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Demographic Security of Russia: Trends and Forecasts

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Abstract. Currently, the analysis of trends and the assessment of promising parameters characterizing the situation regarding demographic security in Russia attract the attention of the country's leading scientists, officials, managers of various levels, and politicians. Such interest is due to the understanding of the role of the demographic component as the key one in ensuring national security. The parameters of demographic security are contained in several strategic initiatives, in particular in the National Security Strategy of the Russian Federation. This determines not just the relevance, but also a dramatic increase in the importance of analyzing the current state and trends of demographic indicators, as well as building their forecast estimates in order to design and construct more favorable parameters for the development of society. Methodological basis of the study includes techniques and methods of comparative analytics, descriptive statistics and adaptive forecasting. The analysis and development of forecasts were carried out on the basis of official statistics provided by Rosstat. When assessing differences in population dynamics

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in accordance with current accounting and with the data obtained as a result of recalculation using the results of the 2020 All-Russian Population Census, we identified different periods of depopulation. The analysis of retrospective data on demographic parameters and the demographic forecasts determine in the short term the continuation of the second wave of depopulation, while its attenuation and the vector toward achieving demographic security are possible if an optimistic scenario is implemented. An optimistic scenario (achieving an increase in the birth rate) is assumed when developing a mechanism that allows implementing the proposed set of recommendations – measures aimed at increasing the birth rate.

Key words: demographic security, challenges and threats, depopulation, total fertility rate, maternity capital, measures to support families with children.

Introduction

Currently, the priority areas in Russia include preservation of the people of Russia and development of human potential; they are determined by the approved National Development Goals of the Russian Federation for the period up to 2030 and for the perspective up to 2036[1], as well as the national interests of the country, enshrined in the National Security Strategy of the Russian Federation[2] and in fact representing a single, integral system of interrelated components of national security, such as demographic security, state and public security, cultural and ideological, military, economic and other types of national security.

Demographic security is a kind of cornerstone (core) in the national security system (Ageev, Zolotareva, 2023). We agree with I.A. Aleshkovsky who argues that without demographic security, whatever model of economic development Russia chooses, "there can be no question of leadership in global politics and economics" (Aleshkovsky, 2012).

Today, Russia is losing its dominant position on the demographic map of the globe. According to the UN, Russia will lose 5 positions in the world population hierarchy by 2050 and will drop from 9th to 14th place in 2022 *(Fig. 1)*.

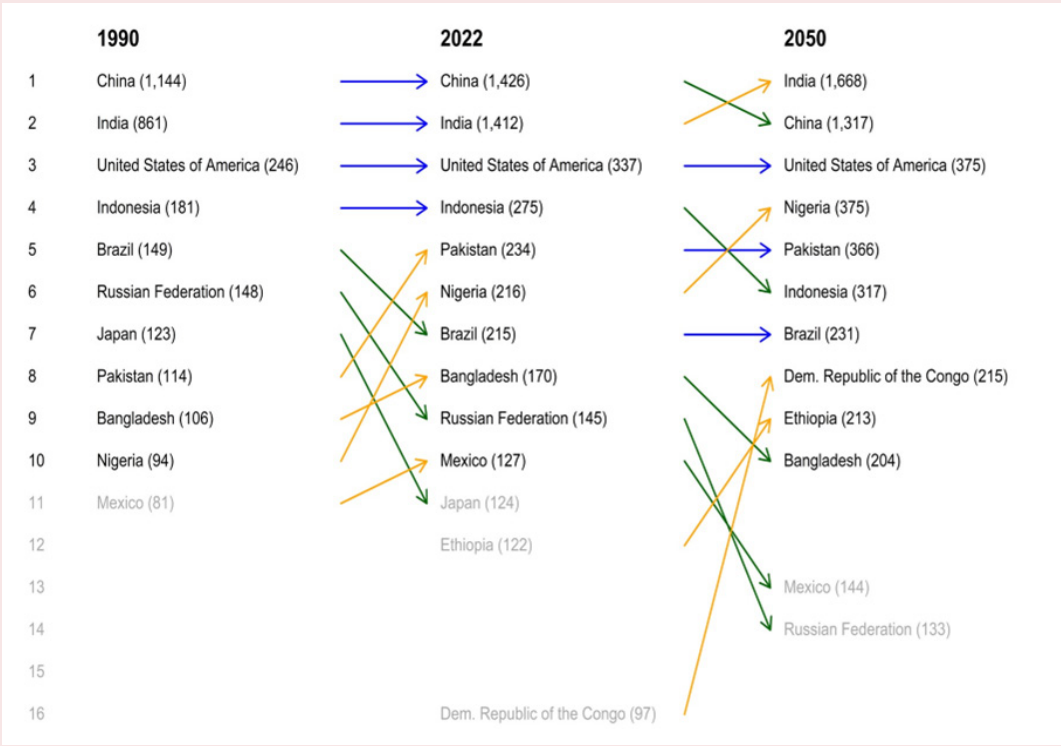
The viability of an ethnic group, people and the state as a whole is directly related to the size of the population, its age and sex structure, family structure, health status, active longevity and, accordingly, life expectancy, etc. The downward population dynamics with a narrowed natural reproduction lead to an inevitable decrease in population density, which predetermines threats to demographic security. Among such threats, demographic expansion is of particular importance, involving a significant transformation of the ethnic structure of a number of regions (when the undeveloped and devastated territories of Russia are filled with migrants from other countries, primarily with very high population density, and conflict zones), loss of historically dominant cultural values, religious, political, etc. positions, and loss of a part of the ancestral territory of residence (as an extreme form of manifestation of demographic expansion).

That is why issues related to national demographic development have become the most important link in the chain of accumulated problems in modern Russian society (Vasilieva et

[1] On the national development goals of the Russian Federation for the period up to 2030 and for the perspective up to 2036: Presidential Decree 309, dated May 7, 2024. Available at: http://www.kremlin.ru/events/president/news/63728

[2] On the National Security Strategy of the Russian Federation: Presidential Decree 400, dated July 2, 2021. Available at: https://www.garant.ru/products/ipo/prime/doc/401325792/

Figure 1. Rating of countries by population



Source: World Population Prospects 2022. Available at: https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/wpp2022_summary_of_results.pdf

al., 2021). Anxiety about the difficult demographic situation can be traced in a number of works by Russian scientists, and in various fields of scientific knowledge: demography, ethnography, sociology, political science, etc. The terms "demographic crisis" and "depopulation" are now used quite frequently, but the catastrophic implications for Russian society and statehood that these phenomena can entail while maintaining negative trends in the future are often not realized. In this context, the task of ensuring the demographic security of modern Russia falls into the category of the most acute problems on a national scale.

According to EMISS, total fertility rate for 2023 was 1.41[3], which is 0.42% less than in 2022. This largely indicates the stability of the indicator (a slight decrease), but determines its critically low value since 2007, when the Concept of Demographic Policy of the Russian Federation for the period up to 20254 was adopted and began to be implemented.

It is quite obvious that in order to achieve demographic security, it is necessary to overcome depopulation processes in society and improve population reproduction. This, in turn, requires the scientifically sound development of additional / updating of existing demographic and socio-economic programs based on comprehensive statistical research in relation to established trends, as well as a prospective assessment of demographic parameters.

