LIFE QUALITY AND HUMAN POTENTIAL OF TERRITORIES

COMPONENT ANALYSIS OF REGIONAL DIFFERENCES IN NATURAL POPULATION GROWTH IN RUSSIA

VLADIMIR N. ARKHANGELSKIY
Institute of Demographic Research FCTAS RAS
Moscow, Russian Federation
e-mail: archangelsky@yandex.ru
ORCID: 0000-0002-7091-9632; ResearcherID: T-4845-2017

EVGENIYA P. SIGAREVA
Institute of Demographic Research FCTAS RAS
Moscow, Russian Federation
e-mail: sigarevae@mail.ru
ORCID: 0000-0003-3760-795X; ResearcherID: ACY-3672-2022

SVETLANA YU. SIVOPLYASOVA
Institute of Demographic Research FCTAS RAS
Moscow, Russian Federation
e-mail: svetlankamos84@rambler.ru
ORCID: 0000-0002-3239-4230; ResearcherID: AAT-1436-2020

The paper provides a component assessment of regional differences in the total natural population growth rate (in comparison with the Russian Federation as a whole), based on the modified use of the index method, which takes into account the possibility of both positive and negative values of this indicator. For each constituent entity of the Russian Federation, it has been established to what extent its

---

total natural population growth rate differs from the national one in 2023 due to age-related fertility and mortality rates and the gender and age structure of the population. These components were also grouped by their contribution to the final result, and the contribution of each component to the dynamics of the total natural population growth rate in the country as a whole in 2016–2023 was analyzed. The aim of the study is to assess the regional differentiation in the component composition of the differences in the total natural population growth rate from its national level. Groups of constituent entities of the Russian Federation have been identified in which individual components of natural movement, combined in different combinations, determine the multidirectional development vectors of regional demographic processes. The theoretical significance of the study and its novelty lies in the development of a new approach to the statistical analysis of the components of natural population growth in the regional context, the applied result is the possibility, based on the developed approach, to adjust regional policy measures aimed at demographic stabilization, taking into account changes in individual elements of the population reproduction process. The research results showed that in most regions where there was a natural increase in population in 2023 or a natural decrease in population less than the national average, the main positive contribution was made by a relatively favorable gender and age structure of the population. In half of the regions with a relatively large natural population decline in 2023, compared with Russia as a whole, this was mainly due to high age-related mortality rates.

Natural population growth, age-related fertility rate, age-related mortality rate, gender and age structure, index method, constituent entity of the Russian Federation.

Introduction

Regional measures of demographic policy are becoming increasingly significant in the context of contemporary depopulation. Given Russia's territorial diversity, it is important a scientific approach to the statistical analysis of the specifics of demographic processes in the regions for maximizing their effectiveness. A detailed approach to the components of natural population change in a regional context is of particular importance. The relevance of our study is associated with the need to improve the methodology for assessing the spatial and component diversity of natural population change in the constituent entities of the Russian Federation in the current period. This will, in the future, enable the formulation of regional demographic policy measures based on a detailed and scientifically sound foundation.

The aim of the study is to assess regional differentiation in the component composition of deviations in the general rate of natural population increase from the all-Russian level.

The objectives are:

– to identify the influence of age-specific birth and death rates, as well as the age-gender structure, on the deviation of the general rate of natural increase in the regions from the indicator for Russia as a whole;

–to identify and characterize groups of regions based on the contribution of various components influencing the difference between the general rate of natural increase in the regions and the indicator for Russia as a whole;

– to determine the most problematic components of natural population increase in the regions as a basis for regionally differentiated prioritization of demographic policy directions.

A review of other researchers' findings on this and related issues reveals three key aspects of scientific approaches: regional, component, and methodological. It is worth noting that the subject of our scientific analysis pertains to the endogenous variables of natural population change. These are the internal changes in regional natural increase outcomes under the

influence of transformations in age-specific birth and death rates, as well as the gender and age structure in the regions. In the work "The birth rate of Russia's population in 1939–1945", V.A. Isupov, discussing the significance of the endogenous or "demographic" factor in transforming the population reproduction regime, noted that demographic modernization began even in the pre-war period and is based on the "demographic transition" (Isupov, 2015). Developing unevenly across Russia's territory, the "demographic transition" causes diversity in birth and death rates, necessitating a differentiated approach to developing regional measures aimed at demographic development.

In the context of the regional aspect, it is of interest the research by O.L. Rybakovsky and O.A. Tyanova "Demographic dynamics of Russian regions and its components", as it focused on the dynamics of natural population increase (Rybakovsky, Tyanova, 2019), and the article "Depopulation in the regions of Asian Russia in 1992–2024" (Rybakovskii, 2024b), and other works (Rybakovsky, Fadeeva, 2020; Rybakovskii, Rybakovskii, 2023; Rybakovsky, 2024a; Rybakovsky, Fadeeva, 2024).

Important for developing approaches to the comparative analysis of demographic prospects in a regional context was the monograph "Population Dynamics in the Mediterranean. Demographic Convergence?". It presents cross-country comparisons within the Mediterranean region (Doignon et al., 2023). Based on a study of demographic parameters in 26 countries, most of which are characterized by a minor influence of migration processes, long-term prospects are defined within the context of the demographic transition. The work of A.V. Brovkova is noteworthy from the perspective of analyzing regional differences using the principal component method. It identifies (according to the author's words) "key indicators of regional human potential reproduction in Russia at the present stage" (Brovkova, 2018). Regional analysis of demographic dynamics, considering both natural and migration movements, was also employed in the work of V.O. Esikova (Esikova, 2023), which notes the regional heterogeneity of population movement at all stages of post-Soviet development.

The component aspect related to the study of individual elements of natural population growth and based on the analysis of fertility, mortality and age structure is described in the article "Index analysis of fertility in the system of methodological support for municipal statistics" (Vasil'eva, 2016), where, based on the use of the index method, groups of the Leningrad Region municipal districts for 2004–2014 were identified., which are heterogeneous in their contribution to the value of a special fertility indicator of the components of gender and age fertility rates and the age structure of fertile age women.

The work of E.I. Ivanova analyzes mortality, morbidity and their structural transformations in the context of regional inequality and socio-demographic generations, where it is noted that "heterogeneity of morbidity and mortality is manifested in structural differences in the course of processes" (Ivanova, 2014). The contribution of mortality to population dynamics was affected by A.V. Kashepov in the article "Socio-economic factors of mortality from 2000 to 2020" (Kashepov, 2020), which stands out for its approach to assessing the statistical relationship of a large number of "factor determinants" on the resulting mortality rates.

The article by E.E. Sharilova focuses on the analysis of the age structure of the Republic of Belarus and provides a rationale for the introduction into scientific practice of the concepts of "demographic significance of the age group" and "demographic significance of the age structure" (Sharilova, 2015). The work of a team of authors (Islam et al., 2024) published

the results of studying the influence of age structure dynamics on demographic dividends in the largest countries by population (India, China, Bangladesh). There, scientists have convincingly demonstrated the persistent dependence of demographic long-term trends in these countries on the gender composition of the population and its age structure.

It is impossible to ignore the work of the foreign classic of demography and one of the authors of the "demographic transition" concept Frank W. Notestein's "Mortality, fertility, the size-age distribution and the growth rates" (Notestein, 1960), which analyzes how changes in the components of demographic processes are related to population growth and age structure. Modern cross-country differences in the demographic potential of the gender and age structure across 201 countries were considered in the work "Demographic potential of the gender and age structure as population dynamics factor". It is rightly noted that "the analysis of the gender and age pyramid makes it possible, if not to make an accurate quantitative assessment, then at least it is very correct to assess the upcoming fluctuations in certain time periods in the dynamics of both the population as a whole and individual age groups, and to determine the socio-economic consequences caused by this" (Arkhangelskiy et al., 2018).

