% smaller than in the base year 2020. Given the current economic climate

during the coronavirus disease pandemic, we can expect immigration to follow the reduced immigration scenario.

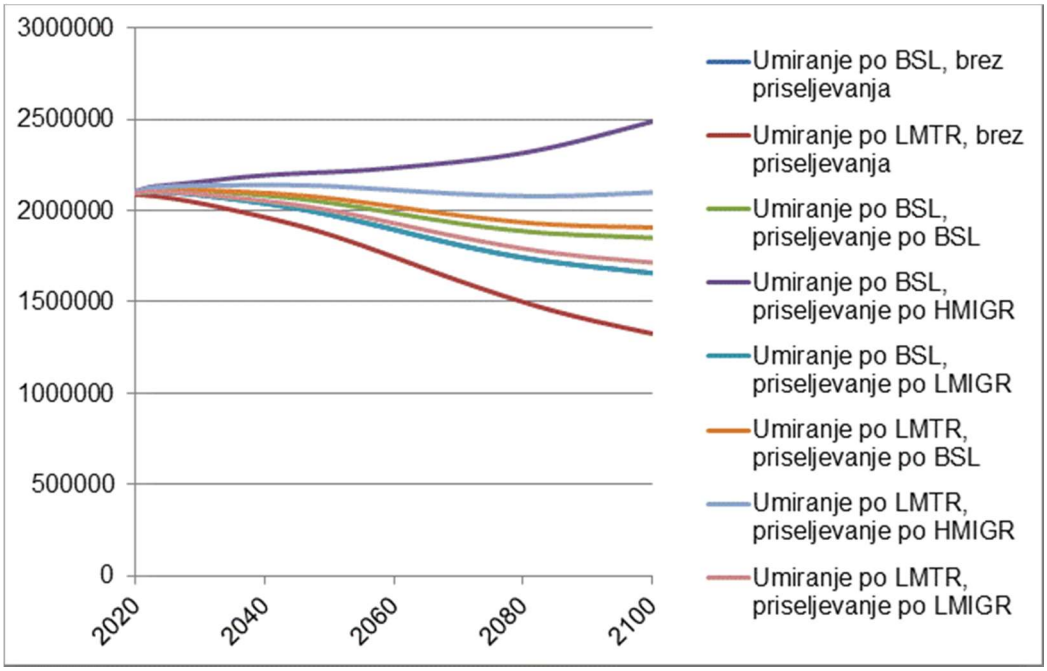


Figure 50: Comparison of population size according to different scenarios of death and immigration in Slovenia in the target year 2100.

Gross domestic product and demographic aging of the population

Since the economic activity of the country, its development and the rate of economic growth depend on the share of working-age and active residents, demographic aging will undoubtedly affect the economic stability of the country. The graph shows an indicator that shows how much GDP must be generated annually by an individual working resident in order to maintain the current standard of living in the future. For the calculation, we assumed that maintaining the standard of living means that the entire annual GDP remains unchanged. The calculations are based on GDP data from 2019 obtained from the World Bank, which for Slovenia amounted to USD 54.17 billion or EUR 48.393 billion.

A country's GDP depends not only on the share of the working-age population, but also on their productivity. Within the analysis of the impact of demographic aging, we define the concept of productivity as the amount of GDP that each working individual produces in a calendar year. Since we know that the 15-64 and 20-64 age groups will decrease due to demographic aging, we wanted to show the impact of the contraction on the gross domestic product in Slovenia. GDP per capita in 2019 amounted to EUR 23,165. If we assume that GDP is created only by the working population, the GDP per working population in Slovenia in 2019 amounted to EUR 35,690 (20-64 years) and EUR 38,326 (15-64 years). If we do not consider net migration in the forecast, in the year 2100 every working resident in Slovenia should generate between 75,000 and 82,000 EUR, to the extent that we want to maintain the current standard and economic power in Slovenia. If every resident of working age will maintain the same productivity, the total GDP of Slovenia will be between EUR 35.5 and 36.1 billion. If net migration is not considered in the modelling, the working population will generate between 22.6 and 23.0 billion EUR in 2100, which is more than 50% less than in 2019. The fall in total GDP is the result of a decrease in the volume of work active population.

Since the data show that mainly individuals between the ages of 15 and 44 immigrate to Slovenia, immigrants are increasing the size of the working population. The diagram in Figure 93 shows the difference in the entire GDP of Slovenia, depending on whether net migration is taken into account in

the statistical model for predicting births. As can be seen, net migration has a strong impact on the total GDP and the GDP that each working-age individual will have to generate annually to maintain the current standard of living.

