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The impact of state agglomeration policy on long-term trends of population changes in Russia

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Abstract. The study analyzes the impact of state agglomeration policy on demographic trends in Russia, with a special focus on the relationship between urbanization and birth rate. The study is based on data on population size and differences in demographic indicators between urban and rural areas, and includes a forecast of possible changes in the demographic situation up to 2100 using scenario modeling methods. The purpose of the study is to identify the key consequences of the agglomeration approach for long-term demographic development in line with the new "Spatial Development Strategy of the Russian Federation for the period up to 2030 with a forecast up to 2036", as well as to assess possible approaches to adjusting state policy in the context of depopulation. The study materials include Rosstat's estimated data on population size and components of its change, including total fertility rates for urban and rural populations. Methods of forecasting demographic dynamics components were applied, in particular SARIMA (implemented in Python) for fertility forecasting. The population is projected using the cohort-component method ("age shifting") with the Spectrum software (DemProj module). Three main scenarios are considered: continuation of the current urbanization trend, maintenance of a static share of urban and rural population, and a "deurbanization" scenario as a possible alternative. The results show that given the current low birth rates and zero migration growth, Russia's population will continue to decline under all three scenarios. The issue of declining birth rates in cities is particularly acute, exacerbated by the consolidation of agglomerations. It is concluded that the ongoing urbanization policy, combined with low birth rates, intensifies the country's depopulation, while a deurbanization policy cannot radically change the demographic situation.

Keywords: urbanization, agglomeration, birth rate, demographic crisis, scenario modeling, demographic forecasting, state policy, spatial development strategy, total fertility rate, strategic planning

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Влияние государственной политики агломерирования на долгосрочные тенденции изменения численности населения России

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Аннотация. Проанализировано влияние государственной политики агломерирования на демографические тенденции в России с особым акцентом на взаимосвязь урбанизации и уровня рождаемости. Исследование базируется на данных о численности населения и различиях демографических показателей между городскими и сельскими территориями, а также включает прогноз возможных изменений демографической ситуации до 2100 г. методами сценарного моделирования. Цель исследования — определить ключевые последствия агломерационного подхода для долгосрочного демографического развития в соответствии с новой «Стратегией пространственного развития РФ на период до 2030 года с прогнозом до 2036 года», а также дать оценку возможных подходов к корректировке государственной политики в условиях депопуляции. В качестве материалов использованы оценочные данные Росстата по численности населения и компонентам его изменения, включая суммарный коэффициент рождаемости для городского и сельского населения. Применены методы прогнозирования компонентов демографической динамики, в частности SARIMA (реализован на языке Python) для прогнозирования рождаемости. Сценарный прогноз численности населения выполнен методом «передвижки возрастов» с помощью программного комплекса Spectrum (модуль DemProj). Рассмотрены три основных сценария: продолжение текущей тенденции урбанизации, сохранение статичной доли городского и сельского населения и сценарий дезурбанизации как возможная альтернатива. Результаты показывают, что при современных низких показателях рождаемости и отсутствии миграционного прироста во всех трех сценариях продолжится сокращение численности населения России. Особенно остро проявляется проблема снижения рождаемости в городах, усугубляемая процессом укрупнения агломераций. Сделан вывод, что проводимая политика урбанизации в сочетании с низкой рождаемостью усиливает депопуляцию страны, а политика дезурбанизации не способна радикально изменить демографическую ситуацию.

Ключевые слова: урбанизация, агломерация, рождаемость, демографический кризис, сценарное моделирование, демографическое прогнозирование, стратегия пространственного развития, суммарный коэффициент рождаемости, стратегическое планирование

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Introduction

In 2024, the first "Spatial Development Strategy of the Russian Federation for the Period up to 2025" was completed[1]. At the beginning of 2025, a new version of the Strategy[2], was approved, designed to determine the directions of development of housing construction and the Russian settlement system until 2030. Changes in the settlement system entail long-term demographic and economic consequences that require careful analysis. The chosen course of consolidation of urban agglomerations is associated with costs no less than the benefits obtained.