The methodological aspect of literary review reflected studies that proposed index methods that make it possible to compare various indicators of individual cohorts of the population in demographic dynamics. To study this topic, it was useful to get acquainted with the research methods that are mainly used by geneticists. The use of the Crowe index and the assessment of the nature of population reproduction based on it were considered in the works "Reproductive characteristics and the Crowe index of the rural and urban population of Karachay-Cherkessia" (El'chinov et al., 2016), "Variability of parameters of natural reproduction and the Crowe index in ethnic groups of Dagestan" (Kurbatova et al., 2012), "Variability of natural reproduction processes in the population of Cheboksary in 1989 and 2019" (Spitsyna, Balinova, 2023).

A number of researchers, using index methods to assess the natural movement of the population, propose theoretical approaches with the development of a functional model of the dependence of fertility and mortality on the population structure (Dawidowicz, Poskrobko, 2009) or are limited to applied research on the scale of countries and federal districts (Dolbik-Vorobei, 2023), individual regions.

The most popular topic of scientific research in recent decades using index methods has been the assessment of the human development index or the human capital index. Such works, which are based on the use of the index method for interregional or cross-country comparisons, include the articles by O.N. Baeva "Human Development Index: Methods of definition and assessment at the regional level" (Baeva, 2012), L.A. Efimova "The Human Development Index in Russia: Analysis and prospects" (Efimova, 2015), V.E. Reutova, L.A. Kravchenko, N.Z. Vel'gosh "Socio-economic problems of human potential development in Russia and its regions" (Reutov et al., 2019). Most of these studies include a significant number of non-demographic factors in the component analysis: indicators of education, standard of living, health, and others. The number of studies that would be based on a detailed analysis of endogenous (demographic) factors influencing the transformation of the natural movement of the population, especially in the regional context, is insignificant. In this regard, the following articles can be mentioned: "Assessment of fertility factors and reproduction regime of the Kyrgyzstan" (Ermekbaeva, Melisova, 2022), "The use of the index method in the analysis of fertility in the Republic of Kazakhstan and its regions in 2009–2022" (Shokamanov,

Demesinova, 2024). The stated topic of the article is an organic continuation of the research of one of the authors, whose works previously outlined new methodological approaches to the detailed study of the regional specifics of the natural movement of the population and its individual components (Arkhangelskiy, Revun, 2009; Arkhangelskiy et al., 2015; Arkhangelskiy et al., 2024).

The scientific novelty of the research is to identify the most problematic components of the natural movement of the population in Russia's regions based on the use of modified index method.

Research methodology

The index method is traditionally used to measure the contribution of various components to the differences in various statistical indicators. With regard to the total natural population growth rate, such components are the age-related fertility and mortality rates (the difference between which can be interpreted as the age-related natural growth rate), and the gender and age structure.

The index system looks like this:

$$\frac{k^1 \left(\Sigma\{(f_x^1 - m_x^1) * s_x^1\}\right)}{k^0 \left(\Sigma\{(f_x^0 - m_x^0) * s_x^0\}\right)} = \frac{\Sigma\{(f_x^1 - m_x^1) * s_x^1\}}{\Sigma\{(f_x^0 - m_x^1) * s_x^1\}} *$$
$$* \frac{\Sigma\{(f_x^0 - m_x^1) * s_x^1\}}{\Sigma\{(f_x^0 - m_x^0) * s_x^1\}} * \frac{\Sigma\{(f_x^0 - m_x^0) * s_x^1\}}{\Sigma\{(f_x^0 - m_x^0) * s_x^0\}} \quad , \text{(1)}$$

where:

k^1 and k^0 – total natural growth rates of the compared populations;

f_x^1 and f_x^0 – age-related fertility rates of the compared populations;

m_x^1 and m_x^0 – age-related mortality rates (separately for women and men) of the compared populations;

s_x^1 and s_x^0 – share of the population of each gender and age group in the total population of the compared populations.

The superscript «1» means that the indicator refers to the population for which

a comparative assessment is being made, and the superscript «0» means that the indicator refers to the population with which natural growth is being compared (in the analysis of dynamics, the indicators of the previous year; in the comparative regional analysis – in this case, it is the population of Russia as a whole).

The first index ($\frac{k^1 \left(\Sigma\{(f_x^1 - m_x^1) * s_x^1\}\right)}{k^0 \left(\Sigma\{(f_x^0 - m_x^0) * s_x^0\}\right)}$) reflects the difference in the total coefficients of natural population growth. The following indices determine the contribution of each component to this difference: the second index ($\frac{\Sigma\{(f_x^1 - m_x^1) * s_x^1\}}{\Sigma\{(f_x^0 - m_x^1) * s_x^1\}}$) determines the contribution of age-related fertility rates; the third index ($\frac{\Sigma\{(f_x^0 - m_x^1) * s_x^1\}}{\Sigma\{(f_x^0 - m_x^0) * s_x^1\}}$) – age-related mortality rates; the fourth index ($\frac{\Sigma\{(f_x^0 - m_x^0) * s_x^1\}}{\Sigma\{(f_x^0 - m_x^0) * s_x^0\}}$) – gender and age structure.

Unfortunately, the index method in this form is not applicable to the total natural population growth rate, since this indicator can be both positive and negative. And the index method "does not see the sign".

Replacing division with subtraction allows removing this restriction. At the same time, it is estimated not how many times one value of the total natural population growth rate is greater or less than another, but how much.

The formula transformed in this way from the index system looks like this:

$$k^1 \left(\Sigma\{(f_x^1 - m_x^1) * s_x^1\}\right) - k^0 \left(\Sigma\{(f_x^0 - m_x^0) * s_x^0\}\right) =$$
$$= [(\Sigma\{(f_x^1 - m_x^1) * s_x^1\}) - (\Sigma\{(f_x^0 - m_x^1) * s_x^1\})] +$$
$$+ [(\Sigma\{(f_x^0 - m_x^1) * s_x^1\}) - (\Sigma\{(f_x^0 - m_x^0) * s_x^1\})] + \quad \text{(2)}.$$
$$+ [(\Sigma\{(f_x^0 - m_x^0) * s_x^1\}) - (\Sigma\{(f_x^0 - m_x^0) * s_x^0\})]$$

The first difference [$k^1 \left(\Sigma\{(f_x^1 - m_x^1) * s_x^1\}\right) - k^0 \left(\Sigma\{(f_x^0 - m_x^0) * s_x^0\}\right)$] shows how much more or less one total coefficient of natural population growth is compared to the other. In the second difference [$(\Sigma\{(f_x^1 - m_x^1) * s_x^1\}) - (\Sigma\{(f_x^0 - m_x^1) * s_x^1\})$], the reduced and subtracted differ only in age-

related fertility rates, therefore, it shows the effect of differences in them on the difference in the total natural population growth rate. In the third difference $[(\Sigma\{(f_x^0 - m_x^1) * s_x^1\}) - (\Sigma\{(f_x^0 - m_x^0) * s_x^1\})]$, the age-related mortality rates differ, respectively, it shows the contribution of this component. And the fourth difference $[(\Sigma\{(f_x^0 - m_x^0) * s_x^1\}) - (\Sigma\{(f_x^0 - m_x^0) * s_x^0\})]$ reflects the contribution of the gender and age structure, since it differs in the share of the population of each gender and age group in the total population.

Research results

The relative natural population decline in Russia increased annually in 2016–2021 and decreased only in 2022 and 2023 compared to the previous year *(Tab. 1)*.