[3] EMISS. Government statistics. Total fertility rate. Available at: https://www.fedstat.ru/indicator/31517

[4] On approving the Concept for Demographic Policy of the Russian Federation for the period up to 2025: Presidential Decree 1351, dated October 9, 2007. Available at: http://kremlin.ru/acts/bank/26299

The aim of our work is to identify emerging trends in key parameters of demographic security in Russia, and to forecast total fertility rate, which will allow us to draw conclusions about obstacles to achieving demographic security in Russia and propose a set of relevant measures aimed at increasing fertility. To achieve the goal, we analyzed the views on understanding the essence of demographic security and defined an approach to its assessment, according to which we consider the retrospective dynamics of parameters characterizing population change, the level of depopulation development and total fertility rate, etc. We provide our own forecasts as well as Rosstat's perspective estimates regarding key indicators of demographic security.

Theoretical overview

First, special attention should be paid to the essence of the object of our study; thus, we consider its conceptual framework, which is substantiated by its exceptional role in determining the logic of analysis, defining state policy priorities, and making effective management decisions (Rostovskaya, Zolotareva, 2022) aimed at ensuring demographic security. In this regard, the points of view of various scientists on the definition of the term "demographic security" are considered and analyzed *(Fig. 2)*.

The definitions show ambiguity of interpretation of the term "demographic security" in the scientific literature. Moreover, there is no approved terminology at the state level (in the Concept for Demographic Policy of the Russian Federation for

Figure 2. Some approaches to the definition of "demographic security"

L.L. Rybakovsky

Demographic security can be represented as a state of demographic processes that is sufficient for population reproduction without significant external influence and the provision of human resources for the geopolitical interests of the country.

S.V. Soboleva

Demographic security is a state of protection of life, continuous natural population reproduction and the formation of demographic structures (sex, age, family, ethnic) from demographic threats, supported by an institutional environment.

Demographic threats are phenomena, trends and actions that negatively affect the functioning of the demographic sphere and contradict national and (or) regional goals of demographic development, violate the integrity, independence and sovereignty of the state.

V.G Glushkova and O.B. Khoreva

Demographic security is the functioning and development of the population as such in its age, sex and ethnaic parameters, its correlation with the national interests of the state, which consist in ensuring its integrity, independence, sovereignty and preservation of the existing geopolitical status.

A. Dzhaganova

Demographic security is the situaiton when the socio-economic development of the state and society is protected from demographic threats, including depopulation, population aging, unregulated migration processes, degradation of the institution of family.

Source: own compilation.

the period up to 2025[5], Presidential Decree 606 "On measures to implement the demographic policy of the Russian Federation" dated May 7, 2012[6], etc.). At the same time, the importance of demographic security, which represents a kind of platform for all other aspects of national security, without exception, is undoubtedly increasing in the modern world (Ageev, Zolotareva, 2023; Aleshkovsky, 2012; Ryazantsev, Miryazov, 2021).

We should note that the academic community has different approaches to determining the list of indicators to analyze demographic security. For example, L.P. Shakhotko and N.N. Privalova identify nine indicators (Shakhotko, Privalova, 2001), according to which we can talk about: (1) a systematic approach to assessing demographic security, taking into account the possibility of comparative characteristics with their threshold/critical values; (2) an orientation toward classical socio-demographic parameters, which have been developed in statistical practice and are given in official publications of state statistics. However, with the uniqueness of this approach and a certain validity, the proposed system of metrics has disadvantages: in some cases, it is the absence of a specific numerical threshold value and an indication, for example, of the "level of economically developed countries" (there is a variation by country, which level should be the reference: average, minimum, maximum, etc.); the absence of population change parameters (emphasis is placed on fertility, morbidity and mortality rates). The second drawback definitely plays a significant role. The population may increase when covering natural loss with migration growth, or vice versa – decrease with a large-scale outflow of population even with natural growth, which, undoubtedly, is reflected in the level of demographic security.

N.D. Epshtein and co-authors present a fairly detailed system of demographic security indicators containing three blocks of indicators that not only cover the levels of "certain aspects of demographic security", but also characterize their changes and consequences (Epshtein et al., 2013). This approach has both advantages and disadvantages. On the one hand, the complexity of the proposed system of indicators makes it possible to identify a negative impact on the course of social development; on the other hand, such a wide range of indicators does not include, for example, characteristics of marital status (in particular, an increase in the propensity of the population to marry early and late, etc.), which, in our opinion, contradicts the logic of the study of these authors, because the "aspects of demographic security" they highlight include the threat of "negative changes in residents' marital and family composition".

The National Demographic Report "Demographic Well-Being of Russia", published in 2022 by the Institute for Demographic Research FCTAS RAS, identifies the following indicators for assessing demographic well-being (the achievement of which, in fact, should determine security): 1) upward population dynamics; 2) positive natural and migration growth; 3) total fertility rate of more than 2.14–2.15 children per woman; 4) mortality structure with a moderate contribution of external (preventable) causes of death; 5) balanced sex and age structure of the population (Ryazantsev et al., 2022).

Undoubtedly, it is possible to cite a wider range of approaches to assessing demographic security[7]

[5] On approving the Concept for Demographic Policy of the Russian Federation for the period up to 2025: Presidential Decree 1351, dated October 9, 2007. Available at: http://kremlin.ru/acts/bank/26299

[6] On measures to implement the demographic policy of the Russian Federation: Presidential Decree 606, dated May 7, 2012 (as amended on October 18, 2017; November 9, 2018; March 20, November 25, 2019; January 13, 2023). Available at: https://base.garant.ru/70170932/

[7] Aleshkovsky I.A. Demographic crisis as a threat to Russia's national security. Available at: http://www.intelros.ru/vek-globalizacii/ya2-2012/18423-demografichtskiy-krizis-kak-ugroza-nacionalnoy-bezopasnosti-rossii.html; Denisenko M.B. Will Russia withstand the demographic blow? Available at: http://www.aif.ru/onlineconf/1392868

(Rybakovsky, 2003; Soboleva, 2016, etc.) and present a more complete critical analysis of one approach or another; but let us focus on the following conclusions: first, there is currently no single approach to assessing demographic security, which is typical for science (here we should quote L.I. Abalkin's words that no one has a monopoly on the truth8); second, scientists proceed from their own theoretical views, their own research findings, the interpretation (again partly subjective) of the actual situation, etc.

The generalization of existing approaches and the study of indicators (direct and/or indirect) approved in strategic documents in the field of demographic policy provided the basis for analyzing the state of demographic security based on the following indicators: the population of Russia and its growth rate, the depopulation coefficient (taking into account fertility and mortality) and the total fertility rate.

Thus, the study will use the concept of "demographic security" in the context of the term proposed by L.L. Rybakovsky, that is, data on the regulation of migration processes are excluded, attention is focused on the dynamics of the population (Rybakovsky, 2023a) and the total fertility rate.

Data and methods

The paper presents data analysis on the main parameters of demographic security, logically proceeding to an assessment of forecast values, which makes it possible to propose substantiated measures in the field of national demographic development. The assessment of population changes and depopulation trends, and the forecast of total fertility rate are carried out on the basis of Rosstat state statistics.

