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**PROBLEMS OF TERRITORY'S DEVELOPMENT**

Peer-reviewed scientific and practical journal covering a wide range of issues on the socio-economic development of territories.

The journal's primary aim is to provide broad scientific communities and practitioners with the opportunity to familiarize themselves with scientific research findings in the field of scientific support for territorial economies and to participate in discussions on these issues. Key topics include territorial development problems, regional and sectoral economics, socio-economic development of territories, issues of regional budget revenue formation and expenditure rationalization, innovation economics, and current issues in the development of the agro-industrial complex.

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**МОНИТОРИНГ ПЕРЕМЕН: ОСНОВНЫЕ ТЕНДЕНЦИИ**

# FROM THE EDITOR

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## NEW APPROACHES TO ADDRESSING REGIONAL ISSUES

The development of any territory is shaped not only by internal factors but also depends to a significant extent on geopolitical and other transformations unfolding across the global economy. Investigating the development challenges of territorial systems at various hierarchical levels requires an understanding of these trends. In keeping with the journal's new concept, whose key tenets were outlined in the previous issue, the "Monitoring of Changes" section has been expanded to include information on global economic developments. In our view, this addition provides a more objective lens through which to examine domestic problems.

Russian scholars are actively seeking approaches to address some of these challenges for practical application by regional and municipal authorities. The current issue features articles whose authors focus on a range of topics: the development of small and medium-sized towns, financial instruments for regional development, growth prospects for the chemical industry's impact on territories, ensuring the economic security of oil- and gas-producing regions, spatial heterogeneity in the educational component of human capital, and the socio-economic determinants of regional demographic potential.

**For citation:** Uskova T.V. (2026). New approaches to addressing regional issues. *Problems of Territory's Development*, 30(2), 7–9. DOI: 10.15838/ptd.2026.2.142.1

Specifically, *M.A. Lebedeva* examines Russia's small and medium-sized towns where the extractive sector dominates the local economy. The author identifies the most common problems afflicting this category of towns – extremely weak economic diversification, a shortage of investment, population decline, and others – and formulates practical recommendations for transforming these towns into regional growth poles.

*R.V. Badylevich* and *M.V. Ulchenko* propose social bonds as an instrument for financing projects within a region's social sectors. Their study establishes that this instrument holds considerable promise for addressing such tasks at the regional level. They also identify the positive effects that can be realized through its practical implementation, as well as the obstacles that currently constrain its use.

*M.K. Malyshev, E.V. Borisov*, and *D.S. Goncharuk* present an analysis of chemical manufacturing. They reveal the industry's growing role in generating regional tax revenues, assess its impact on the host territory, and outline its future development prospects.

The imposition of sanctions on Russia by Western nations has led to a decline in export deliveries and restricted access to global technologies and financial resources, adversely affecting the economic security of both the country and its regions. Accordingly, *I.L. Beilin* sets out to identify approaches for strengthening the economic security of an oil- and gas-producing region. One potential solution to the problem of economic vulnerability, the author argues, lies in fostering greater interregional cooperation by leveraging the advantages of each region's industrial specialization and pursuing the rational spatial integration of scientific and innovative potential. The paper presents a model of hierarchical cluster-based interregional integration for the oil- and gas-producing regions of the Volga Federal District, aimed at enhancing the economic security of the territories under study.

*D.D. Vavilova* and *E.V. Barkhatova* investigate the differentiation of Russian regions in terms of the educational component of human capital. Using clustering methods, the authors develop a typology of regions based on this dimension of human capital and provide a forecast of educational development for the Udmurt Republic – a typical representative of one of the identified clusters.

The work of *A.G. Sukiasyan* is devoted to the study of regional demographic potential. Employing modern statistical and mathematical tools, the author identifies the socio-economic factors that exert the greatest influence on changes in the demographic potential of Russia's regions. Based on the resulting model, a scenario analysis is carried out, confirming the high sensitivity of demographic potential to shifts in socio-economic conditions.

In the section "Monitoring of Changes: Key Trends," *M.A. Sidorov* and *E.V. Lukin* elucidate the economic trends observed in Northwest Russia in 2025, chief among them being a deceleration of economic growth and a pivot toward domestic demand. *M.V. Morev* and *E.E. Leonidova* present the trends in the social well-being of the Vologda Region's population as of February 2026.

It is our hope that the findings generated by these scholars will find practical application in the management of territorial development at both the regional and municipal levels.

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# TERRITORIAL ORGANIZATION AND MANAGEMENT

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## PROBLEMS AND PROSPECTS OF TRANSFORMATION OF SMALL AND MEDIUM MINING CITIES INTO REGIONAL GROWTH POLES (CASE STUDY OF THE NWFD)

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*The development of small and medium cities in Russia has been and remains relevant. Small and medium mining cities deserve special attention. In Soviet times, there was a peak in their development, but now they have partially lost their potential, and some of them are in crisis. The aim of our study is to develop practical recommendations for the transformation of extractive small and medium cities into regional growth poles, taking into account their socio-economic specifics and key development factors. Based on the scientific literature analysis, we found that the key factors in the formation of growth poles are the consideration of the existing total economic potential, developed engineering, commercial infrastructure and institutional environment, and a sufficient level of financing. Using the example of the Northwestern Federal District, common problems of small and medium mining cities have been identified: an undiversified economy; a reduction in investment (Inta and Vorkuta); a decrease in population; difficult natural and climatic conditions due to the location of cities in the Far North and areas equated to it. We proposed the directions of economic transformation for some cities: the development of alternative deposits, the extraction of rare earth elements from landfills, scientific and industrial cooperation, the opening of new areas of personnel training in institutions of higher and secondary special education; general recommendations are given on creating conditions for the transformation of the economy into a growth pole at the regional level. The scientific novelty of the work consists in substantiating promising*

**For citation:** Lebedeva M.A. (2026). Problems and prospects of transformation of small and medium mining cities into regional growth poles (case study of the NWFD). *Problems of Territory's Development*, 30(2), 10–24. DOI: 10.15838/ptd.2026.2.142.2

*areas for the development of extractive small and medium cities based on the commercialization of their strengths. The materials of the article may be useful to local governments of small and medium mining cities and regional government authorities to develop policies for the development of cities of this type and adjacent territories.*

*Poles of growth, mining cities, small and medium cities, economic transformation, spatial development.*

**ACKNOWLEDGMENT**

*The article was prepared in accordance with the state task FMGZ-2025-0013 "Factors and tools for ensuring balanced spatial development of Russian regions in the face of increasing challenges".*

**Introduction**

The issues of spatial development in Russia remain highly relevant. According to the Spatial Development Strategy of the Russian Federation for the period up to 2030 with a forecast up to 2036, one of the important strategic tasks facing the country is "creating conditions to ensure the stability of the settlement system in the Russian Federation, including conditions to halt the outflow of the permanent population from the regions of Siberia, the Far East, and the Arctic, as well as from small and medium-sized towns and rural areas"[1]. Cities, as centers of productive forces, play a key role in the settlement system of any country (Sekushina, 2018; Sekushina, 2022; Rastvortseva, Manaeva, 2023). Among them, an important place is occupied by small and medium-sized towns (SMTs), which serve as hubs of the territorial support framework, ensuring balanced territorial development and providing conditions for living and working outside major urban centers (Lappo, 1997; Lyubovny, 2012; Sekushina, 2024; Seleznev et al., 2025).

Among SMTs of all specializations, mining cities deserve particular attention. For the most part, they are single-industry towns and during the Soviet era acted as growth poles for their regions (Sekushina, 2024). A city, along with several surrounding settlements to support it, was built around a single large mining enterprise. This served as a driver for the development of the city itself, the adjacent territories, and the region as a whole (Fauzer et al., 2021). For instance, in Vorkuta, whose economy was based on coal mining, the population nearly doubled between 1962 and 1991, rising from 60,000 to 117,000 people; the local standard of living was higher than in Moscow[2]. The city served as a key supplier of coal both for the front during the Great Patriotic War and for industry in the post-war period (Lebedeva, Jiang Dan, 2025).