The increase in the relative natural decline of the population in 2017 and 2019 is primarily due to a decrease in age-related fertility rates. In 2020 and 2021, they changed slightly, but their significant decrease in 2022 largely counteracted the positive effect of a decrease in age-related mortality rates on the change in the overall natural population growth rate after their increase in 2020 and 2021 due to the COVID-19 pandemic dominated the increase in relative natural population decline. In 2023, changes in age-related mortality rates continued to have a positive impact on reducing the natural decline of the population,

Table 1. Components of the change in the total natural population growth rate in Russia in 2016–2023, p.p.

Year	Change in the total natural population growth rate compared to the previous year	including due to changes in		
		age-related birth rate	age-related mortality rate	gender and age structure
2016	-0.2	-0.1	0.2	-0.3
2017	-0.9	-1.0	0.5	-0.4
2018	-0.6	-0.3	0.1	-0.4
2019	-0.6	-0.5	0.2	-0.3
2020	-2.7	-0.0	-2.3	-0.4
2021	-2.3	0.0	-2.1	-0.2
2022	3.1	-0.4	3.8	-0.3
2023	0.5	-0.0	1.0	-0.5

According to: Average annual population by gender and age for 2011–2021 (recalculated from the results of the All-Russian Population Census in 2020). Available at: https://rosstat.gov.ru/folder/12781; Natural movement of the population of the Russian Federation in 2023: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13269; Natural movement of the population of the Russian Federation in 2022: Statistical bulletin. Moscow, 2023. Available at: https://rosstat.gov.ru/storage/mediabank/EDN_2022.htm; Natural movement of the population of the Russian Federation in 2021: Statistical bulletin. Moscow, 2022. Available at: https://rosstat.gov.ru/bgd/regl/b21_106/Main.htm; Natural movement of the population of the Russian Federation in 2020: Statistical bulletin. Moscow, 2021. Available at: https://rosstat.gov.ru/bgd/regl/b20_106/Main.htm; Natural movement of the population of the Russian Federation in 2019: Statistical bulletin. Moscow, 2020. Available at: https://rosstat.gov.ru/bgd/regl/b19_106/Main.htm; Natural movement of the population of the Russian Federation in 2018: Statistical bulletin. Moscow, 2019. Available at: https://rosstat.gov.ru/bgd/regl/b18_106/Main.htm; Natural movement of the population of the Russian Federation in 2017: Statistical bulletin. Moscow, 2018. Available at: https://rosstat.gov.ru/bgd/regl/b17_106/Main.htm; Natural movement of the population of the Russian Federation in 2016: Statistical bulletin. Moscow, 2017. Available at: https://rosstat.gov.ru/bgd/regl/b16_106/Main.htm; Natural movement of the population of the Russian Federation in 2015: Statistical bulletin. Moscow, 2016. Available at: https://rosstat.gov.ru/bgd/regl/b15_106/Main.htm; Population of the Russian Federation by gender and age as of January 1, 2024: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Population of the Russian Federation by gender and age as of January 1, 2023: Statistical bulletin. Moscow, 2023. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Population of the Russian Federation by gender and age as of January 1, 2022: Statistical bulletin. Moscow, 2022. Available at: https://rosstat.gov.ru/storage/mediabank/Bul_chislen_nasel-pv_01-01-2022.pdf

while the impact of changes in age-related fertility rates was quite insignificant. Changes in the gender and age structure annually make a negative contribution to the change in the total natural population growth rate in the range from 0.2 to 0.5‰ points.

The natural population decline (the difference between the number of births and deaths) in Russia in 2023 was 3.5 per 1,000 people. This is 0.5‰ less than in 2022. A component analysis based on the modified index method showed that the relative decrease in natural population loss occurred due to a decrease in age-related mortality rates. This component contributed to a decrease in the relative (per 1,000 population) natural loss by 1.0‰. The positive effect of this component was counteracted by a decrease in age-related

fertility rates and a deterioration in the gender and age structure. Moreover, if the impact of the birth rate was very small (close to 0.0‰ points), then the impact of structural changes was very significant. They contributed to an increase in the relative natural population decline by 0.5 ‰ points.

Natural population growth (i.e., more births than deaths) in 2023 was observed only in 15 regions of the Russian Federation, the largest in the Chechen Republic (15.7 per 1,000 people), slightly less was in the Republic of Ingushetia (11.9).

In 9 regions with natural population growth, all three components (age-related birth and death rates, gender and age structure) made a positive contribution in contrast to this indicator from the national one *(Tab. 2)*.

Table 2. Components of the difference between the total natural population growth rate and the national indicator in regions with natural population growth, higher fertility rates, lower mortality rates and a more favorable gender and age structure of the population in 2023, ‰ points

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Chechen Republic	19.2	9.5	1.3	8.4
Republic of Ingushetia	15.4	3.2	2.5	9.7
Republic of Dagestan	12.1	2.2	3.3	6.6
Yamal-Nenets Autonomous Area	10.9	3.5	1.2	6.2
Khanty-MansiAutonomous Area – Yugra	8.1	1.6	1.7	4.8
Kabardino-Balkarian Republic	7.0	0.8	2.1	4.1
Republic of Sakha (Yakutia)	6.9	1.2	0.1	5.6
Tyumen Region	6.9	1.9	1.3	3.7
Republic of North Ossetia – Alania	4.3	1.0	2.0	1.3

According to: Natural movement of the population of the Russian Federation in 2023: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13269; Population of the Russian Federation by gender and age as of January 1, 2024: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Population of the Russian Federation by gender and age as of January 1, 2023: Statistical bulletin. Moscow, 2023. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Age-related birth rates for 2023 by constituent entities of the Russian Federation. EMISS. Available at: https://fedstat.ru/indicator/30973; The number of deaths by gender and five-year age groups in 2023 by constituent entities of the Russian Federation. EMISS. Available at: https://fedstat.ru/indicator/58775

In the Chechen Republic, the greatest contribution to the difference between the total natural population growth rate and the national value was made by higher age-related fertility rates (9.5‰ points). But the contribution of a more favorable gender and age structure was almost equally significant (8.4‰ points). The contribution of lower age-related mortality rates was significantly lower (1.3‰ points). In the Republic of Ingushetia, the main contribution was made by a more favorable gender and age structure (9.7‰ points). The contribution of age-related birth rates (3.2% points) and mortality (2.5‰ points) was significantly less.

In the Republic of Dagestan, Kabardino-Balkaria Republic and the Republic of Sakha (Yakutia), in the Tyumen Region, the Khanty-Mansi Autonomous Area–Yugra and the Yamal-Nenets Autonomous Area, as in the Republic of Ingushetia, the main contribution to ensuring natural population growth was made by a more favorable gender and age structure. At the same time, in the Republic of

Sakha (Yakutia), the contribution of lower age-related mortality rates was quite insignificant (0.1% points).

In the Republic of North Ossetia–Alania, on the contrary, the greatest contribution to the natural population growth was made by lower age-related mortality rates.

In the republics of Altai and Tyva, the Nenets and Chukotka Autonomous areas, higher age-related fertility rates and a more favorable gender and age structure made a positive contribution, while higher age-related mortality rates made a negative contribution. In the Altai Republic, the contribution of the birth rate was slightly higher, and in the Republic of Tuva, the Nenets and Chukotka Autonomous areas, the gender and age structure was higher. If in the Republic of Tuva and the Nenets Autonomous Area the positive contribution of fertility rates was comparable with the contribution of the gender and age structure, then in the Chukotka Autonomous Area the influence of the structural factor was much greater than the birth rate *(Tab. 3)*.