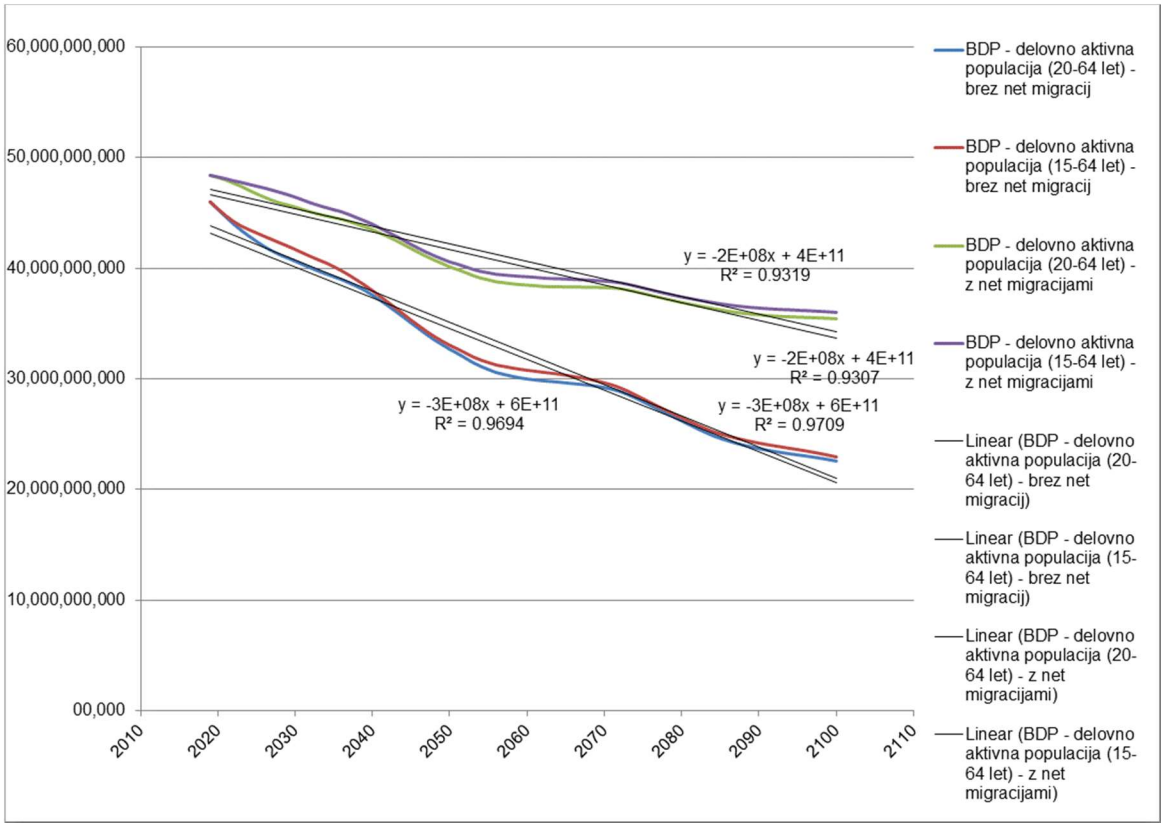


Figure 51: The forecast of the gross domestic product for Slovenia, between 2020 and 2100, if the current GDP per capita is maintained.