Demographic scales, groupings, index analysis methods, time series forecasting techniques, tabular and graphical data representation methods are used as statistical tools.

Forecasting will be carried out with the help of ARIMA, Holt, and Brown models. The practice of using adaptive forecasting methods is quite successful and is presented in many foreign works9 (Garcia et al., 2012; Maniatis, 2012), in particular, forecasting mortality (Lawrence, 1996), fertility (Keilman et al., 2002), migration (Gorbey et al., 1999).

Adaptive models for forecasting in Russian research are mainly used in assessing the prospective values of economic parameters. As noted by T.K. Rostovskaya and O.A. Zolotareva (Rostovskaya, Zolotareva, 2023), the works of R.H. Bakhitova and co-authors (Bakhitova et al., 2016), E.V. Pavlovsky (Pavlovsky, 2017), N.A. Sadovnikova and O.A. Zolotareva (Sadovnikova, Zolotareva, 2020), in which demographic indicators are forecasted by adaptive methods and are almost the only ones of their kind.

Data processing and forecast development were carried out in the "SPSS" application software package.

Based on the IBM SPSS Statistics software, when implementing the forecasting procedure, we obtained the following:

- by an expert in model building – the Brown exponential smoothing model;
- by brute force modeling: ARIMA (portfolio includes more than 30 models) and the Holt exponential smoothing model.

The final forecast model was chosen on the basis of (1) formal statistical criteria: the coefficient of determination (R^2) and the mean absolute percentage error (MAPE); (2) the method of indirect verification – comparison of the obtained forecast values with the forecast values from other sources (Rosstat).

[8] Economic portal. Abalkin Readings: Political economy and economic policy. Available at: https://institutiones.com/personalities/2206-abalkinskie-chteniya.html

[9] Ruppert D., Matteson D.S. (2015). Statistics and Data Analysis for Financial Engineering. Available at: https://link.springer.com/book/10.1007%2F978-1-4939-2614-5

The ARIMA model connects:

✓ an autoregression model of the *p* order:

$$AR(p): y_t = c + \varphi_1 y_{(t-1)} + \varphi_2 y_{(t-2)} + \cdots + \varphi_p y_{(y-p)} + \varepsilon_t,$$

shows the dependence of the value of the current period on the past values of *p*-periods.

✓ a moving average model of the *q* order:

$$MA(q): y_t = c + \varepsilon_t + \theta_1 \varepsilon_{(t-1)} + \theta_2 \varepsilon_{(t-2)} + \cdots + \theta_q \varepsilon_{(t-q)},$$

shows the dependence of the value of the current period on the prediction errors of previous *q* periods[10].

In other words: *p* – order of the autoregressive part of the model; *q* – order of the moving average part.

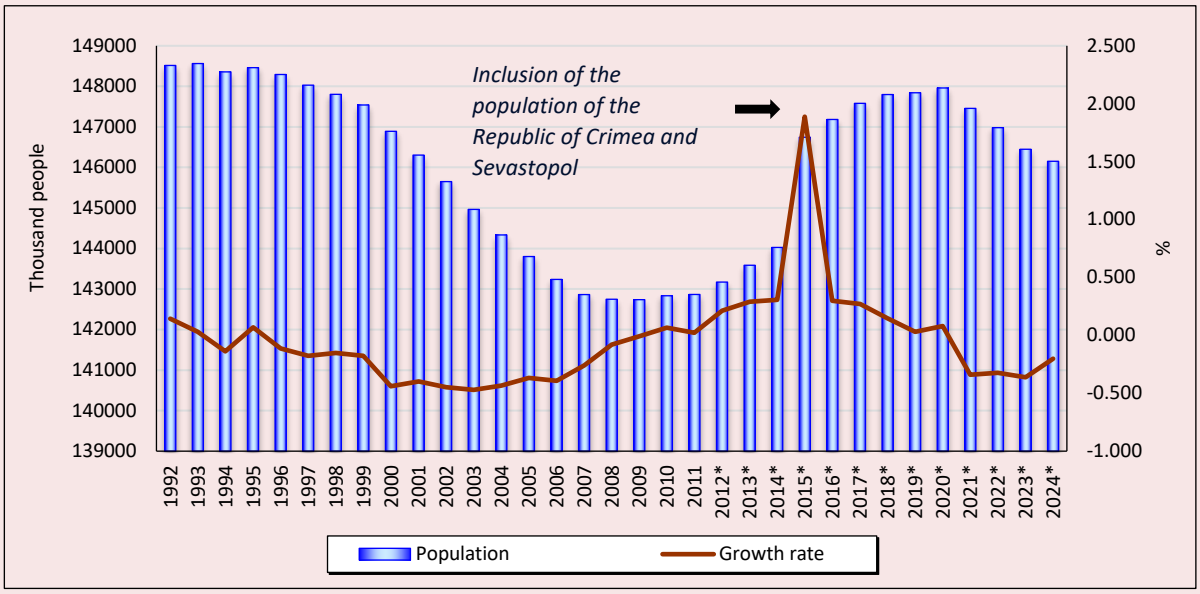
In general, the proposed tools allow us to obtain a relevant assessment of the forecasted values of demographic parameters.

Results

Analysis of demographic security indicators

Population scale and dynamics are the initial parameters for assessing demographic security. The demographic policy concept has approved the goal of creating conditions for population growth to 145 million people by 2025. The achievement of this value can be determined by various factors, both demographic (changes in natural and migration processes) and political (decisions on territorial expansion of the country; there has already been an example in recent practice – a positive increase in the population of Russia in 201411; *Fig. 3*).

Figure 3. Dynamics of the Russian population, data as of January 1, 1992–2024



* Population data for January 1, 2012–2024 have been recalculated taking into account the results of the 2020 All-Russian Population Census.

Source: Rosstat.

[10] Machine learning, neural networks, artificial intelligence. How to create an ARIMA model for forecasting time series in Python. Available at: https://machinelearningmastery.ru/arima-for-time-series-forecasting-with-python/; The ARIMA model in Python for forecasting time series. Available at: https://pythonpip.ru/examples/model-arima-v-python; The ARIMA model. Working group "Center for Macroeconomic Forecasting". National Research University Higher School of Economics. Available at: https://economics.hse.ru/cmf/models_ARIMA

[11] Four new regions are included in the list of constituent entities of the Russian Federation: What will change now. Available at: https://rg.ru/2022/10/06/chetyre-novyh-regiona-vkliucheny-v-perechen-subektov-rf-chto-teper-pomeniaetsia.html

As of January 1, 2024, the population of Russia amounted to 146 million 151 thousand people, having decreased by 2 million 364 thousand people in 32 years (as of January 1, 1992 – 148 million 515 thousand people).