Table 3. Components of the difference between the total natural population growth rate and the national indicator in regions with natural population growth, higher fertility rates and a more favorable gender and age structure in 2023, ‰ points

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Republic of Tyva	11.7	7.2	-3.3	7.8
Altai Republic	5.6	4.0	-2.2	3.8
Nenets Autonomous Area	5.2	3.1	-1.5	3.6
Chukotka Autonomous Area	4.3	1.6	-3.2	5.9

According to: Natural movement of the population of the Russian Federation in 2023: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13269; Population of the Russian Federation by gender and age as of January 1, 2024: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Population of the Russian Federation by gender and age as of January 1, 2023: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Age-related birth rates for 2023 by constituent entities of the Russian Federation. EMISS. Available at: https://fedstat.ru/indicator/30973; Number of deaths by gender and five-year age groups in 2023 by constituent entities of the Russian Federation. EMISS. Available at: https://fedstat.ru/indicator/58775

In the Karachayevo-Circassian Republic, the total natural population growth rate in 2023 was 1.1 per 1,000 people, i.e. 4.6‰ points more than in Russia as a whole. The main contribution to this difference was made by a more favorable gender and age structure (2.9‰ points), somewhat less by lower age-related mortality rates (2.1‰ points). On the contrary, lower age-related fertility rates contributed to the reduction of this difference (by 0.4‰ points).

In Moscow, the dominant positive contribution, in contrast to the all-Russian total natural growth rate (3.9‰ points), is made by lower age-related mortality rates (5.3‰ points). The positive contribution of age-related fertility rates is significantly lower (0.5‰ points), while the negative contribution is made by a less favorable gender and age structure (1.9‰ points).

In 14 regions of the Russian Federation, the relative natural decline (per 1,000 people) in 2023 was less than in Russia as a whole.

In the republics of Kalmykia and Tatarstan, this is due to the positive influence of all three components: a favorable gender and age structure prevailed in the Republic of Kalmykia, and in the Republic of Tatarstan, low age-related mortality rates (Tab. 4).

In the republics of Bashkortostan and Buryatia, in the Trans-Baikal, Kamchatka and Krasnoyarsk territories, in the Astrakhan and Irkutsk regions, the relative lower natural population decline was due to higher age birth rates and a more favorable gender and age structure. In the Irkutsk Region, the influence of both of these components is almost the same; in other regions, the influence of the structure is more significant. On the contrary, the age-related mortality rates in these regions were higher than in Russia as a whole and contributed to a greater natural population decline (Tab. 5).

In the Republic of Adygea, the Stavropol Territory and the Moscow Region, the natural population decline was relatively lower than in Russia as a whole due to lower age mortality rates and a more favorable gender and age structure. At the same time, the influence of the structural component turned out to be more significant. The age-related birth rates in these regions were lower than the national ones and contributed to a greater natural population decline (Tab. 6).

Table 4. Components of the difference between the total natural population growth rate and the national indicator in regions with a lower natural population loss than in Russia as a whole, with higher birth rates, lower mortality rates and a more favorable gender and age structure in 2023, ‰ points

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Republic of Kalmykia	3.1	0.5	0.8	1.8
Republic of Tatarstan	1.8	0.2	1.2	0.4

According to: The natural movement of the population of the Russian Federation in 2023. Statistical bulletin. Moscow. 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13269; The population of the Russian Federation by gender and age as of January 1, 2024. Statistical bulletin. Moscow. 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13284; The population of the Russian Federation by gender and age as of January 1, 2023. Statistical bulletin. Moscow. 2023. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Age-related birth rates for 2023 by constituent entities of the Russian Federation. Government statistics. EMISS. URL: https://fedstat.ru/indicator/30973; Number of deaths by gender and five-year age groups in 2023 by constituent entities of the Russian Federation. Government statistics EMISS. Available at: https://fedstat.ru/indicator/58775

**Table 5. Components of the difference between the total natural population growth rate
and the national indicator in regions with a lower natural population loss than in Russia as a whole,
with higher birth rates and a more favorable gender and age structure of the population in 2023,
‰ points**

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Republic of Buryatia	2.2	1.5	-2.3	3.0
Kamchatka Territory	1.9	1.5	-2.0	2.4
Astrakhan Region	1.6	1.3	-1.2	1.5
Republic of Bashkortostan	0.5	0.1	-0.1	0.5
Krasnoyarsk Region	0.3	0.1	-1.5	1.7
Trans-Baikal Territory	0.3	1.3	-4.4	3.4
Irkutsk Region	0.2	1.4	-2.6	1.4
According to: Natural movement of the population of the Russian Federation in 2023: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13269; Population of the Russian Federation by gender and age as of January 1, 2024: statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Population of the Russian Federation by gender and age as of January 1, 2023: statistical bulletin. Moscow, 2023. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Age-related birth rates for 2023 by constituent entities of the Russian Federation. EMISS. Available at: https://fedstat.ru/indicator/30973; The number of deaths by gender and five-year age groups in 2023 by constituent entities of the Russian Federation. EMISS. Available at: https://fedstat.ru/indicator/58775				

**Table 6. Components of the difference between the total natural population growth rate
and the national indicator in regions with a lower natural population loss than in Russia as a whole,
with lower mortality rates and a more favorable gender and age structure in 2023, ‰ points**

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Republic of Adygea	1.7	-0.6	1.0	1.3
Stavropol Territory	1.2	-1.0	0.9	1.3
Moscow Region	1.0	-0.4	0.5	0.9
According to: Natural movement of the population of the Russian Federation in 2023: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13269; Population of the Russian Federation by gender and age as of January 1, 2024: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Population of the Russian Federation by gender and age as of January 1, 2023: Statistical bulletin. Moscow, 2023. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Age-related birth rates for 2023 by constituent entities of the Russian Federation. EMISS. Available at: https://fedstat.ru/indicator/30973; Number of deaths by gender and five-year age groups in 2023 by subjects of the Russian Federation. EMISS. Available at: https://fedstat.ru/indicator/58775				

In the Krasnodar Territory, higher age-related fertility rates (by 0.8‰ points) and lower mortality rates (by 0.2‰ points) contributed to a lower natural population decline (by 0.3‰ points) than in Russia as a whole. The gender and age structure, on the contrary, is less favorable than the national one. In Saint Petersburg, the relative natural population decline is lower (by 1.4‰ points) than in Russia as a whole, only due to lower age-related mortality rates.

In the Novosibirsk and Sakhalin regions, and in Sevastopol, the natural decline (per 1,000 people) in 2023 was the same as in Russia as a whole. At the same time, the Novosibirsk and Sakhalin regions have slightly higher age-related fertility rates and a more favorable gender and age structure, but slightly higher age-related mortality rates. Sevastopol has lower age-related mortality rates and a more favorable gender and age structure than the rest of the country, but lower age-related fertility rates have a negative impact *(Tab. 7)*.

The relative natural decline (per 1,000 people) was greater in 53 regions of the Russian Federation in 2023 than in Russia as a whole. It is highest in the Pskov Region – 10.0 people per 1,000 people, i.e. 1%. In the Smolensk Region, it was 9.4; in the Tver Region – 9.3; in the Vladimir, Novgorod and Orel regions – 9.1 people per 1,000 population.

In 23 regions, this is due to the influence of all three components (age-related fertility rate, age-related mortality rate, gender and age structure; *Tab. 8*).

The predominant influence of lower age-related birth rates occurs in the Belgorod, Rostov and Saratov regions. In the Smolensk Region, lower age-related fertility rates and higher age-related mortality rates are almost equally affected. In the Bryansk, Ivanovo, Kursk, Lipetsk, Nizhny Novgorod, Novgorod, Orel, Pskov and Tver regions, the relatively large natural population decline is most strongly influenced by higher age-related mortality rates. In 10 regions (Vladimir, Voronezh, Kaluga, Penza, Ryazan, Samara, Tambov, Tula, Ulyanovsk, and Yaroslavl regions) of this group, the gender and age structure has the greatest impact on the relatively large natural population decline than in Russia as a whole, and in the Kaluga, Ryazan, Tambov, Tula, and Ulyanovsk regions. The impact of this component exceeds the combined impact of lower age-related fertility rates and higher age-related mortality rates in the Voronezh and Yaroslavl regions – coincides with the combined effect of these two components.