Any strategy starts with setting a goal. The text of the new Strategy states the goal of "forming a balanced system of settlement and territorial organization of the economy of the Russian Federation, which will contribute to achieving national goals and ensuring national security". It should be noted that this formulation does not correspond to the SMART principles adopted in modern strategic planning [1].

The tasks set out in the Strategy also do not allow us to clearly define the planned direction of spatial development. The document essentially lists as tasks certain national development goals for Russia until 2030 (with a view to 2036), namely: population conservation, health promotion and well-being, family support; a stable and dynamic economy; a comfortable and safe living environment.

Upon detailed consideration of the Strategy concept[3] it becomes obvious that its developers are guided by an agglomeration approach, that is, they focus

[1] Decree of the Government of the Russian Federation dated 02.13.2019 No. 207-R. "On the approval of the Spatial Development Strategy of the Russian Federation for the period up to 2025". *The official Internet portal of the Government of the Russian Federation*. URL: http://static.government.ru/media/files/UVAlqUtT08o60RktoOXl22JjAe7irNxc.pdf (accessed: 28.04.2025). (In Russ.).

[2] Decree of the Government of the Russian Federation dated December 28, 2024 No. 4146-r "On Approval of the Spatial Development Strategy of the Russian Federation for the period up to 2030 with a forecast up to 2036". *Official Internet Portal of the Government of the Russian Federation.* URL: http://government.ru/docs/53917/ (accessed: 28.04.2025). (In Russ.).

[3] The concept of the "Spatial Development Strategy of the Russian Federation for the period up to 2030 with a forecast up to 2036". *Official website of the Ministry of Economic Development of Russia.* URL: https://www.economy.gov.ru/material/file/85fb48440f79df778539e0b215af5345/koncepciya_strategii_prostranstvennogo_razvitiya_rf_na_period_do_2030_goda.pdf (accessed: 28.04.2025). (In Russ.).

on a limited number of priority development territories (agglomerations and "anchor" settlements). For example, the new classification of stronghold settlements includes 187 "growth points", 212 strategic settlements, 76 urban agglomerations and 23 administrative centers of the subjects of the Russian Federation, as well as 1,709 settlements serving as strongholds. It is expected that in 2025 the "Unified List of Reference settlements of the Russian Federation" will be published as an official document.

It is expected that about 2,319 settlements in Russia will be prioritized under the new Strategy. According to the All-Russian Population Census of 2021, there were 155.5 thousand settlements in the country[4]. Thus, only about 1.5% of all settlements are recognized as priorities, where approximately 77.6% of the Russian population lives (about 114.3 million people, assuming that the largest settlements in terms of population are highlighted first).

The approach based on supporting only "core" territories is explained by limited resources, but it has several significant drawbacks that require special attention:

1. Most settlements that are not included in the priority list may be in a state of decline and depopulation. The concentration of resources in a few "priority" territories will inevitably lead to the degradation of the rest, which is fraught with problems with the use of agricultural land and threats to national security.
2. Small settlements are usually located near industrial and agricultural centers. The decrease in population in these locations will increase the shortage of labor in the relevant sectors of the economy.
3. An increase in population density in agglomerations will lead to an increase in the cost of housing and a decrease in available living space per person. As a result, even in the largest country in the world, people would have to live in more cramped conditions.
4. Social polarization will increase: not all residents will be able to move to "priority" cities, and the gap in income and quality of life between territories will widen, forming new marginalized groups along territorial lines.
5. The infrastructure in large cities will be overloaded. The increased concentration of the population will create an excessive burden on the water supply, sewerage, electricity and road networks, requiring huge costs for their modernization.
6. The environmental impact will increase. The accumulation of population in a limited area makes it difficult to disperse pollutants, therefore, without the

[4] Table 3. Number of municipalities, inner-city districts, city districts, interuniverse territories and settlements by subjects of the Russian Federation. *The results of the VPN2020. Volume 1. Population size and location: Rosstat. 2022*. URL: https://rosstat.gov.ru/storage/mediabank/Tom1_tab-3_VPN-2020.xlsx (accessed: 28.04.2025). (In Russ.).

introduction of new environmental measures, the quality of the habitat will deteriorate.