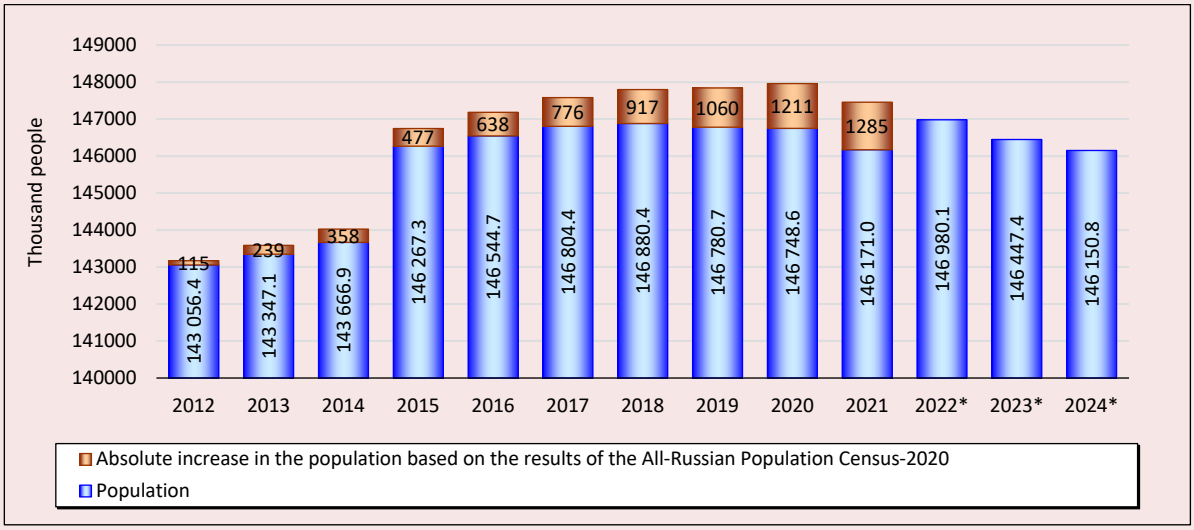
In addition to the increase in the population of Russia due to the accession of the Republic of Crimea and the city of Sevastopol to the Russian Federation, the population change in connection with the 2020 All-Russian Population Census (ARPC-2020; *Fig. 4*) is also of interest. With a decrease in the current population by the delta of recalculation, the reduction over 32 years would amount to 3 million 649 thousand people.

A comparison of population changes according to current figures and recalculation, taking into account the results of the ARPC-2020, gives a different time lag for overcoming the general depopulation, characterized by population decline: according to the current accounting, Russia entered the phase of the second wave of depopulation in 2018 (from January 1, 2010 to January 1, 2018, there was an annual increase in population); taking into account the results of the ARPC-2020 – in 2020, that is, the main reasons for "entering depopulation" can be considered excessive mortality and barriers to migration movements caused by the COVID–19 pandemic (annual population growth was recorded in the period from January 1, 2010 to January 1, 2020). Such ambiguous conclusions determine the need for additional analysis of depopulation processes.

The analysis of the conditional depopulation coefficient (the ratio between the numbers of deaths and births) gives grounds to identify two milestones (waves) of natural depopulation during the analyzed period *(Tab. 1)*:

- ✓ from 1992 to 2012 inclusive (in 1991, the number of births was higher than the number of deaths, the conditional depopulation coefficient was 1.062);
- ✓ from 2016 to the present.

Figure 4. Dynamics of the Russian population, data as of January 1, 2012–2024, and the delta of growth according to recalculations, taking into account the results of the ARPC-2020



* Population data for January 1, 2012–2024 have been recalculated taking into account the results of the 2020 All-Russian Population Census.

Source: Rosstat.

Table 1. Conditional depopulation coefficient in Russia

Year	1992	1993	1994	1995	1996	1997	1998	1999
Conditional depopulation coefficient	1.138	1.544	1.634	1.616	1.596	1.600	1.550	1.765
Growth rate, %	20.85	35.64	5.84	-1.12	-1.23	0.24	-3.14	13.91
Year	2000	2001	2002	2003	2004	2005	2006	2007
Conditional depopulation coefficient	1.757	1.719	1.670	1.601	1.528	1.581	1.464	1.292
Growth rate, %	-0.49	-2.13	-2.89	-4.08	-4.60	3.48	-7.37	-11.76
Year	2008	2009	2010	2011	2012	2013	2014	2015
Conditional depopulation coefficient	1.211	1.141	1.134	1.072	1.002	0.987	0.984	0.983
Growth rate, %	-6.26	-5.78	-0.64	-5.47	-6.50	-1.49	-0.30	-0.09
Year	2016	2017	2018	2019	2020	2021	2022	2023
Conditional depopulation coefficient	1.001	1.080	1.140	1.214	1.489	1.746	1.456	1.392
Growth rate, %	1.80	7.90	5.52	6.51	22.61	17.29	-16.62	-4.42

– aggravation of depopulation; – overcoming of depopulation.

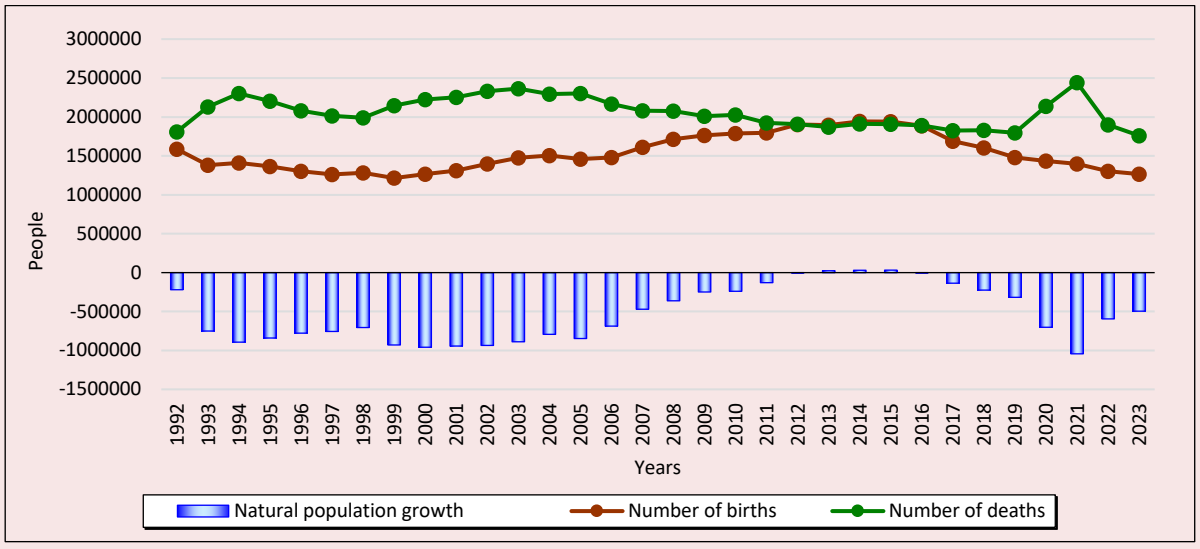
Source: Rosstat.

Assessing the second wave of depopulation, we should pay special attention to the period from 2020 to 2022 (markers of conditional depopulation coefficient values are more maroon in color); while in 2022 the level of the conditional depopulation coefficient decreased significantly (by 16.62%), which was facilitated by the measures taken, primarily aimed at reducing the excess mortality from COVID-19 (increase in the proportion of the vaccinated population).