Table 7. Component differences in the total natural population growth rate in regions with the same natural population decline as in Russia as a whole in 2023, ‰ points

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Novosibirsk Region	0.0	0.4	-0.9	0.5
Sakhalin Region	0.0	1.7	-2.1	0.4
Sevastopol	0.0	-2.7	1.8	0.9

According to: Natural movement of the population of the Russian Federation in 2023: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13269; Population of the Russian Federation by gender and age as of January 1, 2024: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Population of the Russian Federation by gender and age as of January 1, 2023: Statistical bulletin. Moscow, 2023. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Age-related birth rates for 2023 by constituent entities of the Russian Federation. EMISS. Available at: https://fedstat.ru/indicator/30973; The number of deaths by gender and five-year age groups in 2023 by constituent entities of the Russian Federation. EMISS. Available at: https://fedstat.ru/indicator/58775

**Table 8. Components of the difference between the total natural population growth rate
and the national indicator in regions with a greater natural population decline than in Russia as a whole,
with lower fertility rates, higher mortality rates and a less favorable gender and age structure in 2023,
‰ points**

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Rostov Region	-1.8	-1.0	-0.4	-0.4
Kaluga Region	-2.0	-0.4	-0.3	-1.3
Samara Region	-2.4	-0.6	-0.7	-1.1
Ulyanovsk Region	-3.1	-0.4	-0.9	-1.8
Belgorod Region	-3.3	-1.7	-0.2	-1.4
Saratov Region	-3.5	-1.9	-0.3	-1.3
Voronezh Region	-3.6	-1.2	-0.6	-1.8
Nizhny Novgorod Region	-3.6	-0.6	-1.7	-1.3
Lipetsk Region	-3.8	-1.1	-1.5	-1.2
Yaroslavl Region	-3.8	-0.4	-1.5	-1.9
Bryansk Region	-3.9	-1.3	-1.4	-1.2
Kursk Region	-3.9	-1.0	-1.5	-1.4
Penza Region	-4.7	-1.4	-1.3	-2.0
Ryazan Region	-5.3	-1.7	-0.8	-2.8
Tula Region	-5.3	-1.4	-0.9	-3.0
Ivanovo Region	-5.4	-0.4	-2.6	-2.4
Tambov Region	-5.4	-1.2	-1.1	-3.1
Vladimir Region	-5.6	-1.4	-1.9	-2.3
Orel Region	-5.6	-1.5	-2.5	-1.6
Novgorod Region	-5.6	-0.8	-3.1	-1.7
Tver Region	-5.8	-0.8	-2.8	-2.2
Smolensk Region	-5.9	-2.1	-2.1	-1.7
Pskov Region	-6.5	-0.6	-3.8	-2.1

According to: Natural movement of the population of the Russian Federation in 2023: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13269; Population of the Russian Federation by gender and age as of January 1, 2024: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Population of the Russian Federation by gender and age as of January 1, 2023: Statistical bulletin. Moscow, 2023. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Age-related birth rates for 2023 by constituent entities of the Russian Federation. EMISS. Available at: https://fedstat.ru/indicator/30973; Number of deaths by gender and five-year age groups in 2023 by constituent entities of the Russian Federation EMISS. Available at: https://fedstat.ru/indicator/58775

In five regions, the natural population decline in 2023 was relatively higher than in Russia as a whole, due to lower age-related fertility rates and higher age-related mortality rates, while the gender and age structure was more favorable than in the country as a whole *(Tab. 9)*.

**Table 9. Components of the difference between the total natural population growth rate
and the national indicator in regions with a greater natural population decline than in Russia as a whole,
with lower fertility rates and higher mortality rates in 2023,
‰ points**

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Tomsk Region	-0.2	-1.3	-0.2	1.3
Magadan Region	-0.3	-0.3	-2.8	2.8
Republic of Mari El	-0.9	-0.1	-0.9	0.1
Altai Territory	-3.1	-0.6	-2.6	0.1
Kemerovo Region	-3.1	-1.2	-2.1	0.2
According to: Natural movement of the population of the Russian Federation in 2023: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13269; Population of the Russian Federation by gender and age as of January 1, 2024: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Population of the Russian Federation by gender and age as of January 1, 2023: Statistical bulletin. Moscow, 2023. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Age-related birth rates for 2023 by constituent entities of the Russian Federation. EMISS. Available at: https://fedstat.ru/indicator/30973; Number of deaths by gender and five-year age groups in 2023 by constituent entities of the Russian Federation EMISS. Available at: https://fedstat.ru/indicator/58775				

In the Tomsk Region, relatively lower age-related birth rates had a more significant impact, while in the Republic of Mari El, the Altai Territory, the Kemerovo and Magadan regions, and higher age-related mortality rates.

In two regions, the relative natural population decline in 2023 was due to lower age-related fertility rates and an unfavorable gender and age structure. The influence of low birth rates was more significant in the Volgograd Region, and the age structure in the Republic of Mordovia *(Tab. 10)*.

**Table 10. Components of the difference between the total natural population growth rate
and the national indicator in regions with a greater natural population decline than in Russia as a whole,
with lower fertility rates and a less favorable gender and age structure in 2023,
‰ points**

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Volgograd Region	-2.5	-1.8	0.3	-1.0
Republic of Mordovia	-3.8	-2.0	0.5	-2.3
According to: Natural movement of the population of the Russian Federation in 2023: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13269; Population of the Russian Federation by gender and age as of January 1, 2024: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Population of the Russian Federation by gender and age as of January 1, 2023: Statistical bulletin. Moscow, 2023. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Age-related birth rates for 2023 by constituent entities of the Russian Federation. EMISS. Available at: https://fedstat.ru/indicator/30973; Number of deaths by gender and five-year age groups in 2023 by constituent entities of the Russian Federation EMISS. Available at: https://fedstat.ru/indicator/58775				

In 12 regions, a relatively large natural population decline is associated with higher age-related mortality rates and an unfavorable gender and age structure.

In the Republic of Karelia, the Vologda, Kurgan, Omsk, Orenburg, Sverdlovsk and Chelyabinsk regions, mortality makes a slightly greater contribution, while in the Republics of Crimea and Chuvashia, in the Kirov and Kostroma regions, it is the age structure. In the Arkhangelsk Region, the influence of both these components is almost the same *(Tab. 11)*.

In other regions, the relative natural population decline in 2023 was due to the influence of only one of the components.

In the Kaliningrad and Leningrad regions, these are lower age-related fertility rates *(Tab. 12)*.

In the republics of Komi, Udmurtia, Khakassia, the Perm, Primorye, and Khabarovsk territories, the Amur and Murmansk regions, and the Jewish Autonomous Region, the natural population decline was greater than in Russia as a whole due only to relatively higher age-related mortality rates *(Tab. 13)*.