Following the collapse of the USSR, such single-industry towns began to face difficulties in marketing their extracted resources; enterprises started going bankrupt, and populations began to decline. Thus, in Vorkuta, the population in 2024 stood at 56,100 people (47.8% of its 1991 level). The city itself is currently in a state of economic decline, evidenced by the closure of several mines, the abolition of surrounding settlements, large amounts of abandoned housing, and crumbling infrastructure. In Asbest (Sverdlovsk Region), specializing in chrysotile asbestos mining, the population fell from 81,200 to 55,500 people between 2000 and 2025. In Bodaibo,

[1] The Spatial Development Strategy of the Russian Federation for the period up to 2030 with a forecast up to 2036: approved by RF Government Resolution 4146-r dated December 28, 2024.

[2] The Pechora coal basin marks its 90th anniversary. 1966 was a golden year in the history of Vorkutaugol. Available at: https://xn----7sbbgb7ar5anfxls.xn--p1ai/index.php/ kulturno-prosvetitelskaya-deyatelnost/po-stranitsamistorii/129-pechorskomu-ugolnomu-bassejnu-90-let-1966 (accessed: 16.02.2025).

specializing in gold mining, the population dropped from 17,700 to 8,900 people between 2000 and 2021. In Bilibino, also focused on gold mining, the population decreased from 7,700 to 5,400 people.

The relevance of this study stems from the following aspects.

1. Economic significance. Mining small and medium-sized towns supply a significant share of the mineral resources critical to the country (oil, coal, diamonds, metals, including rare earth elements). A crisis in these towns threatens the country's resource security.

2. Social tension. The economic focus on mineral extraction leads to wage polarization. Higher wages are concentrated in the raw materials sector, while wages in other sectors remain significantly lower, which contributes to the reproduction of poverty. In the event of an enterprise closure, mass unemployment arises and social tension increases.

3. Demographic problems. Typically, in such towns, out-migration exceeds in-migration, weakening the territory's human capital and creating imbalances in the settlement system.

4. The need for new development paths. It is necessary to develop diversification strategies that account for the specific characteristics of small and medium-sized mining towns (Zhang et al., 2023).

The emerging challenges facing Russia – such as unprecedented Western sanctions, population decline concerns, the climate agenda (the country has committed to achieving carbon neutrality by 2060), and the transition to a new technological paradigm – further exacerbate the already difficult situation of these settlements. This underscores the relevance of the study's aim: to work out practical recommendations for transforming small and medium-sized mining towns into regional growth poles, taking into account their socio-economic specificities and key development factors.

To achieve this aim, the following tasks were set: to define the essence of growth poles and the factors influencing their formation and development; to analyze the socio-economic development of small and medium-sized mining towns and identify their specific characteristics; and to propose promising directions for transforming these towns into regional growth poles.

**Theoretical framework of the study**

The theory of growth poles originates from the French school of spatial economics. Its author, F. Perroux, defined growth poles as concentrations of dynamically developing economic entities. At the same time, they act as sources of centrifugal forces and as points of attraction for centripetal forces. Each pole, being both a center of attraction and repulsion, has its own field, which exists within the fields of other poles (Perroux, 1950). J. Boudeville demonstrated that not only enterprises but also territories can serve as growth poles (Boudeville, 1972). The French economist P. Pottier extended this theory by examining the potential effects of growth poles through development axes. In his view, territories located between such axes also receive development impulses through increased freight flows, the spread of innovations, and the construction of necessary infrastructure (Pottier, 1963). In this study, a growth pole is understood as a territorial concentration of dynamically developing economic entities (Bukhval'd, 2017).

Growth poles typically form where conditions are favorable, specifically where necessary traditional and new factors of production location are present *(Fig. 1)*. These factors enable growth poles to acquire such distinctive features as high investment attractiveness; stable demand for the products that form the core of their economic specialization; close cooperative and innovative interaction among businesses; and well-developed infrastructure.

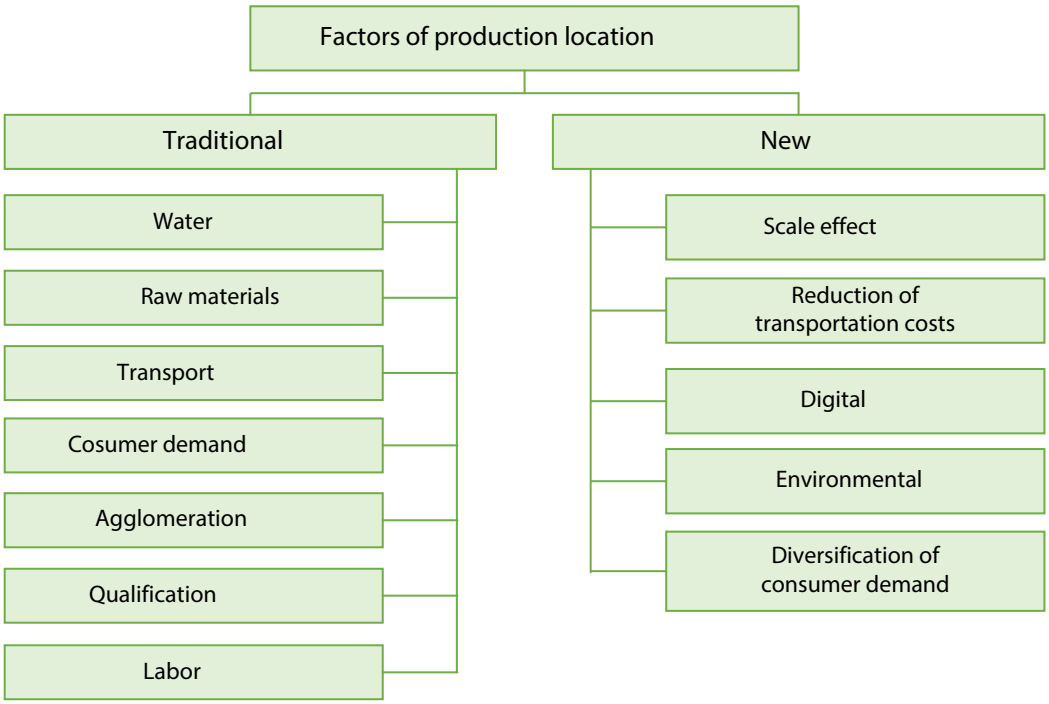


**Figure 1. Traditional and new factors of production location**
Sources: (Kolosovsky, 1969; Bandman, 1980; Fujita, Krugman, 2003).

In studying the process of establishing such growth poles, it was found that the greatest development impetus was provided by those whose formation occurred under conditions where the necessary factors of production location were present. In particular, international experience highlights the importance of a favorable institutional environment, consideration of economic potential, coordinated policies at the local and regional levels, and well-developed infrastructure *(Tab. 1)*.

Researchers who have studied international experience in creating growth poles have identified several features of the policies that enabled these towns to achieve notable results. For example, in Brazil, the fruit cluster in Petrolina-Juazeiro was created, which by 2005 accounted for 40% of the country's fruit exports, and in some sectors, such as viticulture, this figure reached 90% (Damiani, 2007). In Costa Rica, an IT cluster was established based on a USD 300 million Intel semiconductor assembly and testing plant. This served as a catalyst for revising educational curricula for workforce training and for creating a Center for High Technology, whose activities aimed to foster linkages between academic research and industries in information technology, nanotechnology, and advanced manufacturing. Thanks to this plant, not only the electronics sector grew, but also the medical device, automotive components, and business services sectors (Oviedo et al., 2015; Frick, Rodríguez-Pose, 2025).

In the cities of Taolagnaro and Nosy Be in Madagascar, following the implementation of the "Integrated Growth Poles" project, tax revenues grew by 85% annually, and the share of the population with access to basic infrastructure, particularly drinking water sources, increased: in Nosy Be from 13 to 74%, and in Taolagnaro from 50 to 95%[3].