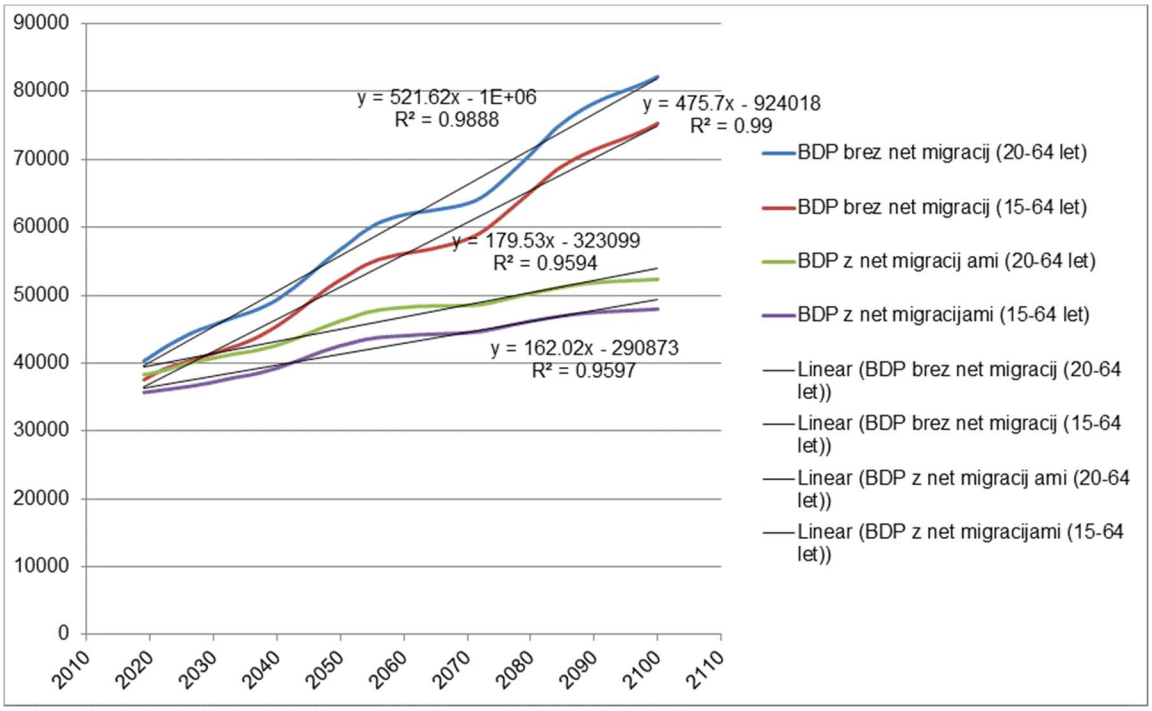


Figure 52: The projected increase in GDP per capita to maintain the current standard of living, which every working-age person in Slovenia will have to create annually, between 2020 and 2100.

Taking into account the base scenario of immigration, in 2050 each resident between the ages of 20-64 and 15-64 will have to generate between 42,000 and 46,000 EUR annually, which is between 1.8 and 2.0 times more than in 2019. Forecasts show, that the productivity of the working-age population will have to further increase in the target year 2100. Namely, every working-age individual between the ages of 20-64 and 15-64 will have to generate between 52,000 and 47,500 EUR annually, which is between 2 and 2.3 times more than in 2019.

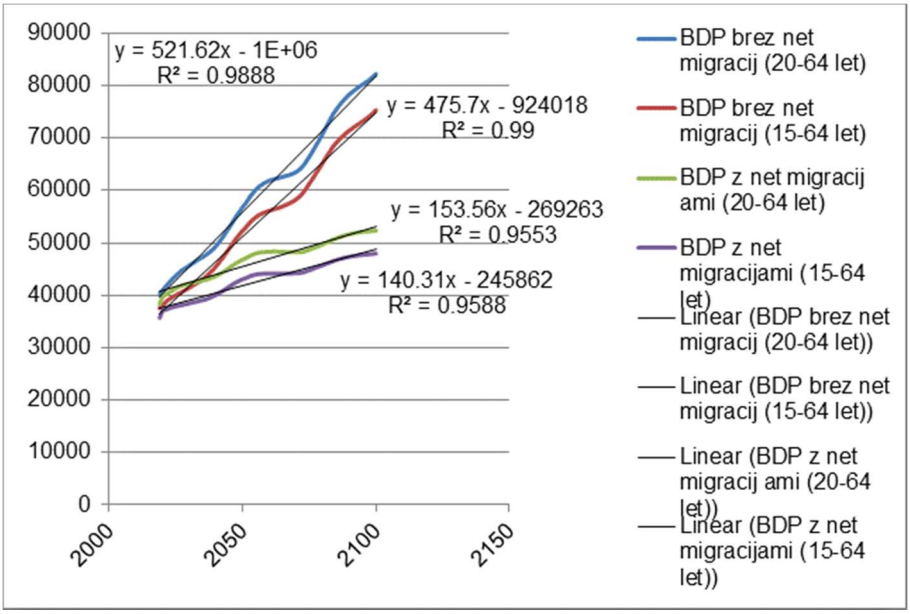


Figure 53: Comparison of the trend of change in GDP per capita to maintain the current standard of living between 2020 and 2100. The blue and red curves show the situation when net migration is not taken into account in the statistical fertility model. The green and purple curves show the situation when the statistical birth model takes net migration into account. The net migration forecast is based on data from EUROPOP2019.