It is important to note that if inter-regional comparisons and analysis of the dynamics of fertility and mortality are carried out on the basis of age coefficients and summary indicators (total fertility rate, average life expectancy), The gender and age structure analysis in terms

Table 11. Components of the difference between the total natural population growth rate and the national indicator in regions with a greater natural population decline than in Russia as a whole, with higher mortality rates and a less favorable gender and age structure in 2023, ‰ points

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Chelyabinsk Region	-0.4	0.3	-0.6	-0.1
Sverdlovsk Region	-0.7	0.8	-1.4	-0.1
Chuvash Republic	-0.9	0.0	-0.3	-0.6
Omsk Region	-1.3	0.4	-1.3	-0.4
Orenburg Region	-1.5	0.5	-1.8	-0.2
Republic of Crimea	-2.0	0.1	-1.0	-1.1
Vologda Region	-2.4	0.0	-1.8	-0.6
Arkhangelsk Region	-2.9	0.3	-1.6	-1.6
Kirov Region	-4.1	0.3	-1.4	-3.0
Kostroma Region	-4.2	0.7	-2.4	-2.5
Republic of Karelia	-4.9	0.7	-3.6	-2.0
Kurgan Region	-5.0	1.0	-3.1	-2.9

According to: Natural movement of the population of the Russian Federation in 2023: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13269; Population of the Russian Federation by gender and age as of January 1, 2024: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Population of the Russian Federation by gender and age as of January 1, 2023: Statistical bulletin. Moscow, 2023. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Age-related birth rates for 2023 by constituent entities of the Russian Federation. EMISS. Available at: https://fedstat.ru/indicator/30973; Number of deaths by gender and five-year age groups in 2023 by constituent entities of the Russian Federation EMISS. Available at: https://fedstat.ru/indicator/58775

of its impact on natural population growth is possible only on the basis of comparing actual indicators with standardized ones (eliminating the influence of the structural factor in territorial and dynamic comparisons) and more specifically using a modified index method.

**Table 12. Components of the difference between the total natural population growth rate
and the national indicator in regions with a greater natural population decline than in Russia as a whole,
with lower birth rates in 2023,
‰ points**

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Kaliningrad Region	-1.0	-1.3	0.0	0.3
Leningrad Region	-2.0	-3.4	1.1	0.3
According to: Natural movement of the population of the Russian Federation in 2023: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13269; Population of the Russian Federation by gender and age as of January 1, 2024: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Population of the Russian Federation by gender and age as of January 1, 2023: Statistical bulletin. Moscow, 2023. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Age-related birth rates for 2023 by constituent entities of the Russian Federation. EMISS. Available at: https://fedstat.ru/indicator/30973; Number of deaths by gender and five-year age groups in 2023 by constituent entities of the Russian Federation EMISS. Available at: https://fedstat.ru/indicator/58775				

**Table 13. Components of the difference between the total natural population growth rate
and the national indicator in regions with a greater natural population loss than in Russia as a whole,
with higher mortality rates in 2023, ‰ points**

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Republic of Khakassia	-0.1	0.5	-2.2	1.6
Udmurt Republic	-0.4	0.1	-1.0	0.5
Khabarovsk Territory	-0.7	0.3	-2.2	1.2
Perm Territory	-0.8	0.8	-1.8	0.2
Murmansk Region	-0.9	0.2	-2.5	1.4
Komi Republic	-1.2	0.9	-2.3	0.2
Amur Region	-1.4	0.4	-4.1	2.3
Jewish Autonomous Region	-1.7	0.7	-3.7	1.3
Primorye Territory	-1.9	0.2	-2.6	0.5
According to: Natural movement of the population of the Russian Federation in 2023: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13269; Population of the Russian Federation by gender and age as of January 1, 2024: Statistical bulletin. Moscow, 2024. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Population of the Russian Federation by gender and age as of January 1, 2023: Statistical bulletin. Moscow, 2023. Available at: https://rosstat.gov.ru/folder/11110/document/13284; Age-related birth rates for 2023 by constituent entities of the Russian Federation. EMISS. Available at: https://fedstat.ru/indicator/30973; Number of deaths by gender and five-year age groups in 2023 by constituent entities of the Russian Federation EMISS. Available at: https://fedstat.ru/indicator/58775				

Conclusion

The research results showed the possibility and expediency of a component analysis of the dynamics and regional differences of the total natural population growth rate based on the transformed index method with the replacement of the division of indicators by subtraction. This transformation is due to the fact that the total natural population growth rate can be either positive or negative, and when dividing the indicators by + or - it is leveled.

Groups of regions have been identified and analyzed in which the difference between the total natural population growth rate and the indicator in Russia as a whole is due to the influence of certain components: age-related fertility and mortality rates, and the gender and age structure.

The analysis showed that in most of the regions where natural population growth took place in 2023, the main positive contribution was made by a relatively favorable gender and age structure of the population (republics of Dagestan, Ingushetia, Kabardino-Balkaria, Karachay-Cherkessia, Sakha (Yakutia), Tuva; Tyumen Region; Nenets, Khanty-Mansi–Yugra, Chukotka and Yamal-Nenets autonomous areas). The predominant influence of higher age-related birth rates was observed in the Altai Republic and the Chechen Republic, while lower age-related death rates were observed in the Republic of North Ossetia–Alania and Moscow.

The structural component also made a major positive contribution in most regions where the relative natural population decline was lower than in Russia as a whole (republics of Adygea, Bashkortostan, Buryatia, Kalmykia; Trans-Baikal, Kamchatka, Krasnoyarsk, and Stavropol territories; Astrakhan and Moscow regions).

In many regions, the natural population decline in 2023 was relatively greater than in Russia as a whole, largely influenced by the gender and age structure, only in this case less favorable (in terms of natural population movement) than in the whole country (republics of Crimea, Mordovia and Chuvashia; Vladimir, Voronezh, Kaluga, Kirov, Kostroma, Penza, Ryazan, Samara, Tambov, Tula, Ulyanovsk and Yaroslavl regions). However, this was more often determined by higher age-related mortality rates (republics of Karelia, Komi, Mari El, Udmurtia and Khakassia; Altai, Perm, Primorye, and Khabarovsk territories; Amur, Bryansk, Volgograd, Vologda, Ivanovo, Kemerovo, Kurgan, Kursk, Lipetsk, Magadan, Murmansk, Nizhny Novgorod, Novgorod, Omsk, Orenburg, Orel, Pskov, Sverdlovsk, Tver and Chelyabinsk regions; Jewish Autonomous Region) or lower age birth rates (Belgorod, Kaliningrad, Leningrad, Rostov, Saratov, and Tomsk regions).

The analysis presented the most problematic components of the natural population movement in Russia's regions, forming the basis for prioritizing the directions and measures of regional demographic policy.

REFERENCES

Arkhangelskiy V.N., Potanina Yu.A., Khasanova R.R. (2015). Regional differences in the natural movement of the population in Russia. *Narodonaselenie=Population,* 4(70), 68–78 (in Russian).

Arkhangelskiy V.N., Revun V.I. (2009). The use of the index method in studying the components of natural population growth. *Narodonaselenie=Population,* 1, 27–35 (in Russian).

Arkhangelskiy V.N., Zolotareva O.A., Kuchmaeva O.V. (2024). Age-based fertility model for calendar years and real generations: Construction methodology and analytical capabilities. *Voprosy statistiki*, 31(6), 49–68. DOI: https://doi.org/10.34023/2313-6383-2024-31-6-49-68 (in Russian).

Arkhangelskiy V.N., Zin'kina Yu.V., Shulgin S.G. (2018). Demographic potential of sex-age structure as a factor of population dynamics. *Statistika i ekonomika=Statistics and Economics*, 6, 69–79. DOI: http://dx.doi.org/10.21686/2500-3925-2018-6-69-79 (in Russian).

Baeva O.N. (2012). Human Development Index: Methods of definition and assessment at the regional level. *Izvestiya BGU*, 5, 143–147 (in Russian).

Brovkova A.V. (2018). Statistical analysis of the uneven spatial development of Russian regions. *Promyshlennost': ekonomika, upravlenie, tekhnologii*, 5(74). Available at: https://cyberleninka.ru/article/n/statisticheskiy-analiz-neravnomernosti-prostranstvennogo-razvitiya-regionov-rossii (accessed: 16.06.2025; in Russian).