A further decrease in the conditional depopulation coefficient (in 2023) is also determined by a reduction in mortality, rather than an increase in the birth rate *(Fig. 5)*.

In 1992, for the first time in the post-war period, the number of deaths (during the reforms, but in

Figure 5. Dynamics of the number of births, deaths and natural population growth/decline in Russia for 1992–2023



Source: Rosstat.

peacetime) exceeded the number of births (natural population growth was replaced by a decrease) and the corresponding curves reflecting the dynamics of indicators intersected. This phenomenon was called the "Russian cross" (Rimashevskaya, 1999).

Natural population decline in 1992 amounted to 219 thousand 797 people and was determined by both an increase in mortality (the number of deaths increased by 6.91% over the year) and a decrease in fertility (the number of births decreased by 11.53%), while the dynamics of fertility, based on the comparability of growth rates, definitely had a more significant negative impact than the dynamics of mortality. The situation worsened in 1993 – the excess of the number of deaths over births reached 750 thousand 356 people, while the decrease in the number of births became more dramatic (by 13.42% over the year), but the critical increase in mortality became the dominant factor (the number of deaths increased by 17.81% over the year). Fluctuations in the number of deaths during the analyzed period were determined either by periods of decline (for example, from 1995 to 1998, from 2006 to 2009, from 2011 to 2013, from 2015 to 2017, etc.), or by growth. The dynamics of the number of births show more pronounced/prolonged periods of growth (from 2000 to 2004, from 2006 to 2012), while long time lags of reduction are also recorded, primarily at the present stage: from 2015 to the present, the number of births decreases annually (from 1 million 940 thousand 579 to 1 million 264 thousand 938 children in 2023).

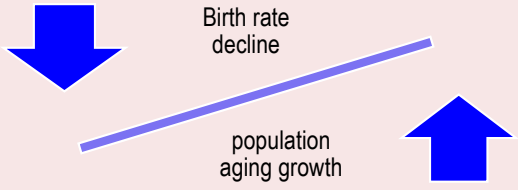
Such a development of demographic processes, which overlapped with the previously formed demographic waves and was partly predetermined by them, formed the main features of demographic development at the present stage and in the foreseeable future: a decrease in the birth rate with a high level of population aging.

Undoubtedly, the key depopulation factors presented in *Figure 6* are, among others, the most acute demographic threats. Due to the demographic situation (Ageev, Zolotareva, 2023) and demographic attitudes in society (Rostovskaya et al., 2021), demographic security challenges today are reasonably identified as priorities in the basic strategic document – the National Security Strategy of the Russian Federation, approved on July 2, 2021 by the Presidential Decree[12].

The assessment of demographic aging according to the J. Beaujeau-Garnier – E. Rosset scale is presented in *Table 2*.

In the near future, the current population age structure (Ageev, Zolotareva, 2023) does not imply reaching the level of demographic old age preceding the "very high" one. Population aging process is becoming one of the most significant

Figure 6. Key factors in depopulation in Russia at the present stage



Source: own compilation.

[12] On the National Security Strategy of the Russian Federation: Presidential Decree 400, dated July 2, 2021. Available at: https://www.garant.ru/products/ipo/prime/doc/401325792/

Table 2. Development of the aging process in Russia

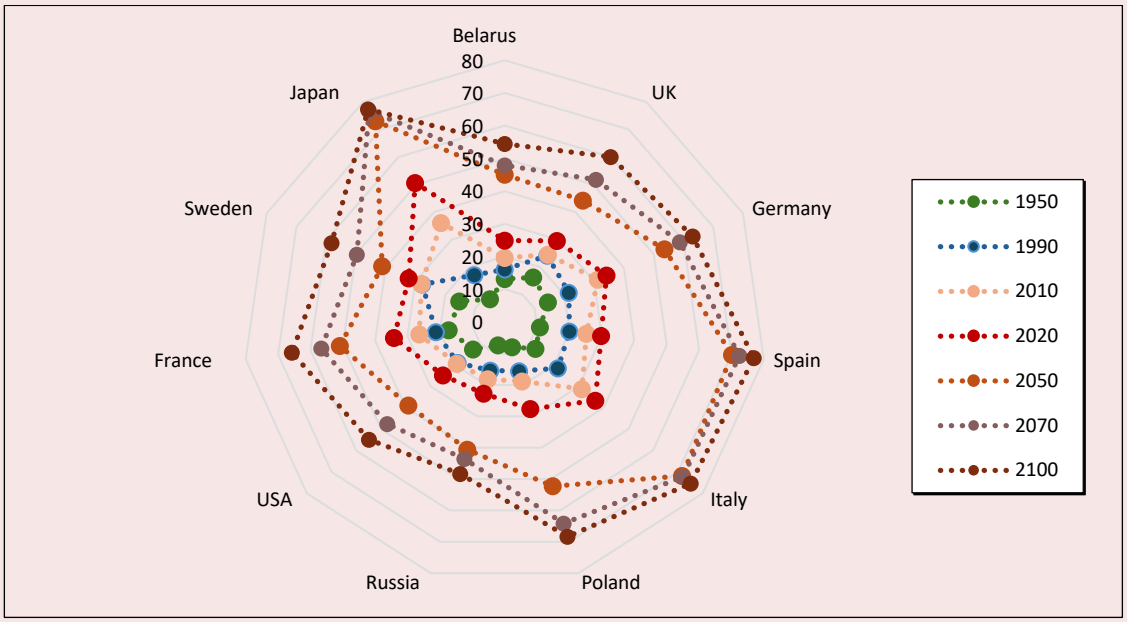
Year	Proportion of the population aged 60 and over, %	Stage of development of the aging process
1897	6.84	Demographic youth
1920	8.25	Threshold of old age
1939	6.72	Demographic youth
1959	8.98	Threshold of old age
1970	11.93	Old age
1979	13.65	Demographic old age initial level
1989	15.3	average level
2002	18.5	very high level
2010	18.9	very high level
2022	23.1	very high level

Source: Population census data.

social transformations of the 21st century, affecting all aspects of society, which is recognized internationally. The global aging prospects, according to UN estimates, suggest that by 2050 the number of people aged 65 and older worldwide will double the number of children under the age of 5 and almost equal the number of children under the age of 12[13].

The UN forecasts on the development of aging in a number of countries around the world, based on forward-looking estimates of the demographic burden of the elderly, representing the ratio of the population aged 65 years and older and the population aged 15–64 years[14], are alarming *(Fig. 7)*.

Figure 7. Ratio of the population aged 65 years and older to the population aged 15–64 years in the countries of the world, including forecast estimates, %



Source: Rosstat.