The figure below shows the increasing need for higher productivity to maintain existing living standards and economic strength. A baseline mortality and immigration scenario, as well as a baseline mortality and high immigration scenario are shown. Only under the latter scenario would the share of children and the working population increase in Slovenia by the year 2100. Due to the increase in the size of the working population under the base scenario of death and the scenario of a high level of immigration, the productivity required to maintain economic power decreases over time. However, under most scenarios, the size of the working population is shrinking, so the productivity of the active population will have to increase. According to the base scenario of death and immigration, productivity will need to be increased by 2-2.3 times compared to the productivity of 2019. According to forecasts, the demographic aging of the population will increase the pressure on the economic situation and stability of Slovenia.

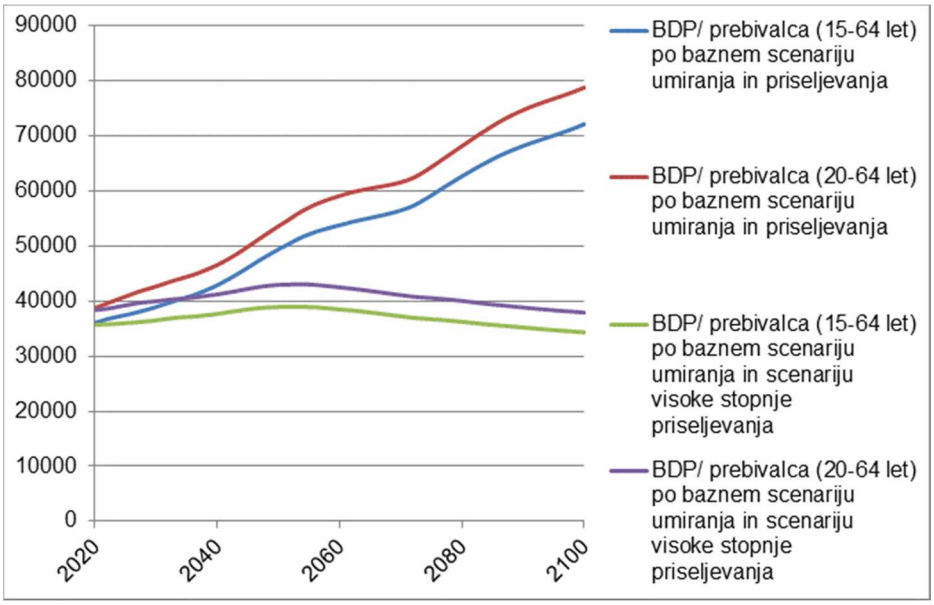


Figure 54: Change in GDP per capita according to the mortality and immigration scenario.

Conclusion

The demographic forecast shows that the age structure of Slovenians will change in the next 50 years; the number of the elderly will increase. At the same time, a change in the spatial distribution of the population is also expected, as the long-term migration of working-age residents to the settlements near the highway intersection will lead to the emptying and aging of other areas of Slovenia.

The increase in life expectancy and the growth of the elderly population will affect waiting times in healthcare, which will be a problem in the future. Waiting lines, as otherwise the most negative phenomenon on the part of the individual, are the result of relatively rapid changes in the longevity of the population on the one hand, and on the other hand, a faster increase in the number of residents in older groups, who require relatively more health services. In connection with spatial changes in the needs of health services, a spatial mismatch of health capacities will also appear, e.g. premises, equipment and personnel.

Methodology development

The results presented in the research paper, the product STHCP (Eng. "Space-Time Health Care Platform"), which represents the envelope of mathematical computer models developed by OMEGA consult d.o.o., Ljubljana. The input data for the platform is a demographic model and healthcare statistics. Health care data presents the incidence of diseases by groups of diagnoses according to the age and gender of the patient. Additional independent variables can be included in the platform as an additional model or as new variables in already existing models.

Platform products include, but are not limited to:

• Designing a large data base for further analysis

• Database for reuse and sharing

• Medium and long-term forecasts:

on the incidence of diseases in connection with the change in demography

o the necessary reorganization of health resources in connection with the change in demographics

• Local, regional, national (and EU) forecasts:

o spatial redistribution of disease incidence in connection with changes in demographic data

on the spatial prediction of the necessary reorganization of health resources due to demographic change

• Future estimate of treatment costs

Platform options include, but are not limited to:

• Identification of future problems at the national level for timely preparation and response, which may include directing resources to the problem area;

• Testing and simulating future strategies in healthcare;

• Transition to personal medicine;

• Testing and simulating future technological and methodological changes or changes in the field of pharmacy;

• Refinement of models to identify interactions in specific health areas on groups of patients or individual patients.