Dawidowicz A.L., Poskrobko A. (2009). On the age-dependent population dynamics with delayed dependence of the structure. *Nonlinear Analysis: Theory, Methods & Applications*, 71(12), 2657–2664. DOI: https://doi.org/10.1016/j.na.2009.06.019

Doignon Y., Blöss-Widmer I., Ambrosetti E., Oliveau S. (2023). *Population Dynamics in the Mediterranean. A Demographic Convergence?* Springer. DOI: https://doi.org/10.1007/978-3-031-37759-4

Dolbik-Vorobei T.A. (2023). Demographic and statistical analysis of the state and trends of population reproduction in Russia. *Voprosy ekonomiki i prava*, 10(184), 43–49. DOI: 10.14451/2.184.43 (in Russian).

Efimova L.A. (2015). The Human Development Index in Russia: Analysis and prospects. *Regional'naya ekonomika: teoriya i praktika*, 22(397), 53–62 (in Russian).

El'chinova G.I., Makarov A.Kh.M., Revazova Yu.A., Petrin A.N., Zinchenko R.A. (2016). Reproductive characteristics and the Crow index of the rural and urban population of Karachay-Cherkessia. *Vestnik Moskovskogo universiteta. Seriya 23: Antropologiya*, 4, 118–126 (in Russian).

Ermekbaeva G.A., Melisova S.A. (2022). Assessment of fertility factors and reproduction regime in Kyrgyzstan. *Nauka, novye tekhnologii i innovatsii Kyrgyzstana*, 9, 173–176. DOI: 10.26104/NNTIK.2023.78.51.035 (in Russian).

Esikova V.O. (2023). Geoinformation monitoring of population reproduction in Russia. *Nauka. Innovatsii. Tekhnologii*, 2, 53–90. DOI: 10.37493/2308-4758.2023.2.3 (in Russian).

Islam M.M., Sahoo H., Akib M.S.A., Sanjowal R.K. (2024). Population age structure and sex composition in Bangladesh, China and India: A comparative study. *International Journal of Population Issues*, 1(2), 118–146. DOI: https://doi.org/10.36312/ijpi.v1i2.2077

Isupov V.A. (2015). Birth rate of the Russian population in 1939–1945. *Rossiiskaya istoriya*, 1, 3–18 (in Russian).

Ivanova E.I. (2014). Structural and social health factors of the Russian population. *Vestnik RGGU. Seriya: Filosofiya. Sotsiologiya. Iskusstvovedenie*, 4(126), 138–155 (in Russian).

Kashepov A.V. (2020). Socio-economic factors of mortality from 2000 to 2020. *Sotsial'no-trudovye issledovaniya=Social and Labor Research*, 40(3), 18–30. DOI: 10.34022/2658-3712-2020-40-3-18-30 (in Russian).

Kurbatova O.L., Pobedonostseva E.Yu., Gurgenova F.R., Bulaeva K.B. (2012). Variability of parameters of natural reproduction and the Crow index in ethnic groups of Dagestan. *Genetika*, 48(10), 1221 (in Russian).

Notestein F.W. (1960). Mortality, fertility, the size-age distribution and the growth rate. In: *Demographic and Economic Change in Developed Countries.* Columbia University Press. Available at: https://findingaids.princeton.edu/catalog/MC184_c0198

Reutov V.E., Kravchenko L.A., Vel'gosh N.Z. (2019). Socio-economic problems of human potential development in Russia and its regions. *Servis v Rossii i za rubezhom*, 2(84), 69–82. DOI: 10.24411/1995-042X-2019-10207 (in Russian).

Rybakovskii L.L., Fadeeva T.A. (2024). Regional dynamics of the birth rate of the Russian population in the second fifteen years of the 21st century. *Uroven' zhizni naseleniya regionov Rossii=Living Standards of the Population in the Regions of Russia,* 20(2), 271–281. DOI: https://doi.org/10.52180/1999-9836_2024_20_2_10_271_281 (in Russian).

Rybakovskii L.L., Rybakovskii O.L. (2023). Depopulation in Russia: results for 1992-2022, components and compensation of migration at the regional level. *Sotsial'no-trudovye issledovaniya=Social and Labor Research*, 51(2), 16–26. DOI: 10.34022/2658-3712-2023-51-2-16-26 (in Russian).

Rybakovskii O.L. (2024b). Depopulation in the regions of the Asian part of Russia in 1992–2024. *Sotsial'no-trudovye issledovaniya=Social and Labor Research,* 4(57), 101–107. DOI: 10.34022/2658-3712-2024-57-4-101-107 (in Russian).

Rybakovsky O.L. (2024a). Reproduction of the population of regions of Russia in 1992–2024: Results, components, factors. *Narodonaselenie=Population,* 27(4), 4–17. DOI: 10.24412 / 1561-7785-2024-4-4-17 (in Russian).

Rybakovsky O.L., Fadeeva T.A. (2020). Depopulation in Russian regions by early 2020. *Narodonaselenie=Population,* 3(23), 119–129. DOI: https://doi.org/10.19181/population.2020.23.3.11 (in Russian).

Rybakovsky O.L., Tayunova O.A. (2019). Demographic dynamics of Russian regions and its components in 1959–2017. *Narodonaselenie=Population,* 22(1), 4–20. DOI: https://doi.org/10.19181/1561-7785-2019-00001 (in Russian).

Sharilova E.E. (2015). Statistical assessment and analysis of the demographic significance of the age structure of the population of the Republic of Belarus. *Voprosy statistiki*, 3, 48–56. DOI: https://doi.org/10.34023/2313-6383-2015-0-3-48-56 (in Russian).

Shokamanov Yu.K., Demesinova A.A. (2024). The use of the index method in the analysis of fertility in the Republic of Kazakhstan and its regions in 2009–2022. *Voprosy statistiki*, 31(3), 65–79. DOI: https://doi.org/10.34023/2313-6383-2024-31-3-65-79 (in Russian).

Spitsyna N.Kh., Balinova N.V. (2023). Variability of natural reproduction processes in the population of Cheboksary in 1989 and 2019. *Meditsinskaya genetika*, 22(8), 30–36. DOI: https://doi.org/10.25557/2073-7998.2023.08.30-36 (in Russian).

Vasil'eva E.K. (2016). Index analysis of the birth rate in the methodological support system of municipal statistics. *Voprosy statistiki*, 4, 13–22. DOI: https://doi.org/10.34023/2313-6383-2016-0-4-13-22 (in Russian).

INFORMATION ABOUT THE AUTHORS

Vladimir N. Arkhangelskiy – Candidate of Sciences (Economics), head of department, Institute of Demographic Research FCTAS RAS (Building 1, Fotieva Street, Moscow, 119333, Russian Federation; e-mail: archangelsky@yandex.ru)

Evgeniya P. Sigareva – Candidate of Sciences (Economics), Leading Researcher, Institute of Demographic Research FCTAS RAS (Building 1, Fotieva Street, Moscow, 119333, Russian Federation; e-mail: sigarevae@mail.ru)

Svetlana Yu. Sivoplyasova – Candidate of Sciences (Economics), Leading Researcher, Institute of Demographic Research FCTAS RAS (Building 1, Fotieva Street, Moscow, 119333, Russian Federation; e-mail: svetlankamos84@rambler.ru)

ЛИТЕРАТУРА

Архангельский В.Н., Ревун В.И. (2009). Использование индексного метода в изучении компонент естественного прироста населения // Народонаселение. № 1. С. 27–35.

Архангельский В.Н., Потанина Ю.А., Хасанова Р.Р. (2015). Региональные различия естественного движения населения в России // Народонаселение. № 4 (70). С. 68–78.