7. Urbanized lifestyle and high cost of housing negatively affect the birth rate. The total fertility rate (TFR) in Russian cities is significantly lower than in rural areas, and in the most densely populated urban agglomerations this indicator is minimal.

The most difficult and significant of these problems, according to the author, is demographic. Later in the article, it is the last of these restrictions that is considered in detail — a decrease in the population due to an increase in the proportion of the urban population.

The purpose of the study is to identify the main demographic consequences of the implementation of the agglomeration policy within the framework of the new "Strategy for Spatial Development of the Russian Federation until 2030", as well as to assess possible directions for adjusting government policy in the context of depopulation.

Materials and methods

The impact of urbanization on fertility reduction is widely discussed in the scientific literature [2–11]. Among the Russian studies of this issue, the works of A.I. Alekseev and N.V. Zubarevich [2], V.N. Arkhangelsky [3], V.A. Bezverbny [4], A.G. Vishnevsky and others [5], V.A. Iontsev [6], V.M. Medkov [7], V.V. Khodorkovsky [8], Yu.L. Pivovarov [9], L.L. Rybakovsky [10] and other authors [11].

To assess the impact of the state agglomeration policy on long-term population trends, a scenario demographic forecast was performed. Researchers have several methods at their disposal to predict the main demographic indicators for the medium term: the interpolation, analytical, agent-shifting method (also known as the component method), as well as approaches based on the theory of cyclic ethnogenesis. In addition, an agent-based approach to modeling demographic processes is considered promising, although still poorly understood [12]. In practice, the most common and reliable method of age shifting proposed by the American demographer P.K. Welpton in the first half of the 20th century [13].

The "age shift" method is a step-by-step mathematical model describing the dynamics of the age and gender composition of the population. The initial information is the population size by gender and age group for the last known year. Further, for each subsequent year, the number is recalculated taking into account demographic factors. In other words, each individual "ages" by one year per forecast step, while birth, death, or migration events are taken into account with a given probability for each age group. Mathematically, this can be expressed by the formula

$$N_{x+1}(t+1) = N_x(t) \times a_x + M_x(t),$$

where $N_x(t)$ — the number of the age group x in the year t; $N_{x+1}(t+1)$ is the number of the age group $x+1$ in the next year; a_x is the coefficient of transition to the next age (the probability of living to the age of $x + 1$); $M_x(t)$ is the migration balance for this age group [14].

This method is multifactorial: the exact composition of the factors varies depending on the quality of statistical information. The necessary parameters for the calculation are, at a minimum, life expectancy at birth, the TFR and the total mortality rate. Increasing the number of factors taken into account increases the accuracy of the forecast, but complicates calculations.

For the practical implementation of the age-shifting method, the DemProj software module has been developed. This model, first created by D. Stover in 1980 [15. P. 5–6], is used by the United Nations and other researchers to predict the size and structure of the population of various countries and regions. DemProj allows you to get forecasts for up to 150 years from the base year. This model is included in the free Spectrum (Avenir Health) software package[5], the Spectrum 6.4 version was used in the work.

The empirical basis of the study was the official data from Rosstat on the permanent population of Russia and the components of its change, differentiated by type of locality (urban or rural population). The SARIMA method was used to predict fertility in urban and rural areas [16]. The predicted values of the TFR were limited to the range observed in 1990–2023, i.e. they did not exceed historical lows and highs. The population forecast was carried out separately for urban and rural parts of the population by age shifting, after which the final results were adjusted in accordance with scenarios of changes in the proportion of urban and rural population. Migration growth over the entire forecast range is assumed to be zero to focus on the dynamics of natural population movement.

The results

Statistics show that the birth rate in rural areas is steadily higher than in urban areas. For the entire period of Russia's recent history, the TFR at the level of simple reproduction of the population (> 2.1) was recorded only among the rural population (Fig. 1). In cities, the TFR never reached 2.1.

As a rule, an increase in the share of the urban population is accompanied by a decrease in the birth rate (a decrease in the TFR). Judging by the Strategy, its authors consider the enlargement of cities as an objectively irreversible process.