[3] Madagascar – Integrated Growth Poles and Corridor Project 2: P113971 – Implementation Status Results Report: Sequence 03. World Bank. 2015. 16 p. Available at: https://documents1.worldbank.org/curated/en/277351467135807185/pdf/ISR-Disclosable-P113971-06-28-2016-1467135793823.pdf (accessed: 10.08.2025).

**Table 1. Examples of successful international experience in establishing growth poles**

| Territory | Expected result | Measures | Success factors |
|---|---|---|---|
| Petrolina and Juazeiro (Brazil) | Fruit cluster. Development of a high-income agricultural cluster leveraging soil quality, topography, and year-round sunshine | Creation of a large-scale irrigation system; attraction of agricultural companies; provision of financial and technical support to small farmers; conducting agricultural R&D | Large-scale public investment in irrigation infrastructure combined with strategic attraction of agricultural companies, financial and technical support for small farmers, and provision of agricultural research |
| Costa Rica | Creation of an IT cluster | Updating the existing free trade zone scheme; adapting workforce training for the electronics cluster; supplier development program | Large private investment, favorable business environment, workforce training |
| Nosy Be and Taolagnaro (Madagascar) | Tourism development (under the "Integrated Growth Poles" program) | Combination of locally targeted measures (including modernization of urban development plans, port facilities, and utilities) and broader measures to improve the country's business environment | Favorable business environment, modernization of urban development plans, ports, and utilities |
| Da Nang, Vietnam | Achieving growth rates above the national average | Creation of industrial zones; airport modernization; participation in the "Green Cities" project supported by the Asian Development Bank | High levels of financing, favorable business environment, developed infrastructure |
| Compiled based on: (Frick, Rodríguez-Pose, 2025; Vietnam's Provinces, Regions, and Key Economic Zones (2017). Vietnam, Briefing. No. 3. 12 p.; Madagascar – Integrated Growth Poles and Corridor Project 2: P113971 – Implementation Status Results Report: Sequence 03. World Bank. 2015. 16 p. Available at: https://documents1.worldbank.org/curated/en/277351467135807185/pdf/ISR-Disclosable-P113971-06-28-2016-1467135793823.pdf (accessed: 10.08.2025); The Impact of Intel in Costa Rica. World Bank. 2006. 52 p.). | | | |

In Vietnam, the transformation of Da Nang led to a fivefold increase in the GDP of the central region between 1997 and 2014, and the implementation of 350 projects into which foreign investors poured USD 3.5 billion. The region's economic structure also transformed: if at the end of the 20th century agriculture dominated, the current stage is characterized by a predominance of services, industry, and construction (over 90% of GRP)[4] (Frick, Rodríguez-Pose, 2025).

According to the authors (Frick, Rodríguez-Pose, 2025), the success of these growth poles is due to clear economic and institutional potential, coherence of the measures taken, public support, and the presence of an active private investor.

Furthermore, researchers have also examined unsuccessful experiences in developing growth poles. The main reasons for the failure of such projects were inadequate infrastructure (both engineering and commercial), the absence of an assessment of economic potential and prerequisites for developing specific industries, and an underdeveloped institutional environment.

For example, in Indonesia, the objectives for creating growth poles were to enhance the competitiveness of peripheral regions, increase their investment attractiveness, create jobs, and develop exports. To this end, in 1993, 14 municipal programs known as "integrated economic development zones" were launched. These programs set targets for raising per capita

[4] Data Collection Survey on Sustainable and Integrated Urban Development in Da Nang. Japan international cooperation agency. 2016. Available at: http://open_jicareport.jica.go.jp/pdf/12260584.pdf; https://documents.worldbank.org/en/publication/documents-reports/documentdetail/780871468191351269/madagascar-integrated-growth-poles-project (accessed: 10.08.2025).

GRP to the national average and for increasing the share of investment and exports in the regions to 20% of the national level. However, an analysis of the implementation results showed that these programs largely failed to achieve their goals. The regions attracted only 3.4% of total investment, significantly below the 20% target. Furthermore, interregional inequality did not decrease.

Another example of unsuccessful transformation of cities into growth poles is Jordan. Here, the primary goal was to develop IT parks outside the capital to address infrastructure deficiencies. Although the IT sector grew by 37% annually and increased its share of GDP from 1.8% to 2.9%, most emerging IT companies preferred to locate precisely in the capital. Moreover, of the three planned IT parks, only one (CyberCity) actually became operational, and it only managed to attract low-tech companies; subsequently, it was partially converted into a refugee camp. Researchers attribute the primary reasons for Jordan's failure to low university engagement, inadequate infrastructure, and the poor location of IT parks in areas with low economic activity (Magableh, 2010; Frick, Rodríguez-Pose, 2025).

## Materials and methods

The object of this study is small and medium-sized mining towns in the Northwestern Federal District (NWFD). Their selection is based on the predominant share of the economic activity "Mining and Quarrying" in the total revenue of the municipality. The subject of the study is their socio-economic development, considering their specialization in mining. The choice of these towns is justified by the challenges characteristic of them, namely their vulnerability to new challenges facing the country, manifested in the declining economic activity of city-forming enterprises, including due to decreased demand for their products. The search for transformation prospects for such towns was carried out in two stages: 1) analysis of the socio-economic development of the towns at the current stage; 2) identification and proposal of promising types of activities for establishing these towns as growth poles, based on the identified problems and specific features.

The study employs general scientific research methods, such as analysis, synthesis, induction, deduction, and graphical and tabular visualization techniques.

The information base consists of data from the Federal State Statistics Service of Russia and its territorial offices in the regions of the NWFD, as well as the non-profit web-mapping project OpenStreetMap (https://www.openstreetmap.org).

## Results and discussion

A total of 11 small and medium-sized towns specializing in mineral extraction are located in the NWFD *(Tab. 2)*. Of these, five are in the Komi Republic, three in the Murmansk Region, one in Karelia, and one in the Nenets Autonomous Area.

Previously, the economy of the town of Slantsy in the Leningrad Region also specialized in mineral extraction, but in 2013, the enterprise "Leningradslanets" was abolished[5]. The town of Inta, whose economic specialization was coal mining, should also be noted. In 2019, the enterprise "Intaugol" went bankrupt, and the only operational "Intinskaya" mine was mothballed[6]. Currently, however, the "Kozhimskoye Prospecting and Mining

[5] Leningradslanets OJSC. List-Org: Counterparty verification service. Available at: https://www.list-org.com/company/4562 (accessed: 01.08.2025).

[6] Komi stated that the conservation of the "Intinskaya" mine would take three years. Available at: https://tass.ru/ekonomika/18971181 (accessed: 01.08.2025).

**Table 2. Small and medium-sized towns of the NWFD specializing in mineral extraction**

| Region | Town | Natural resource in economic use |
|---|---|---|
| Komi Republic | Vorkuta | Coal |
| | Inta | Quartz |
| | Vuktyl | Gas, oil, gas condensate |
| | Pechora | Oil, gas, coal |
| | Usinsk | Oil and associated gas |
| Nenets Autonomous Area | Naryan-Mar | Oil and natural gas |
| Murmansk Region | Olenegorsk | Iron ore |
| | Kovdor | Magnetite ores |
| | Kirovsk | Apatite-nepheline ore |
| | Monchegorsk | Copper-nickel ores |
| Republic of Karelia | Kostomuksha | Iron ore |
| Compiled from: Spark-Interfax services. Available at: https://spark-interfax.ru; OpenStreetMap. Available at: https://www.openstreetmap.org | | |

Enterprise" operates in Inta, extracting quartz on the western slope of the Urals[7].

As noted earlier, small and medium-sized mining towns face challenges in their socio-economic development when confronted with new challenges. One of the most significant is population decline. Among the towns under consideration, only Naryan-Mar has seen population growth (by 2,566 people between 2010 and 2023), which is due to a high standard of living (high wages in the oil and gas sector, northern bonuses and benefits, etc.; *Fig. 2*).