[13] UN. Peace, dignity and equality on a healthy planet. Aging. Available at: https://www.un.org/ru/global-issues/ageing

[14] UN. Department of Economic and Social Affairs. Population Division. Available at: https://population.un.org/wpp/Download/Standard/Population/

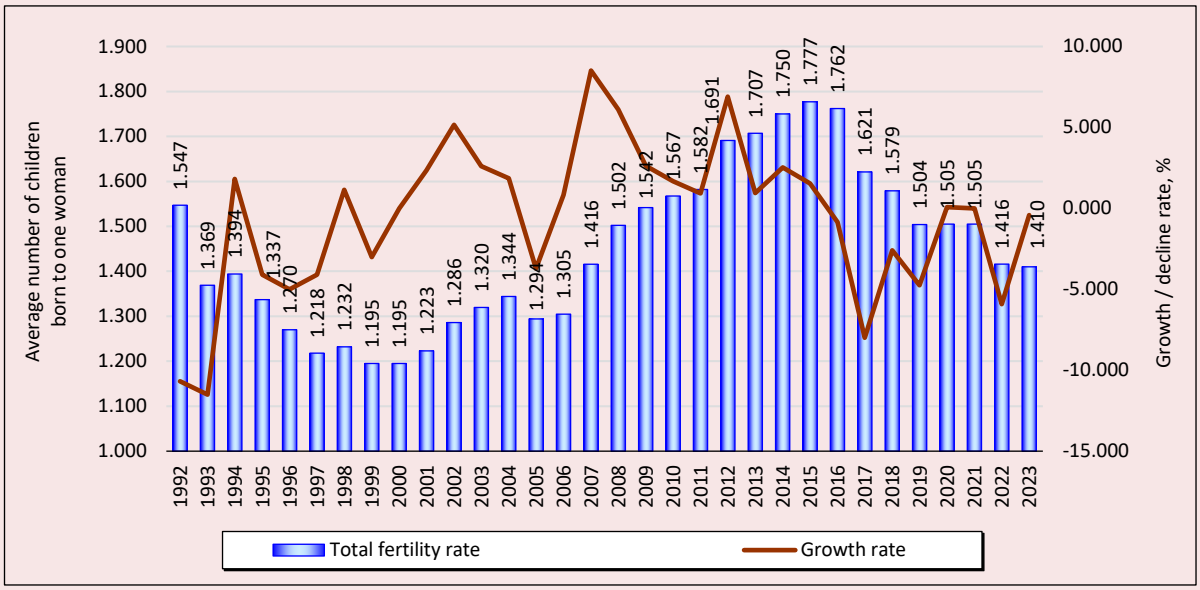
According to the UN forecast, in Russia in 2050 the ratio of the population aged 65 years and older to the population aged 15–64 years will be 40.6%, in 2100 – 48.4% (at the level of 22.8% in 2020), but these are far from the "gravest" figures. For example, in Japan, this figure is expected to be 73% by 2050.

As mentioned earlier, another serious demographic challenge for Russia is low birth rate, more precisely, the narrowed population reproduction throughout the analyzed period (32 years); that is, the trend determining the total fertility rate is below the average of 2.12 births per woman of fertile age (the level of simple reproduction of the population; *Fig. 8*). *For reference*, in 1988 the total fertility rate was 2.13, but later the indicator did not reach the level of simple reproduction.

The retrospective dynamics of the total fertility rate allowed us to identify three milestones in its development (the last two are substantiated in the article by A.I. Ageev and O.A. Zolotareva).

1. 1992–2006: fertility dynamics at this time were formed in very difficult conditions, amid a socio-economic and demographic transition, the impact of which on fertility is widely represented in the works of domestic15 (Borisov, 2007; Ryazantsev et al., 2022) and foreign[16] (Coleman, 2006) authors. These conditions generally changed the way of life and the worldview of society. The first years of the period were characterized by degradation of the institution of family, decrease in the value of a family with children, change in the model of demographic behavior of the population: citizens began to create families at a later age, it was easier to divorce,

Figure 8. Total fertility rate in Russia in dynamics for the period from 1992 to 2023



Source: Rosstat.

[15] Zakharov S.V. Birth rate in Russia: The first and second demographic transition. Available at: https://www.demoscope.ru/weekly/knigi/konfer/konfer_08.html

[16] Livi Bacci M. Future demographic trends and scenarios. Available at: https://paperfoodandmigration.netlify.app/en/chapters/future-demographic-trends-and-scenarios/

extramarital births and all kinds of informal unions spread, the value of "having children" decreased (Ageev, Zolotareva, 2023). The state did not pay due attention to the demographic policy. The average annual value of the total fertility rate for 15 years was 1,302; on average, the indicator decreased by 1.21% annually, from 1.547 in 1992 to 1.305 births per woman in 2006. At the same time, a critical drop in the indicator was noted within the period to the level of 1,195 in 1999 (the historical minimum since 1958[17]).

2. 2007–2015: the birth rate began to increase under the influence of the introduced measures of active demographic policy. In particular, in 2006, in his Address to the Federal Assembly, the President of the Russian Federation proposed the main solution – to introduce "maternity capital", which was approved in 2007 in the Concept for Demographic Policy of the Russian Federation for the period up to 202518; special attention was also paid to the restoration of the institution of family, the importance of traditional family values was declared – the Concept for State Family Policy in the Russian Federation for the period up to 202519 and a number of other government initiatives aimed directly or indirectly at increasing the birth rate were adopted and implemented. The average annual value of the total fertility rate in Russia for 9 years was 1.615; on average, the indicator increased by 2.88% annually, from 1.416 to 1.777 children per woman (maximum value for 32 years).

3. 2016–2023: changes in the birth rate at this time were determined by the combination of existing federal and regional measures, their increase and strengthening. For example, national projects have been developed in accordance with relevant national goals20, the National Strategy of Action for Women for 2017–202221 was approved in 2017, etc. However, judging by the figures, the impact on the population does not have the desired effect observed in the previous decade. The average annual value of the total fertility rate for 8 years was 1.538; on average, the indicator decreased by 3.13% annually (to the level of 1,410 births per woman in the reporting year 2023 – this is the minimum since the introduction of the "maternity capital", i.e. since 2007).

Essentially, our work does not present a comparison of the birth rate in Russia and in other countries, since we consider it unacceptable to focus on trends, for example, characteristic of Western countries (see Bergnehr, 2009; Frejka, 2008; Sobotka, 2004; Waldenström, 2016). Such comparisons can often form an understanding of the normality of negative changes, and then there may emerge a kind of confusion regarding goals and values, when the system of basic / traditional values may be substituted (which was observed in the 1990s).

The article focuses on population dynamics, natural population movement components, conditional depopulation coefficient, aging coefficient

[17] According to Rosstat (Demographic Yearbook of Russia – 2002). Available at: https://rosstat.gov.ru/bgd/regl/B02_16/IssWWW.exe/Stg/d010/i010200r.htm; Demoscope Weekly website. Available at: https:// www.demoscope.ru/weekly/pril.php

[18] On approving the Concept for Demographic Policy of the Russian Federation for the period up to 2025: Presidential Decree 1351, dated October 9, 2007. Available at: http://kremlin.ru/acts/bank/26299

[19] On approval of the Concept for State Family Policy in the Russian Federation for the period up to 2025: RF Government Resolution 1618-r, dated August 25, 2014. Available at: https://www.consultant.ru/document/cons_doc_LAW_167897/1ae3172271088ff17d13f732abf826846524ab91/

[20] National development goals of the Russian Federation for the period up to 2030: the first of these is the goal "preservation of the population, health and well-being of people". Available at: http://www.kremlin.ru/events/president/news/63728; the following national projects have been developed and are being implemented: "Demography". Available at: https://национальныепроекты.рф/projects/demografiya; "Healthcare". Available at: https://национальныепроекты.рф/projects/zdravookhranenie, etc.