[5] Spectrum. *Avenir Health: official site*. 2025. URL: https://avenirhealth.org/software-spectrum.php (accessed: 28.04.2025).

However, government policy can, in principle, be aimed at mitigating such trends in order to achieve stable development. It can be stated that stimulating the growth of large cities actually leads to an acceleration of depopulation.

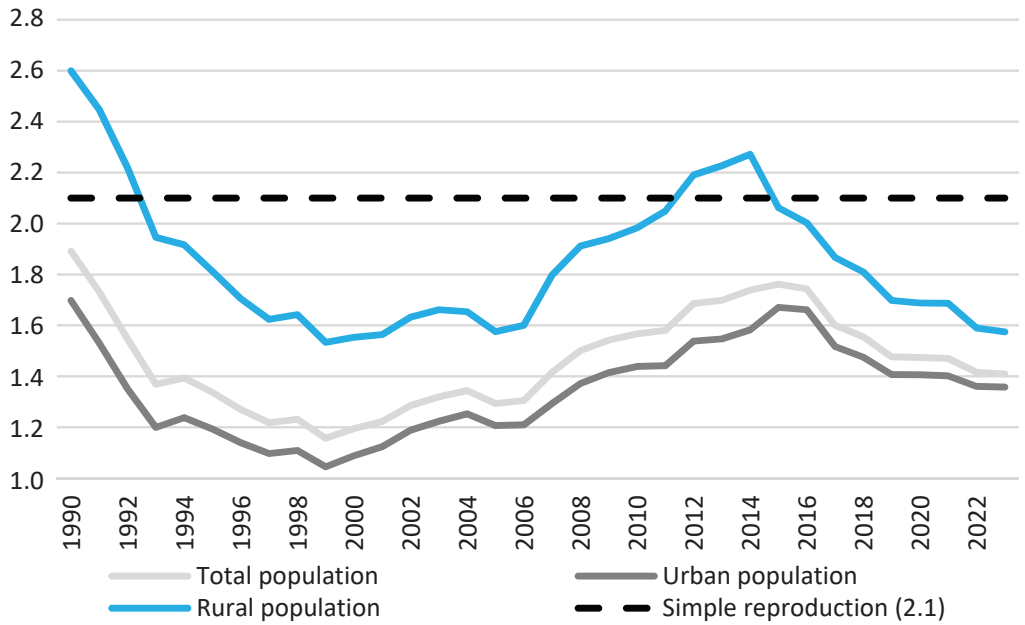

Fig. 1. Total fertility rate (TFR) in Russia depending on the type of population, 1990–2023
Source: made by A.M. Sitkovskiy according to Rosstat data[6] using MS Excel.

The question arises as to how the change in the proportion of urban and rural populations will affect the total number of residents in the long term. The answer can be obtained using a scenario forecast of the population of Russia up to 2100, performed according to the described methodology. Fig. 2 shows the forecast dynamics of the TFR for the period 2024–2100, obtained by the SARIMA method (values are limited to the range 1990–2023).

An analysis of the data for 1990–2023 shows that the share of the urban population in Russia increased almost linearly (Fig. 3), which indicates the ongoing process of urbanization, partly stimulated by government policy. In this regard, the forecast considered three scenarios of changes in the share of urban/rural population:

- The "urbanization" scenario is the continuation of the current trend of growth in the proportion of urban residents at the same rate as in 1990–2023;
- The "fixation" scenario — the share of urban (74.9%) and rural (25.1%) populations remains constant throughout the forecast range (at the level of 2023);

[6] Total fertility rate. *EMISS.* 2024. URL: https://www.fedstat.ru/indicator/31517 (accessed: 28.04.2025).

- The "deurbanization" scenario — the share of rural population is increasing (and the share of urban population is decreasing) at the same rate as the process of urbanization in recent decades.