Архангельский В.Н., Зинькина Ю.В., Шульгин С.Г. (2018). Демографический потенциал половозрастной структуры как фактор динамики численности населения // Статистика и экономика. № 6. С. 69–79. DOI: http://dx.doi.org/10.21686/2500-3925-2018-6-69-79

Архангельский В.Н., Золотарева О.А., Кучмаева О.В. (2024). Возрастная модель рождаемости для календарных лет и реальных поколений: методика построения и аналитические возможности // Вопросы статистики. Т. 31. № 6. С. 49–68. DOI: https://doi.org/10.34023/2313-6383-2024-31-6-49-68

Баева О.Н. (2012). Индекс человеческого развития: методики определения и оценки на уровне региона // Известия БГУ. № 5. С. 143–147.

Бровкова А.В. (2018). Статистический анализ неравномерности пространственного развития регионов России // Промышленность: экономика, управление, технологии. № 5 (74). URL: https://cyberleninka.ru/article/n/statisticheskiy-analiz-neravnomernosti-prostranstvennogo-razvitiya-regionov-rossii (дата обращения 16.06.2025).

Васильева Э.К. (2016). Индексный анализ рождаемости в системе методического обеспечения муниципальной статистики // Вопросы статистики. № 4. С. 13–22. DOI: https://doi.org/10.34023/2313-6383-2016-0-4-13-22

Долбик-Воробей Т.А. (2023). Демографо-статистический анализ состояния и тенденций воспроизводства населения в России // Вопросы экономики и права. № 10 (184). С. 43–49. DOI: 10.14451/2.184.43

Ельчинова Г.И., Макаров А.Х.М., Ревазова Ю.А., Петрин А.Н., Зинченко Р.А. (2016). Репродуктивная характеристика и индекс Кроу сельского и городского населения Карачаево-Черкесии // Вестник Московского университета. Серия 23: Антропология. № 4. С. 118–126.

Ермекбаева Г.А., Мэлисова С.А. (2022). Оценка факторов рождаемости и режима воспроизводства населения Кыргызстана // Наука, новые технологии и инновации Кыргызстана. № 9. С. 173–176. DOI: 10.26104/NNTIK.2023.78.51.035

Есикова В.О. (2023). Геоинформационный мониторинг воспроизводства населения в России // Наука. Инновации. Технологии. № 2. С. 53–90. DOI: 10.37493/2308-4758.2023.2.3

Ефимова Л.А. (2015). Индекс человеческого развития в России: анализ и перспективы // Региональная экономика: теория и практика. № 22 (397). С. 53–62.

Иванова Е.И. (2014). Структурные и социальные факторы здоровья населения России // Вестник РГГУ. Серия: Философия. Социология. Искусствоведение. № 4 (126). С. 138–155.

Исупов В.А. (2015). Рождаемость населения России в 1939–1945 гг. // Российская история. № 1. С. 3–18.

Кашепов А.В. (2020). Социально-экономические факторы смертности в период с 2000 по 2020 гг. // Социально-трудовые исследования. № 40 (3). С. 18–30. DOI: 10.34022/2658-3712-2020-40-3-18-30

Курбатова О.Л., Победоносцева Е.Ю., Гургенова Ф.Р., Булаева К.Б. (2012). Изменчивость параметров естественного воспроизводства и индекса Кроу в этнических группах Дагестана // Генетика. Т. 48. № 10. С. 1221.

Реутов В.Е., Кравченко Л.А., Вельгош Н.З. (2019). Социально-экономические проблемы развития человеческого потенциала России и её регионов // Сервис в России и за рубежом. № 2 (84). С. 69–82. DOI: 10.24411/1995-042X-2019-10207

Рыбаковский Л.Л., Рыбаковский О.Л. (2023). Депопуляция в России: итоги за 1992–2022 гг., компоненты и компенсация миграцией на региональном уровне // Социально-трудовые исследования. № 51 (2). С. 16–26. DOI: 10.34022/2658-3712-2023-51-2-16-26

Рыбаковский Л.Л., Фадеева Т.А. (2024). Региональная динамика рождаемости населения России во второе пятнадцатилетие XXI столетия // Уровень жизни населения регионов России. Т. 20. № 2. С. 271–281. DOI: https://doi.org/10.52180/1999-9836_2024_20_2_10_271_281

Рыбаковский О.Л., Таюнова О.А. (2019). Демографическая динамика регионов России и её компоненты в 1959–2017 гг. // Народонаселение. Т. 22. № 1. С. 4–20. DOI: https://doi.org/10.19181/1561-7785-2019-00001

Рыбаковский О.Л., Фадеева Т.А. (2020). Депопуляция в регионах России к началу 2020 года // Народонаселение. № 3 (23). С. 119–129. DOI: https://doi.org/10.19181/population.2020.23.3.11

Рыбаковский О.Л. (2024a). Воспроизводство населения регионов России в 1992–2024 гг.: итоги, компоненты, факторы // Народонаселение. Т. 27. № 4. С. 4–17. DOI: 10.24412 / 1561-7785-2024-4-4-17

Рыбаковский О.Л. (2024b). Депопуляция в регионах азиатской части России в 1992–2024 гг. // Социально-трудовые исследования. № 4 (57). С. 101–107. DOI: 10.34022/2658-3712-2024-57-4-101-107

Спицына Н.Х., Балинова Н.В. (2023). Изменчивость процессов естественного воспроизводства в популяции города Чебоксары в 1989 и 2019 гг. // Медицинская генетика. № 22 (8). С. 30–36. DOI: https://doi.org/10.25557/2073-7998.2023.08.30-36

Шарилова Е.Е. (2015). Статистическая оценка и анализ демографической значимости возрастной структуры населения Республики Беларусь // Вопросы статистики. № 3. С. 48–56. DOI: https://doi.org/10.34023/2313-6383-2015-0-3-48-56

Шокаманов Ю.К., Демесинова А.А. (2024). Использование индексного метода в анализе рождаемости в Республике Казахстан и ее регионах в 2009–2022 годах // Вопросы статистики. Т. 31. № 3. С. 65–79. DOI: https://doi.org/10.34023/2313-6383-2024-31-3-65-79

Dawidowicz A.L., Poskrobko A. (2009). On the age-dependent population dynamics with delayed dependence of the structure. *Nonlinear Analysis: Theory, Methods & Applications*, 71(12), 2657–2664. DOI: https://doi.org/10.1016/j.na.2009.06.019

Doignon Y., Blöss-Widmer I., Ambrosetti E., Oliveau S. (2023). *Population Dynamics in the Mediterranean. A Demographic Convergence?* Springer. DOI: https://doi.org/10.1007/978-3-031-37759-4

Islam M.M., Sahoo H., Akib M.S.A., Sanjowal R.K. (2024). Population age structure and sex composition in Bangladesh, China and India: A comparative study. *International Journal of Population Issues*, 1(2), 118–146. DOI: https://doi.org/10.36312/ijpi.v1i2.2077

Notestein F.W. (1960). Mortality, fertility, the size-age distribution and the growth rate. In: *Demographic and Economic Change in Developed Countries*. Columbia University Press. Available at: https://findingaids.princeton.edu/catalog/MC184_c0198

ИНФОРМАЦИЯ ОБ АВТОРАХ

Владимир Николаевич Архангельский – кандидат экономических наук, заведующий отделом, Институт демографических исследований, ФНИСЦ РАН (Российская Федерация, 119333, г. Москва, ул. Фотиевой, д. 6, к. 1; e-mail: archangelsky@yandex.ru)

Евгения Петровна Сигарева – кандидат экономических наук, ведущий научный сотрудник, Институт демографических исследований, ФНИСЦ РАН (Российская Федерация, 119333, г. Москва, ул. Фотиевой, д. 6, к. 1; e-mail: sigarevae@mail.ru)

Светлана Юрьевна Сивоплясова – кандидат экономических наук, ведущий научный сотрудник, Институт демографических исследований, ФНИСЦ РАН (Российская Федерация, 119333, г. Москва, ул. Фотиевой, д. 6, к. 1; e-mail: svetlankamos84@rambler.ru)