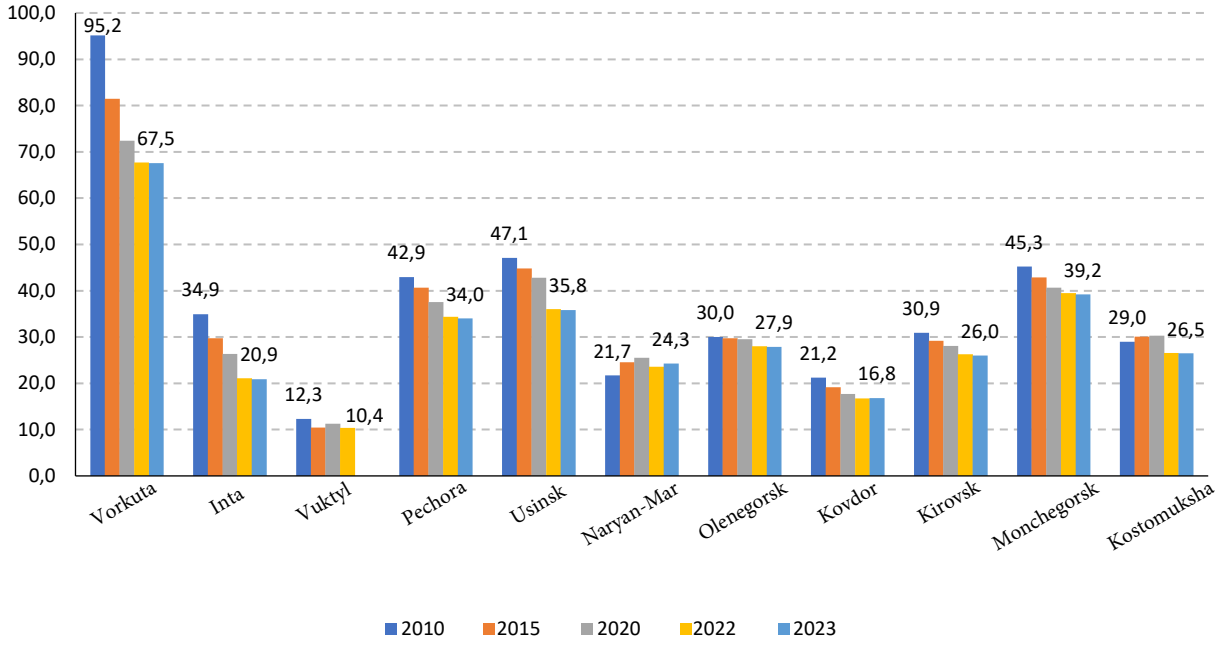


**Figure 2. Population of small and medium-sized mining towns in the NWFD in 2010, 2015, 2020, 2022, and 2023, thousands of people**

Source: Database of municipal indicators.

[7] Kozhimskoye Prospecting and Mining Enterprise CJSC. Available at: http://www.kozhim.ru/ (accessed: 03.08.2025).

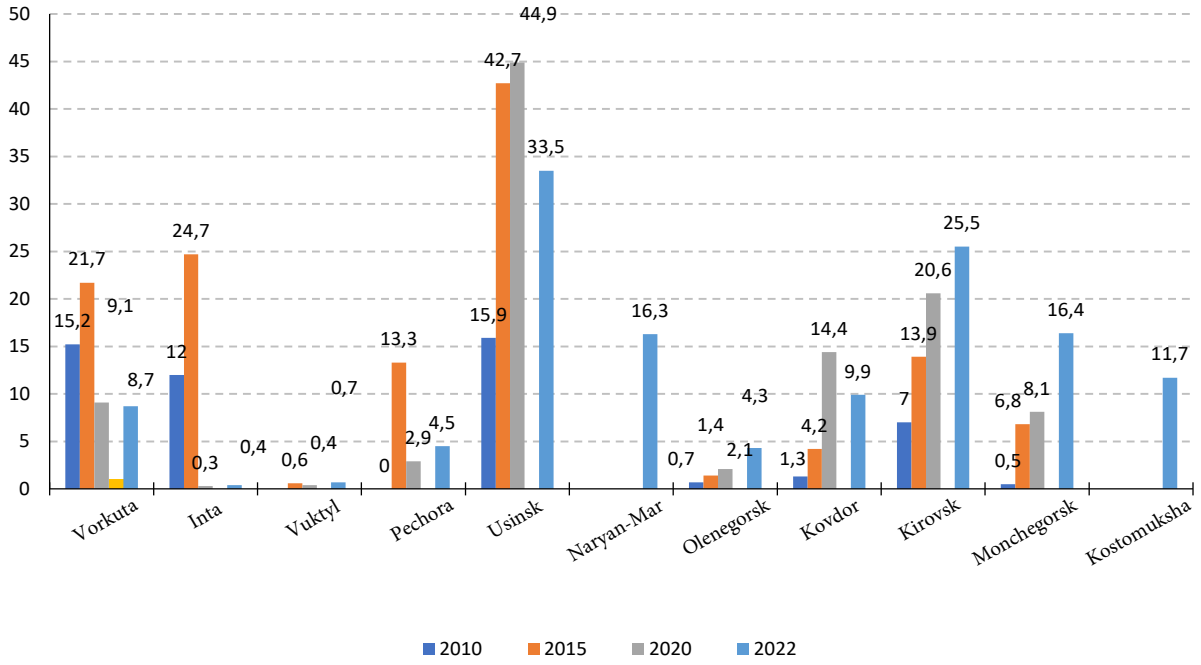


**Figure 3. Net migration in small and medium-sized mining towns of the NWFD in 2010, 2015, 2020, 2022, and 2023, people**

Source: Database of municipal indicators.

The population decline is largely associated with significant out-migration *(Fig. 3)*. In seven out of ten mining SMTs, out-migration is decreasing, but still remains higher than in-migration.

Compared to 2010, the number of arrivals in the towns under consideration has increased; however, when examining this trend relative to 2015, a decline in in-migration can be observed. Out-migration in many cases is associated with job cuts and the scaling back of social infrastructure, which ultimately leads to a reduced quality of life.

The analysis of the economic situation in the mining SMTs of the NWFD found that the most investment-active cities are those whose city-forming enterprises specialize in oil and/or gas extraction (Vuktyl, Usinsk) or are part of vertically integrated companies (the Olenegorsk Mining and Processing Plant (MPP) is part of Severstal; the Kirov branch of Apatit is part of PhosAgro; the Kovdor MPP is part of EuroChem; *Fig. 4*). The significant decline in investment in Vorkuta and Inta is associated with the closure of several coal mines.

In addition to fixed capital investment, we consider it appropriate to analyze local budget revenues and expenditures in these towns. The analysis showed that in 2020, the local budget was nearly balanced in eight towns, compared to only five towns in 2010. Moreover, both expenditures and revenues of local budgets increased in all towns except Naryan-Mar, where this is attributed to quarantine measures during the coronavirus pandemic and a reduction in budget investments in capital construction projects[8] *(Fig. 5)*.

Furthermore, common problems for the towns under consideration include an undiversified economy, harsh climatic conditions, and the presence of unreclaimed tailings piles and waste dumps from mining operations.

[8] The NAA authorities have reduced budget revenues and expenditures for 2020 due to losses during the pandemic. Available at: https://tass.ru/ekonomika/8737603 (accessed: 05.08.2025).