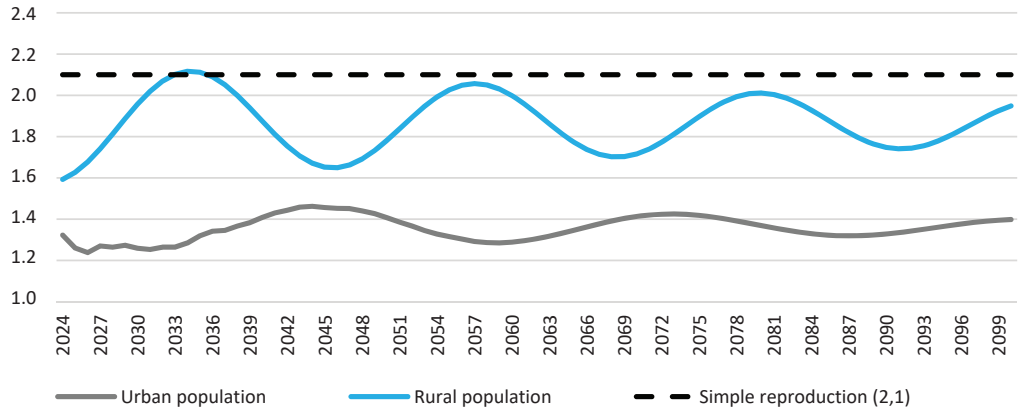

Fig. 2. Total Fertility Rate Forecast Using the SARIMA method, 2024–2100

Source: made by A.M. Sitkovskiy using MS Excel based on data calculated by the author using Python according to the method described in the article.

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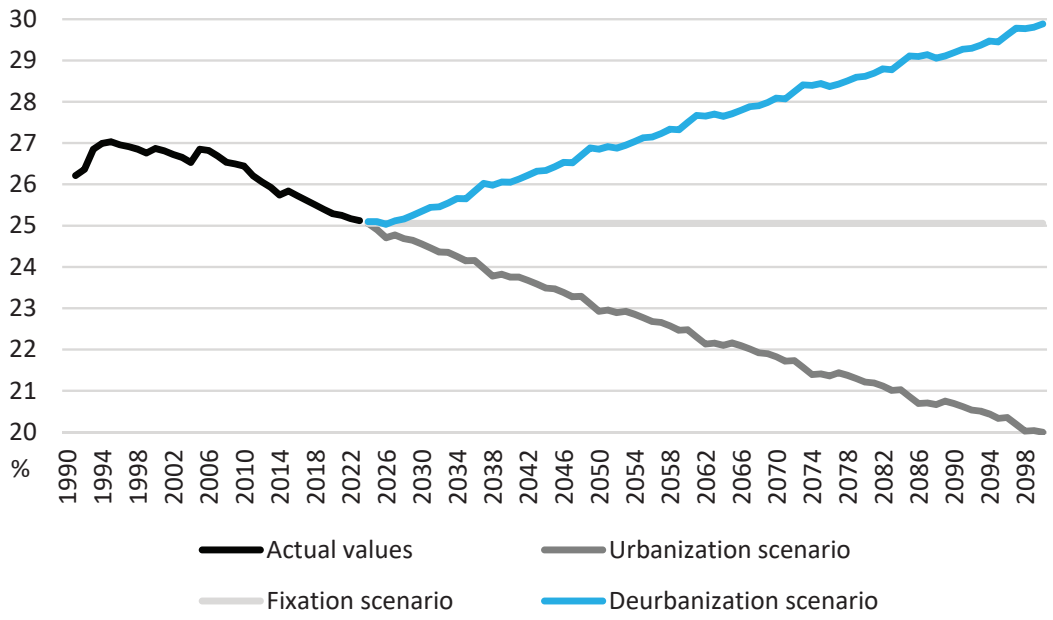

Fig. 3. Share of rural population in Russia: actual values, 1990–2023 and scenario forecast values, 2024–2100, %

Source: made by A.M. Sitkovskiy using MS Excel based on actual data from Rosstat in 1990–2023[7] and based on data calculated by the author using the extrapolation method in 2024–2100.

[7] Permanent population as of January 1. *Statistical data showcase: Rosstat.* 2024. URL: https://showdata.gks.ru/report/278928/ (accessed: 28.04.2025). (In Russ.).