[21] On the approval of the National Strategy of Action for Women for 2017–2022: RF Government Resolution 410-r, dated August 3, 2017. Available at: https://www.consultant.ru/document/cons_doc_LAW_213740/647900e93e6b68b5770bca253de3c639d8719f8f/

(structural factor) and total fertility rate, since they are the basic ones for ensuring demographic security22 (Ageev, Zolotareva, 2023; Ryazantsev et al., 2022; Rybakovsky, 2003a; Rybakovsky, 2003b). Covering a wider pool of indicators involves writing a monograph (for example, see the previously mentioned work: Epshtein et al., 2013). At the same time, according to the presented analysis, the importance of state policy aimed at ensuring demographic security is clearly determined. Today, it is important to see the need for further elaboration of measures, primarily aimed at increasing the birth rate and life expectancy, and reducing mortality.

Forecast

Obtaining a reliable and accurate forecast of demographic parameters is possible by using both special demographic forecasting methods (for example, age shifting) and econometric modeling methods (adaptive forecasting methods deserve special attention).

Our work presents a forecast of the total fertility rate developed on the basis of adaptive methods. The choice of this particular indicator to assess the prospects for demographic development is predetermined by the need to understand whether the threat of natural population decline will increase. It is also necessary to explain the refusal of the authors to provide a demographic forecast of the number of population – the decision is determined by the fact that in the near future the population of Russia will include the number of residents of the newly admitted territories (until now, state statistics data are provided without them) and the calculated forecast will lose its significance and relevance.

As mentioned above, the Brown exponential smoothing model was initially obtained by an expert in building models based on IBM SPSS Statistics software *(Tab. 3)*.

The result of the forecast based on the Brown model indicates a possible significant reduction in the total fertility rate by 2028 compared to 2021 (by -11.33%), which is characterized by an underestimate, taking into account actively pursued policies, but substantiated against the background of formed fertility trends in the period from 2016 to the present (the third described milestone of changes in the indicator). This forecast can be considered as a pessimistic/regressive scenario, assuming a "freeze" of measures and activities, primarily related to the support of families with children.

This forecast result provides grounds for searching for alternative models and obtaining a portfolio of models that allows selecting the best one, in particular with higher quality parameters.

A comparative analysis of statistics based on the models obtained on the basis of "brute force" (*Table 4* presents several models from the comparison package) showed that the ARIMA model (7,1,2) best approximates the assessment of trends in the total fertility rate for the next five years.

Table 3. The Brown exponential smoothing model for the total fertility rate

Brown model			2024	2025	2026	2027	2028
Coefficient of determination (R^2)	Mean absolute percentage error (MAPE)	Forecast	1.38	1.34	1.31	1.28	1.25
0.873	3.287	Upper bound	1.50	1.56	1.64	1.73	1.83
		Lower bound	1.25	1.12	0.99	0.83	0.67
Source: data calculated in IBM SPSS Statistics.							

[22] Aleshkovsky I.A. Demographic crisis as a threat to Russia's national security. Available at: http://www.intelros.ru/vek-globalizacii/ya2-2012/18423-demografichtskiy-krizis-kak-ugroza-nacionalnoy-bezopasnosti-rossii.html

Table 4. Adaptive forecasting models of the total fertility rate

Model	Fit statistics of forecast models	
	Coefficient of determination (R-squared)	MAPE – "Mean Absolute Percentage Error"
Holt	0.884	3.059
ARIMA (0,1,0)	0.870	3.402
ARIMA (1,1,0)	0.881	3.247
ARIMA (0,1,1)	0.911	2.961
ARIMA (0,1,2)	0.917	2.741
ARIMA (0,1,3)	0.918	2.703
ARIMA (0,1,4)	0.918	2.739
ARIMA (1,1,1)	0.885	3. 050
ARIMA (2,1,1)	0.885	3. 044
ARIMA (2,1,2)	0.887	2.953
ARIMA (2,2,2)	0.897	2.821
ARIMA (3,2,1)	0.898	2.743
ARIMA (3,1,1)	0.885	3.023
ARIMA (3,1,2)	0.888	2.961
ARIMA (3,1,3)	0.889	3.064
ARIMA (7,1,2)	0.939	2.374
ARIMA (8,1,2)	0.903	2.977
Source: data calculated in IBM SPSS Statistics.		

The given characteristics of the quality of forecasting models allow us to select the best (best approximated) ones from the set. This is the ARIMA Box – Jenkins model (7,1,2): the statistics of the R2 model have a maximum value of 0.939 with the lowest value of the mean absolute percentage error (MAPE) of 2.374. The parameters of the ARIMA model (7,1,2) are given in *Table 5*.

The model values fairly accurately describe the dynamics of actual changes in the total fertility rate *(Fig. 9)*.

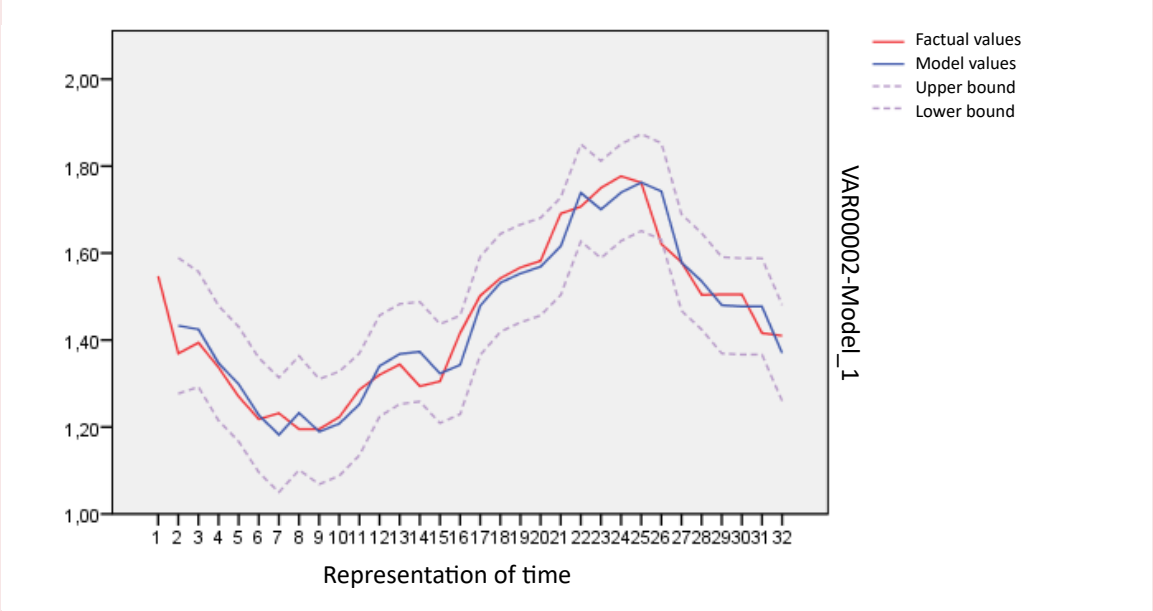
Let us compare the results we obtained for forecasting the total fertility rate of Russia's population according to the ARIMA model (7,1,2) with the forecast values of Rosstat[23] *(Tab. 6)*.