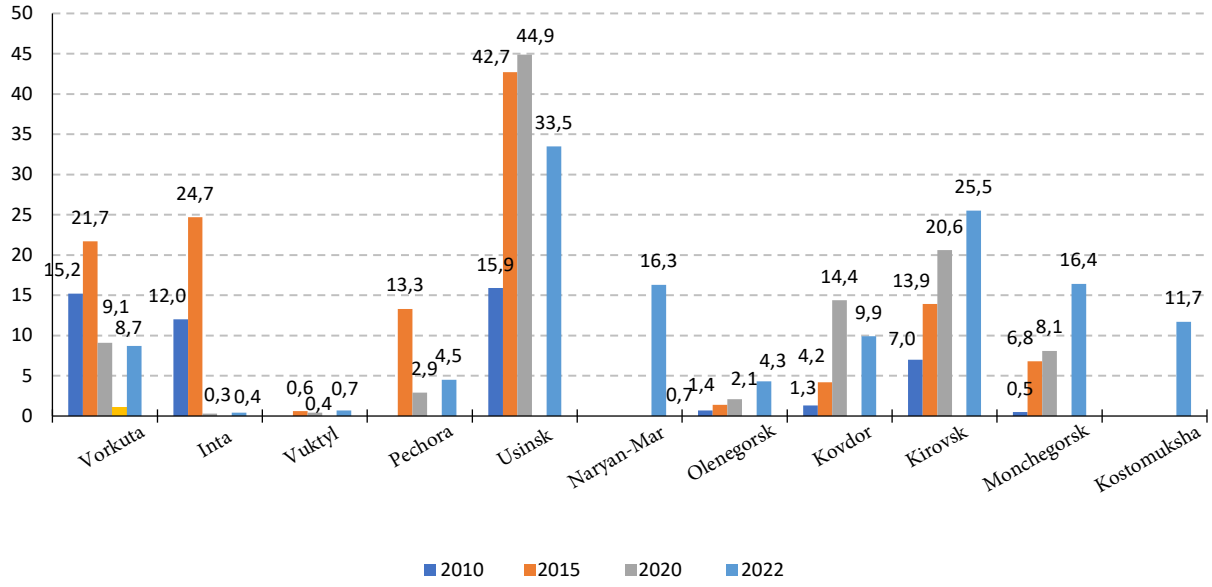


**Figure 4. Fixed capital investment in small and medium-sized mining towns of the NWFD in 2010, 2015, 2020, and 2022, billions of rubles**

Source: Database of municipal indicators.

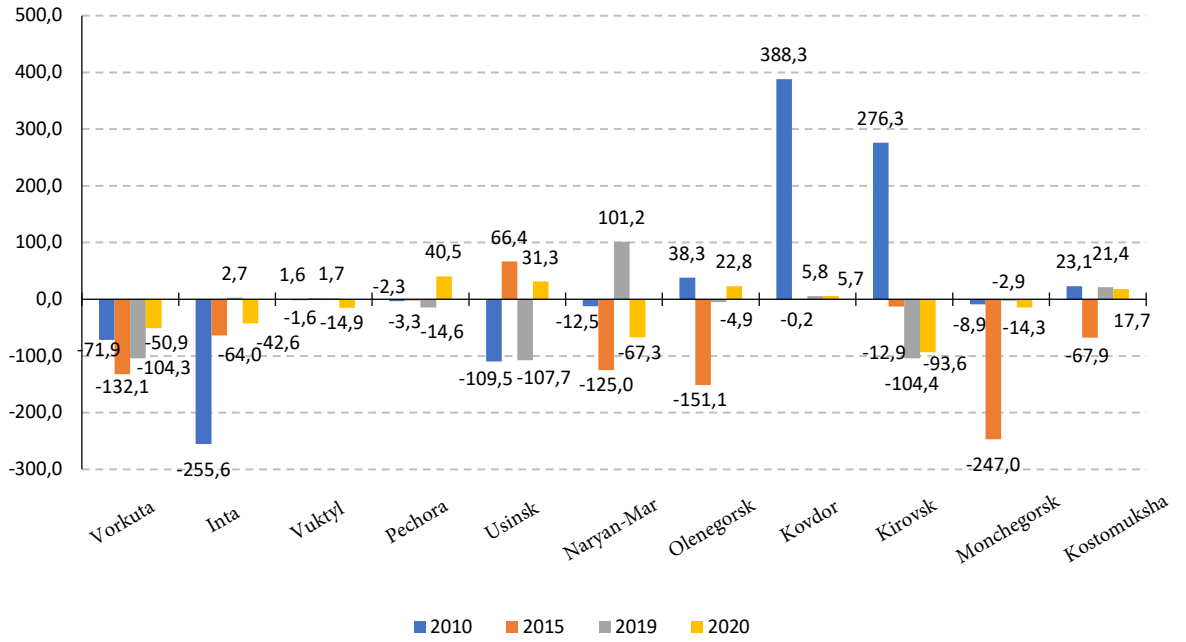


**Figure 5. Local budget surplus / deficit of mining SMTs, millions of rubles**

Source: Database of municipal indicators.

The data do not cover all spheres of life and only provide a general picture of development trends in mining SMTs. Despite the existing problems, these towns have potential and their own strengths. The specific features of some of the towns under consideration, which are in a more critical state, along with their corresponding development prospects for further transformation into growth poles, are presented in *Table 3*.

In Kirovsk and Olenegorsk, we believe it is advisable to strengthen cooperation with the

**Table 3. Promising directions for the development of small and medium-sized mining towns in the NWFD**

| Region | SMT | Strengths | Prospects |
|---|---|---|---|
| Murmansk Region | Olenegorsk | Availability of mineral resources (iron ore); proximity to scientific base in Apatity; presence of the full-cycle Olenegorsk Mechanical Plant | Extraction of rare earth elements from sludge dumps for use in metallurgy, chemistry, and electronics manufacturing; research and production cooperation with the Kola Science Center RAS (Apatity); expansion of the client base for the Olenegorsk Mechanical Plant |
| | Kirovsk | Availability of mineral resources (apatite-nepheline ores); proximity to scientific base in Apatity; presence of a ski resort | Extraction of rare earth elements from sludge dumps for use in metallurgy, chemistry, and electronics manufacturing; research and production cooperation with the Kola Science Center RAS (Apatity); sports event tourism; development of the Kirovsk-Apatity agglomeration |
| Republic of Karelia | Kostomuksha | Presence of two large enterprises that are part of vertically integrated companies (Severstal and Segezha Group); proximity to the Kostomuksha Nature Reserve | Implementation of urban development projects funded by Severstal and Segezha Group as part of their corporate social responsibility policies; industrial and ecotourism |
| Komi Republic | Inta | Proximity to the Parnokskoye iron-manganese deposit; presence of an enterprise mining a quartz deposit (Zhelanninskoye quartz vein field); presence of a branch of the Vorkuta Arctic Mining and Polytechnic College (VAMPC) | Development of the Parnokskoye deposit site with manganese ores for the chemical and metallurgical industries; creation of an enterprise for quartz processing and manufacturing electronics and fiber-optic cables; introduction of training programs for mine surveyors and geologists/exploration specialists at the Inta branch of VAMPC |
| | Komi Republic | Proximity to the Yugyd Va National Park; presence of active and inactive mines | Extraction of methane from the Vorgashorskaya mine for subsequent use in diamond synthesis or energy generation; creation of enterprises for synthetic diamond production for industrial and jewelry use; development of stalker tourism and ecotourism |
| Source: own compilation. | | | |

town of Apatity, particularly in the areas of research and production collaboration. Apatity is home to several specialized institutes of the Kola Science Center of the Russian Academy of Sciences (the Geological Institute, the Mining Institute, the I.V. Tananaev Institute of Chemistry and Technology of Rare Elements and Mineral Raw Materials, and the Institute of North Industrial Ecology Problems), whose innovative proposals could be applied at active mining deposits and processing enterprises. They could also prove useful in processing production waste (e.g., phosphogypsum, fly ash, red mud, etc.) for the extraction of rare earth elements.

Near the town of Inta, on the western slope of the Urals, a promising manganese deposit has been discovered, which, after processing, can be used in many industries, including electronics, chemicals, construction, and optics.

Given that the number of workers in the mining industry of the Komi Republic is declining overall (from 33,700 in 2010 to 21,800 in 2023[9]), due not only to migration and natural population decline but also to earlier retirement, we consider it advisable to introduce a training

[9] Statistical Yearbook of the Komi Republic. 2024: Statistical collection. Komistat. Syktyvkar, 2024. 328 p.

program for geologists and exploration specialists in addition to the existing program in "Underground Mining of Mineral Deposits" at the Inta branch of the Vorkuta Arctic Mining and Polytechnic College (VAMPC).