The scenario forecast of the total population was calculated separately for urban and rural populations by gender and age groups, followed by adjustments according to the scenario trajectories of the proportion between them. The migration influx is assumed to be zero for the entire forecast period in order to focus on the internal dynamics of the existing population.

According to calculations, in the absence of migration growth (Fig. 4), in all three scenarios, a significant decrease in the Russian population is expected by the end of the 21st century. According to the forecast, by 2100 the population will decrease to about 75.7 million people in the "urbanization" scenario, to 77.9 million people in the "fixation" scenario and to 79.9 million people in the "deurbanization" scenario (comparing with 146.5 million people in 2023). Even the maximum slowdown in urbanization (scenario "deurbanization") cannot prevent depopulation, but only slightly reduces its scale compared to the scenario of further urbanization.

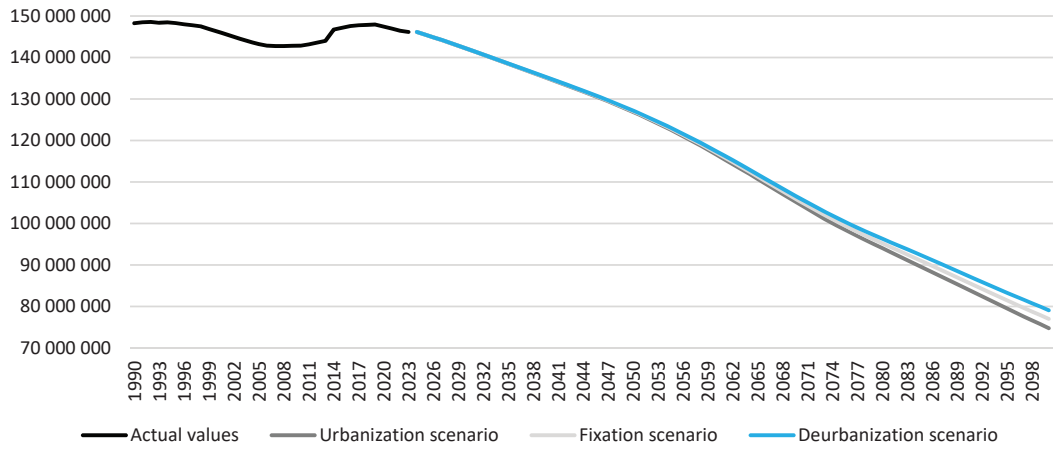

Fig. 4. Share of rural population in Russia: actual values 1990–2023 and scenario forecast values 2024–2100, peoples

Source: made by A.M. Sitkovskiy using MS Excel based on actual Rosstat data for 1990–2023[8] and on values calculated by the author for 2024–2100 using the age shifting method using the DemProj module of the Avenir Health Spectrum software product.

Conclusion

Thus, with the continuing low birth rate (TFR < 2.1) and excluding migration, the population of Russia will steadily decrease in any case of population distribution between urban and rural areas. Choosing one scenario or another of urbanization actually boils down to choosing the "lesser

[8] Permanent population — women by age as of January 1. *Statistical data showcase: Rosstat.* 2024. URL: https://showdata.gks.ru/report/278938/ (accessed: 28.04.2025); Permanent population — men by age as of January 1. *Statistical data showcase: Rosstat.* 2024. URL: https://showdata.gks.ru/report/278936/ (accessed: 28.04.2025). (In Russ.).

of evils". According to the model, by 2100, the difference between the most "urban" and the most "rural" scenarios is about 5 million people, with a total population decline of almost 70 million people over the period 2024–2100. It should be emphasized that this forecast is based on the continuation of current demographic trends and does not consider the potential increase in the birth rate in the future.

The results obtained allow us to conclude that the implementation of a policy of deurbanization alone will not solve the problem of depopulation, while the continuation of a policy aimed at enlarging agglomerations will only exacerbate the demographic crisis. To stabilize the population, a significant increase in the birth rate and attraction of migration are required; at the same time, optimization of the spatial distribution of the population can only partially slow down the decline rate.

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