Table 5. Parameters of the ARIMA model (7,1,2)

Model	Constant	AR							Difference	MA	
		φ_1	φ_2	φ_3	φ_4	φ_5	φ_6	φ_7		θ_1	θ_2
ARIMA (7,1,2)	-0.15	0.632	0.383	-0.162	0.029	0.079	0.052	-0.371	1	0.444	0.555
Source: data calculated in IBM SPSS Statistics.											

[23] Rosstat. Demographic forecast. Available at: https://rosstat.gov.ru/folder/12781

Figure 9. Actual and model values of the total fertility rate according to the ARIMA model (7, 1, 2)



Source: calculation in IBM SPSS Statistics.

Table 6. Forecast values of the total fertility rate of Russia's population (ARIMA model (7,1,2) and Rosstat)

Forecast period	ARIMA model (7,1,2)			Rosstat forecast		
	Lower bound of the forecast	Forecasted values	Upper bound of the forecast	Low forecast scenario	Average forecast scenario	High forecast scenario
2024	1.331	1.441	1.552	1.311	1.321	1.419
2025	1.298	1.472	1.647	1.290	1.332	1.428
2026	1.320	1.539	1.759	1.303	1.352	1.436
2027	1.339	1.591	1.842	1.323	1.374	1.448
2028	1.373	1.609	1.867	1.347	1.412	1.463

Source: data calculated in IBM SPSS Statistics and Rosstat data.

The results of forecasting using the ARIMA model (7,1,2) indicate an estimated average annual increase in the forecast values of the total fertility rate by 3.37% to 1.609 by 2028 in the next five years. In comparison with the value of 2023, the increase in the indicator by 2028 will be 14.11%. However, the value will not reach the maximum recorded in 2015, but will be approximately at the level of 2017–2018. These forecast values, in fact, determine an optimistic scenario. They are higher than the high version of the Rosstat forecast. We should note that the average version of Rosstat's forecast looks pessimistic and assumes a decrease in the total fertility rate to 1.321 in

Table 7. Forecast of Russia's population until 2028, at the beginning of the year (average scenario)

Year	Population, thousand people	Absolute increase / decrease, thousand people	Growth / decline rate, %
2023*	146150.8	-	-
2024	146079.7	-71.1	-0.04864
2025	145631.8	-447.9	-0.30661
2026	145159.3	-472.5	-0.32445
2027	144672.2	-487.1	-0.33556
2028	144181.3	-490.9	-0.33932
Dynamics for 5 years	-	-1969.5	-1.34757

* Data of the reporting period, recalculated taking into account the results of the ARPC-2020.
Source: Rosstat.

2024, which is a "throwback" to the values of the indicator characteristic before the development and introduction of measures aimed at increasing fertility, such as maternity capital. According to the ARIMA model (7,1,2), in an inertial or regressive scenario, a decrease in the total fertility rate is also assumed.

In order to study more seriously the prospects for achieving demographic security and identifying threats, let us turn to the population forecast developed by Rosstat. The analysis of changes in Russia's population in the next five years according to the average scenario is presented in *Table 7*.

In the next five years, the population is expected to decrease by about two million inhabitants. Such a decrease can be covered by recalculating the number when including residents of new territories. However, the current trend itself determines the threat to the demographic security of the country. Moreover, it is assumed that the proportion of children in the population will decrease, by 2028 the proportion of the population younger than the working age (0–15 years) will amount to 17.0% (which corresponds to the trends in fertility predicted by Rosstat), while the proportion of people over the working age will be 22.5%. These demographic changes will inevitably affect the Russian labor market in the medium term, setting possible limits for changes in the size of the labor force.

Discussion

The analysis of the retrospective dynamics of a number of demographic indicators not only determines the stages of population decline, but also indicates serious obstacles to achieving demographic security in Russia.

The forecast of the total fertility rate and the analysis of the population forecast provided by Rosstat made it possible to identify the following threats and challenges in the near future:

– continuing trend of population decline;

– narrowed population reproduction (in the inertial scenario, a decrease in the total fertility rate);

– population aging.

The growth of an already rather high proportion of the elderly population determines the burden on the healthcare system.

A reduction in the proportion of children requires a significant increase in funding for education and science, without which it is not possible to ensure advanced economic development.

Basic threats to demographic security are a decrease in the birth rate and, consequently, population decline.

In order to increase the birth rate (to achieve an optimistic scenario), the state should support families as much as possible, offer more flexible support measures so that families can count on help from the birth of a child to the beginning of their adult life.

Among the main recommendations, the priority ones are as follows:

– to introduce a differentiated approach to maternity capital: separate sums for the first, second, third and subsequent children; that is, it is necessary to return the maternity capital in full for the second child (without deduction for the firstborn); for the second child it should be at least 1.5 times more than for the first; for the third and subsequent in number for children, it should also be a separate amount, at least twice the size of the mother's capital for the firstborn;

– to change the main criterion for receiving allowances for families with children under 17 and pregnant women who registered with the prenatal clinic early: accessibility, given the criterion of need in the amount of the average per capita family income not exceeding at least twice the subsistence minimum of the working-age population in a particular constituent entity of the Russian Federation;

– annual increase in the single childcare allowance should be determined flexibly: either on the basis of indexing taking into account the price index calculated for the category of children's goods (if it is higher than inflation); or on the basis of indexing the subsistence minimum to the consumer price index (if the price index for the category of children's goods is lower than inflation);

– to develop a mechanism for issuing mortgage housing loans for individual housing construction; two scenarios are possible: a mortgage for individual housing construction can be introduced instead of existing preferential mortgage lending programs, or it will complement existing programs; in the first case, the mass consumer will not have alternatives similar in cost, and therefore most families who express a need for housing, will take advantage of the provided benefits and issue mortgage housing loans for individual housing construction; in the second case, the state should increase the comparative attractiveness of residential mortgage loans for individual housing construction, and it can do this in the following ways:

1) the weighted average mortgage rate for individual housing construction should be less than the weighted average mortgage rate for the purchase of an apartment in the city;

2) provision of subsidies for the purchase of motor vehicles (in order to offset the influence of the factor of transport accessibility when deciding on the type of mortgage loan to be issued).

The proposed measure on mortgage lending for individual housing construction is substantiated by the fact that today platform employment is becoming more widespread. The era of digitalization marked the transition from daily office visits to hybrid or completely remote work formats when working. This, in turn, contributes to increasing the attractiveness of individual housing construction in rural areas. The development of the e-commerce market and the delivery of food and grocery products allows the population outside the city to receive all the same benefits, the availability of which was previously extremely difficult. This, in particular, will allow achieving a certain work – family balance, which should contribute to an increase in the birth rate.

In conclusion, we should note that state support for families with children is a proven tool for influencing reproductive behavior and attitudes. It seems possible, by expanding the directions and scales of state support, to reverse the current negative trends, minimize challenges and threats to demographic security.

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