In the town of Kostomuksha, the woodworking enterprise Karelian Wood Company LLC, which is part of Segezha Group and specializes in logging and primary wood processing, and JSC Karelsky Okatysh, part of Severstal, are located. Both vertically integrated companies pursue corporate social responsibility policies, which involve implementing social and environmental projects in the towns where they operate. Therefore, city administrations should focus on developing the business environment and maintaining cooperation with these enterprises.

Furthermore, it is worth noting that the Kostomuksha Nature Reserve is located near the town and could serve as a site for ecotourism.

In Vorkuta, given the abundance of carbon resources, we believe it is advisable to establish synthetic diamond production facilities. The mines in Vorkuta have high methane content; therefore, it would be prudent to explore the possibility of extracting methane from them and subsequently using it as a raw material for diamond production (Podmarkov et al., 1997; Lebedeva, Jiang Dan, 2025).

Furthermore, considering the large number of abandoned houses and two abolished settlements (Yur-Shor and Promyshlenny) near Vorkuta, which attract stalker tourists, it would be logical to organize such stalker tourism in a structured way. This would help reduce the number of potential accidents and incidents of looting (Lebedeva, Jiang Dan, 2025).

**Conclusion**

Thus, the issues of development of small and medium-sized towns in Russia remain highly relevant today. In the face of new challenges, the development problems of such towns, especially those specializing in mineral extraction, become even more acute, requiring measures to enhance the economic potential of SMTs.

The study has identified common problems characteristic of small and medium-sized mining towns in the NWFD (population decline, undiversified economies). For some of these towns, considering their specific strengths, corresponding promising types of economic activity have been proposed with a view to transforming them into growth poles.

However, in addition to differentiated recommendations for developing promising directions to turn mining SMTs into growth poles, general recommendations can also be formulated:

1) develop infrastructure, particularly by maintaining roads and railways in proper condition;

2) improve the institutional environment, especially local self-government institutions, to address issues of urban improvement, education and healthcare, enhance the quality of life for the population, and develop the territory as a whole;

3) create conditions for obtaining higher and secondary vocational education aligned with the specialization of key enterprises in the town by opening branches of universities and colleges;

4) establish conditions for organizing leisure activities for the population (in most of the towns under consideration, leisure options are limited to the municipal cultural center).

In our view, these recommendations will enable small and medium-sized mining towns to more quickly overcome their development challenges and, in the medium term, become growth poles for their regions.

The scientific novelty of the work lies in substantiating promising development directions for small and medium-sized mining towns based on commercializing the strengths

these towns possess. In the future, this will make it possible to diversify the economies of such towns, thereby increasing their resilience to various challenges and addressing a number of problems, such as population decline, significant infrastructure deterioration, and reduced economic activity. The practical significance of the research lies in the potential for regional and local authorities to use the results when developing tools for the economic development of small and medium-sized mining towns.

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**Лебедева М.А.**

## ПРОБЛЕМЫ И ПЕРСПЕКТИВЫ ТРАНСФОРМАЦИИ ДОБЫВАЮЩИХ МАЛЫХ И СРЕДНИХ ГОРОДОВ В ПОЛЮСА РОСТА РЕГИОНАЛЬНОГО УРОВНЯ (НА ПРИМЕРЕ СЗФО)

*Проблематика развития малых и средних городов России была и остается актуальной. Особого внимания заслуживают добывающие малые и средние города. В советское время наблюдался пик их развития, однако сейчас они частично утратили потенциал, а некоторые из них находятся в кризисном состоянии. Цель исследования – разработать практические рекомендации по трансформации добывающих малых и средних городов в полюса роста регионального уровня с учетом их социально-экономической специфики и ключевых факторов развития. На основе анализа научной литературы было установлено, что ключевыми факторами становления полюсов роста являются учет имеющегося совокупного экономического потенциала, развитые инженерная, коммерческая инфраструктура и институциональная среда, достаточный уровень финансирования. На примере Северо-Западного федерального округа выявлены общие проблемы добывающих малых и средних городов: недиверсифицированность экономики; сокращение объема инвестиций (Инта и Воркута); снижение численности населения; сложные природно-климатические условия в силу размещения городов на Крайнем Севере и местностях, приравненных к нему. Предложены направления трансформации экономики для некоторых городов: разработка альтернативных месторождений, извлечение редкоземельных элементов из отвалов месторождений, научно-производственная кооперация, открытие новых направлений подготовки кадров в учреждениях высшего и среднего специального образования; даны общие рекомендации по созданию условий для трансформации экономики в полюса роста регионального уровня. Научная новизна работы состоит в обосновании перспективных направлений развития добывающих малых и средних городов на основе коммерциализации имеющихся у них сильных сторон. Материалы статьи могут быть полезны органам местного самоуправления добывающих малых и средних городов и органам государственной власти регионального уровня для разработки политики развития городов подобного типа и прилегающих к ним территорий.*

*Полюса роста, добывающие города, малые и средние города, трансформация экономики, пространственное развитие.*

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## ИНФОРМАЦИЯ ОБ АВТОРЕ

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# TERRITORIAL FINANCE

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## SOCIAL IMPACT PROJECT AS A TOOL FOR REGIONAL DEVELOPMENT (CASE STUDY OF THE MURMANSK REGION)

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*This article explores new mechanisms for attracting financial resources to fund social projects and address critical social challenges at the regional level. The object of the study is social impact bonds as a potential financing instrument for social sector projects in the Murmansk Region. It examines the concept and specific features of social impact bonds, and outlines the regulatory frameworks governing their use in both international practice and Russia. Drawing on the experience of social impact bond implementation in Russia and abroad, the article demonstrates that this instrument holds considerable promise for addressing social issues regionally. We analyze the conditions necessary for launching social impact projects in the Murmansk Region, propose suitable project goals, identify potential stakeholders who could participate in such initiatives, and assess the*

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*positive outcomes these bonds could generate for different categories of participants. The study also highlights barriers hindering the development of social impact bonds in Russia and offers recommendations for promoting this mechanism. The scientific novelty of the research consists in developing and testing, using the example of a specific Arctic region, an approach to the strategic coupling of the SIB mechanism with territorial planning documents and the interests of key corporate players in the Arctic. The practical relevance of the research stems from the potential application of its findings in shaping regional economic policy in the Murmansk Region, as well as their possible adaptation for use in other Russian regions.*

*Social impact bonds, SIB bonds, social impact projects, Arctic region, Murmansk Region, social sector.*

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**Introduction**

The Russian Arctic is currently one of the key priorities for territorial development in the Russian Federation. Interest in developing the region stems from its geostrategic importance, the growing role of the Northern Sea Route in global shipping, and its vast natural resources, which underpin Russia's resource potential.

Today, a range of mechanisms is being developed within the framework of state Arctic policy to ensure the sustainable development of the Arctic Zone of the Russian Federation (AZRF). The current priority approach focuses on establishing support cities and agglomerations intended to serve as a structural backbone for the entire AZRF. The ambitious targets set for these cities and agglomerations call for substantial financial resources. According to statements by the Government of the Russian Federation, developing the AZRF support hubs will require approximately 3 trillion rubles in the coming years, of which only about 1 trillion will come from federal sources[1]. Thus, achieving effective development and meeting strategic goals in the Arctic will be possible only by attracting considerable extrabudgetary resources. At the same time, the financial capacity of large Russian corporations is limited, while small and medium-sized investors are primarily interested in commercially viable, profitable projects. This makes it increasingly important to explore new, still underexplored mechanisms for channeling extrabudgetary funds into the social sectors of Arctic regions. The social impact bond model offers a fundamentally different approach. It is based on the state paying only for specific, measurable, and successfully achieved social outcomes. This model could help attract private investment to the social sphere and facilitate the adoption of innovative practices. The key research question addressed in this article is how to

[1] More than 3 trillion rubles will be allocated for the implementation of the Arctic master plans. The material of the AZRF investment portal. Available at: https://arctic-russia.ru/news/na-realizatsiyu-master-planov-arktiki-napravyat-bolee-3-trln-rubley/?ysclid=m24ieaifkg897666404 (accessed: 05.10.2025).

identify and justify new mechanisms for financing the social sector in Arctic regions using extrabudgetary resources. This issue has a strong regional dimension: traditional budgetary instruments and public-private partnerships do not fully account for the harsh operating conditions, the high cost of social services, or the specific human capital requirements found in the Arctic. Therefore, exploring the potential of social impact bonds as a tool for the sustainable territorial development of the AZRF regions is both timely and important.