Demographic aging and childbearing in the future

The figure below shows the change in the number of women of reproductive age in the period between 1981 and 2019, and the number of children born. In 20 years, the number of women of reproductive age in Slovenia decreased by more than 120,000. The deficit of women of reproductive age will be noticeable in the birth rate trend in about 25 years, when generations of young women will decide on motherhood, from periods when the birth rate in Slovenia was low.

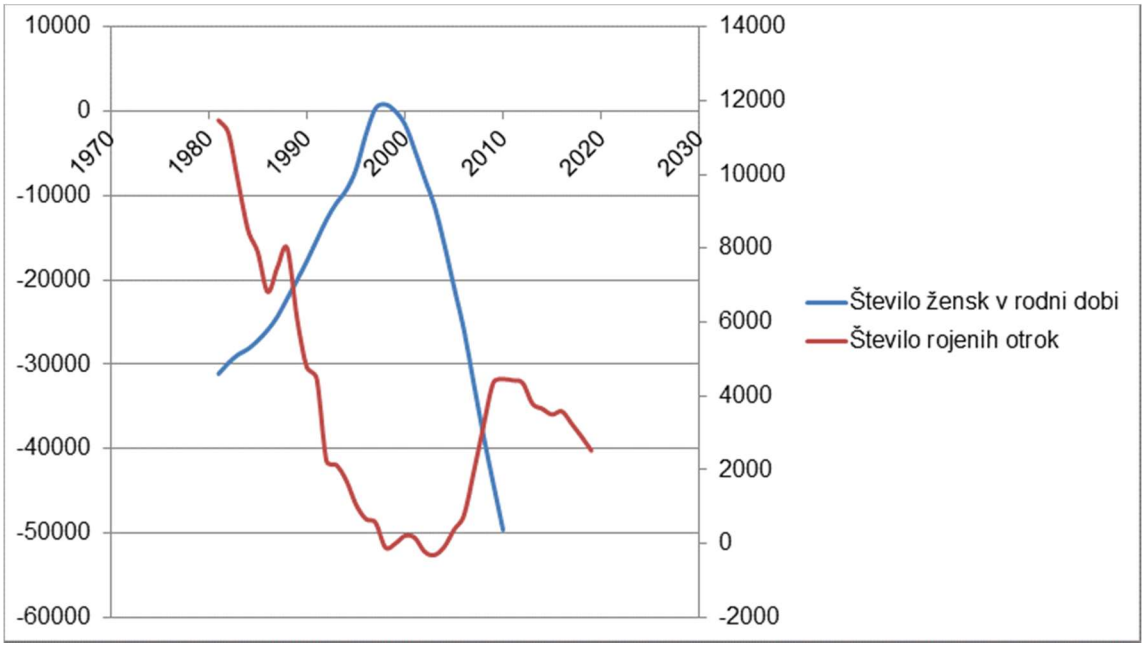


Figure 55: The number of children born and the deficit of women in Slovenia between 1981 and 2019.

In the paper, we showed that the demographic aging situation in Slovenia is worrying. Due to demographic aging, the number of women of childbearing age is decreasing, which contributes to Slovenia's declining demographic potential. Based on the birth rate model, which is based on birth rate trends recorded in Slovenia over the past 37 years, the number of children and thus the birth rate will decrease significantly by the year 2100. Compared to the projections according to Europop 2019, which also consider internal and external migration flows, the forecasts show an even bleaker scenario than the one predicted by the base scenario according to Europop. Since migration flows are not considered

when predicting the number of births using a statistical model, it is likely that with the immigration of young people from countries south and east of Slovenia, the birth rate will improve slightly in the future. However, studies of the birth rates of immigrants from other countries show that the birth patterns of young people who come from high-fertility areas change after they settle and become like the patterns typical of the region to which they immigrated. In addition, the question arises whether Slovenia is economically interesting enough for the immigration of many economic immigrants who come to Europe for the possibility of better living conditions. The findings of the Office of Macroeconomic Analysis and Development of the Republic of Slovenia show that the increase in migration in Slovenia is strongly related to the structure of economic growth. At a time when economic growth was lower, migration growth did not reach the expected rate according to Europop projections.

Demographic changes will become a limiting factor for economic growth in Slovenia in the future due to the reduction in the number of persons of working age. While maintaining the existing social protection systems (pensions, health services and social and long-term care services), which are partially financed from budget funds,

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