The research hypothesis is that the social impact bond (SIB) mechanism can become an effective tool for addressing social challenges in the Arctic region (specifically, the Murmansk Region) provided that three conditions are met: 1) the focus is on problems typical of small cities that are heavily dependent on large industrial enterprises and facing negative migration trends; 2) investors are major corporations interested in the long-term sustainable development of the regions where they operate; 3) projects are integrated into existing strategic planning documents, such as the master plans for the support settlements of the Arctic Zone of the Russian Federation.

The central contradiction this hypothesis seeks to resolve lies in the conflict between the short-term financial interests of private investors – who seek a quick return on their initial investment – and the state's long-term goals for sustainable territorial development. In the Arctic context, this conflict is exacerbated by the high cost of project implementation and the uncertainty surrounding social outcomes. Resolving this contradiction is possible by designing SIB projects that offer investors not only a return on investment but also reputational (ESG) benefits, while also creating the conditions for scaling successful practices to other municipalities within the AZRF.

**Materials and methods**

The aim of this study is to explore the potential for attracting financial resources from large corporations to develop the social sectors of an Arctic region (Murmansk Region) through the use of a relatively new public-private partnership tool: social impact bonds.

The information base includes data from the official websites of the Federal State Statistics Service of the Russian Federation (Rosstat), the Ministry of Economic Development of the Russian Federation, the Government of the Murmansk Region, VEB.RF, and the Government Outcomes Lab (GO Lab) at the University of Oxford.

The choice of research methods is determined by the need to verify the proposed hypothesis in several stages.

An analysis of regulatory sources and academic literature allowed us to identify the universal characteristics of SIBs and, based on international experience, to pinpoint the key contradiction between investor and state interests.

Comparative analysis and statistical processing of data on projects implemented in Russia were used to assess investor motivation (confirming the importance of non-financial factors) and to identify the adaptive features of the Russian SIB model.

Methods of synthesis and generalization were employed to adapt the identified patterns to the specific context of the Murmansk Region. Based on these methods, along with an analysis of strategic planning documents (master plans for support cities) and an

assessment of the current state of public-private partnership development in the region, practical recommendations for implementing SIB mechanisms in the Murmansk Region were developed.

Methodologically, the study draws on the work of Russian and international authors in the field of regulating and implementing social impact bonds both in Russia and abroad.

**Results of the study**

***Regulation and specific features of social impact bonds***

Social impact bonds (SIBs) are a financial instrument in which private investors fund social projects, and the government repays the investment plus a return only if the project achieves pre-agreed, measurable social outcomes.

Although SIBs are a relatively new tool for raising funds to address social challenges in both international and domestic practice, the experience gained to date has already provided a sufficient methodological and regulatory framework for their issuance and use.

In international practice, the regulation of SIBs varies considerably, reflecting differences in legal systems, financial market structures, and the role of the state in the social sphere. Unlike traditional financial instruments, SIBs operate within an interdisciplinary legal space spanning financial, administrative, and social law. This gives rise to complex and often fragmented regulatory models.

A notable feature of international regulation is the predominance of soft law and framework agreements over strict statutory rules. In many jurisdictions, the focus is not on drafting new laws but on developing methodological guidelines and standards for verifying social outcomes. Thus, a key characteristic of international practice is the dual nature of regulation: the financial aspect of SIBs is subject to general securities law, while the social component is governed primarily by contracts between the public authority, investors, and social service providers, with growing reliance on international standards for reporting on social impact.

The core principles of the international approach have shaped the emerging regulatory framework for the issuance and circulation of social bonds in Russia.

The foundations for regulating this segment of the financial market were laid in 2019 with the adoption of RF Government Resolution 1491 dated November 21, 2019 "On Organizing Pilot Approbation of Social Impact Projects by Constituent Entities of the Russian Federation in 2019–2024". The Resolution established a pilot mechanism for implementing social impact projects, similar to the SIB model used in Western countries. Based on this document, VEB.RF issued directives formalizing its role as the operator of social impact projects and defining the procedure for monitoring progress toward the target indicators set for such projects.

Currently, the implementation of social impact projects is also governed by regional regulatory acts. In most cases, these projects are carried out without a full bond issuance. Typically, the organizer and investor is a commercial entity with an interest in the development of the region where it operates, or a federal development institution. Upon successful completion of a social impact project, the investor is paid through a grant in the form of subsidies from the budget.

In recent years, the specifics and applications of social impact bonds as a tool for raising funds to address social challenges have been actively discussed in the Russian academic community. Researchers tend to adopt approaches similar to those found in regulatory documents, focusing on the content and key features of SIBs *(Tab. 1)*.

The general framework for implementing the SIB mechanism is shown in *Figure*.

Under the SIB mechanism, a regional or municipal authority (the commissioner) identifies a social problem and defines target indicators for solving it. The operator (VEB.RF), together with experts, designs the project structure.

The parties (the authorities and the investor) enter into a social impact bond agreement – a legal contract that formalizes the transfer of the investor's funds to address the social problem. Investors may include

**Table 1. Authorial approaches to the content and specifics of social impact bonds**

| No. | Author | Definition |
|---|---|---|
| 1 | A.G. Kucherov, P.N. Zakharov (Kucherov, Zakharov, 2018) | A way for the private sector to outsource social programs and receive compensation for achieving results |
| 2 | O.L. Shuleiko (Shuleiko, 2022) | A debt instrument for raising funds to fully or partially finance or refinance social projects that meet established requirements |
| 3 | Yu.Yu. Filichkina, N.S. Denisova (Filichkina, Denisova, 2021) | A public-private partnership tool that enables funding of effective social programs through agreements that require specific results |
| 4 | R.L. Karmina, F.A. Kurakov (Karmina, Kurakov, 2025) | A financial instrument capable of supporting effective development of the public sector through activities aimed at achieving defined social outcomes |
| 5 | V.V. Bezotecheskaya, N.L. Poltoradneva, E.D. Struts (Bezotecheskaya et al., 2024) | Targeted bonds designed to implement new or existing projects aimed at addressing or alleviating specific social problems or achieving positive social change |
| Source: own compilation. | | |

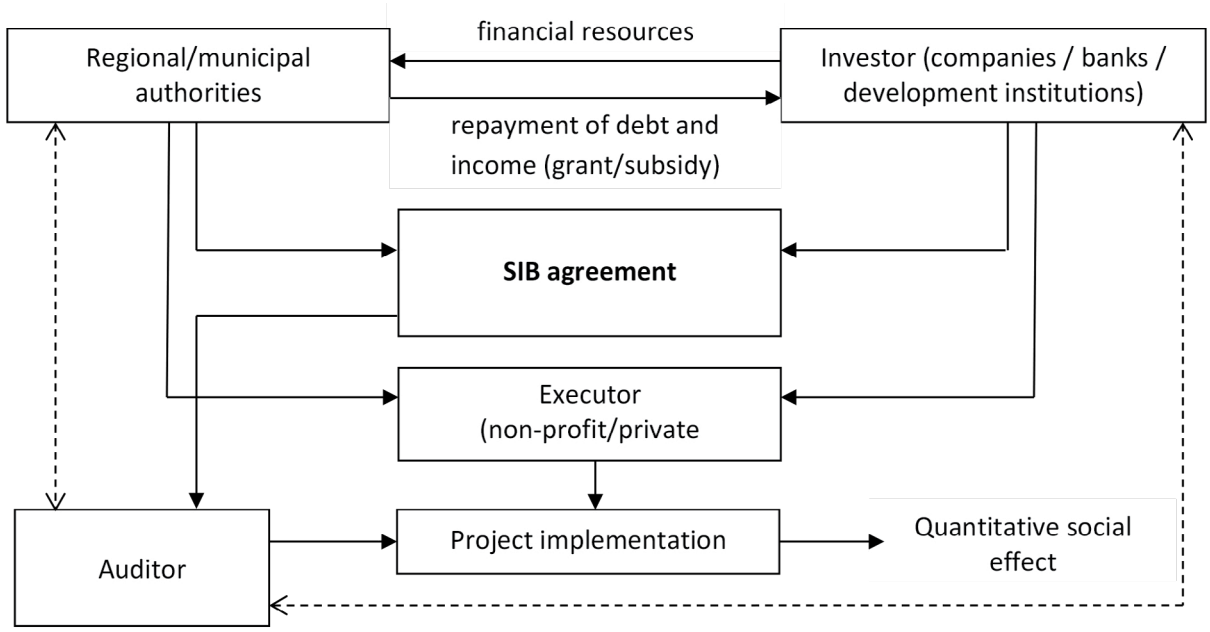


**Figure. General framework for implementing the SIB mechanism**
Source: own compilation.

large companies operating in the region, development institutions, and commercial banks. The funds raised are channeled to a service provider – a non-profit or private organization – that implements a set of activities (such as educational programs, medical services, career guidance, etc.). Although the investor does not directly carry out the project, they participate in selecting the provider and monitoring implementation. Once the project is completed, an independent evaluator (an expert commission or auditor) verifies whether the target indicators have been met. If successful, the commissioner pays the issuer an amount equal to the funds invested plus an agreed rate of return. If the targets are not achieved, the investor loses their investment (or part of it), and the budget incurs no costs. In this way, the investor bears the sole risk of not recovering their capital if the social outcome is either not achieved or not properly verified (Razumova et al., 2024, p. 42).

It is important to note that, unlike traditional infrastructure bonds, where the investor receives a guaranteed return regardless of the outcome, SIB payments are conditional solely on the social impact. This increases the service provider's accountability and reduces the budgetary burden in case of failure.

In Russian practice, payments are made from regional and municipal budgets in the form of grants (subsidies) upon successful achievement of results. Interest costs (the return to investors) generally do not exceed the inflation rate and are offset by the social impact achieved, which leads to lower budget expenditures in the future.

The scientific literature today provides a fairly detailed overview of the advantages of using social impact bonds. For example, A.G. Kucherov and P.N. Zakharov highlight the opportunity for public authorities to conduct a preliminary assessment of the effectiveness of specific social programs and projects before committing to full-scale government funding (Kucherov, Zakharov, 2018). O.L. Shuleiko notes that issuing social impact bonds can, on the one hand, improve the efficiency of budget spending (since funds are allocated only to projects that achieve measurable social outcomes reflected in improved indicators) and, on the other hand, enhance the public image of corporate investors (Shuleiko, 2022). A.A. Bisultanova and A.Yu. Kolpakov point to the significant role of social bonds in strengthening social infrastructure and improving the quality of life of the population (Bisultanova, Kolpakov, 2024). In international practice, authors often emphasize the ability of social impact bonds to address the needs of the most vulnerable population groups when government resources are limited (Costa et al., 2014); they also highlight the emergence of innovative approaches to solving long-standing social problems that the state has traditionally addressed using conventional methods (Pandey et al., 2018), as well as the broad adaptability of the instrument to the conditions of a specific country or region (Munksgaard Andersen et al., 2022).

At the same time, the main disadvantages of using social impact bonds include the long-term nature of social investments (typically ranging from three to five years); the difficulty of finding and engaging a highly qualified management company with the necessary expertise to design and implement a package of activities and projects, and to effectively manage the funds raised; the labor-intensive process of preparing documentation, which requires aligning the interests of both the commissioner and investors; the challenges of evaluating the effectiveness of implemented activities due to the imperfect nature of methodologies for measuring social impact;

the higher cost of private capital compared to government borrowing (Solntsev, 2021, p. 202); and the complexity of managing multiple stakeholders (Chudinovskikh, 2017, p. 131).

It is important to distinguish social impact bonds from other financing instruments used in Russian practice, such as infrastructure budget loans, DOM.RF infrastructure bonds for financing social infrastructure development in the regions, treasury infrastructure loans, and projects for constructing public utility infrastructure funded from the National Wealth Fund under the program of the Territorial Development Fund. While infrastructure budget loans and DOM.RF bonds are aimed at creating tangible assets – such as schools, hospitals, and transport infrastructure – and involve repayment of principal and interest from budget sources regardless of the social outcomes achieved, SIBs focus on addressing social issues through the delivery of services and programs. Under a SIB, investors receive a return only if measurable improvements are achieved (such as a reduction in recidivism or an increase in educational attainment). This makes the mechanism more flexible and less risky for the budget. At the same time, SIBs are not intended to fully replace infrastructure instruments; rather, they complement them by providing funding for areas that are currently underserved by government programs.

***Experience with social impact bonds in Russia and abroad***

Social impact bonds as a tool for raising funds to implement socially significant projects and activities first appeared in the United Kingdom about a decade and a half ago. Under the "Big Society" program, the Peterborough SIB project was launched in 2010 with the aim of reducing recidivism (Broom, 2021). The contract for the bond issuance was signed by the UK Ministry of Justice and enabled Social Finance UK, the managing company, to raise £5 million from 17 social investors for a rehabilitation program targeting prisoners released from a private prison in Peterborough. Although the program's stated goals were only partially achieved, investors did receive payments from the Ministry, and the experience of implementing this new resource mobilization mechanism was assessed positively.

The UK experience with social impact bonds was quickly adopted by other countries, which began actively using this instrument to address their most pressing social challenges. In the 2010s, successful SIB projects were implemented in the United States (including a program to reduce recidivism among former prisoners (Smekalin, 2022), addressing high asthma treatment costs[2], building affordable housing for low-income families[3], etc.), Australia (a program to prevent children from being placed in institutional care[4], a program supporting women's access to the labor market[5], etc.), and Canada (a program investing in various activities aimed at increasing physical activity among schoolchildren[6]).

In recent years, the social bond market has grown rapidly. As of early 2025, 42 countries

[2] California city seeks to cut asthma rate via bond issue. Available at: https://www.reuters.com/article/us-investing-impactbonds-health-idUSBRE89I0U120121019/ (accessed: 10.10.2025).

[3] Morgan Stanley has placed social bonds in support of affordable housing for $1 billion. Available at: https://infragreen.ru/news/134796 (accessed: 10.10.2025).

[4] Resilient Families Social Benefit Bond (SBB). Available at: https://www.benevolent.org.au/about-us/innovative-approaches/social-benefit-bond (accessed: 11.10.2025).

[5] National Australia Bank sells rare A$500 million gender equality bond. Available at: https://www.reuters.com/article/nab-bond-ethical-idUSL3N1GT26D/ (accessed: 12.10.2025).

[6] Archived - Piloting social impact bonds in Ontario: The development path and lessons learned. Available at: https://www.ontario.ca/page/piloting-social-impact-bonds-ontario-development-path-and-lessons-learned (accessed: 12.10.2025).

had experience implementing projects based on social impact bonds, with a total of 320 completed projects. The leaders in terms of successful SIB projects are the United Kingdom (100 projects), the United States (28 projects), France (26 projects), and Portugal (25 projects)[7]. In international practice, social impact bonds are most commonly used to address challenges in healthcare, education, and employment.

In Russia, the implementation of social impact projects began relatively recently, yet even in this short period, considerable experience has been accumulated in using them to address a variety of social challenges.

The first issuance of social impact bonds in the Russian Federation took place in 2019 in the Republic of Sakha (Yakutia). The issuer was the company Social Development SFO LLC, and VEB.RF served as the project operator, facilitating the conclusion of all necessary agreements. The funds raised from the bond issuance were directed toward the project "Improving Educational Outcomes of Students in the Republic of Sakha (Yakutia)". In 2023, the project was recognized as successful by all parties involved[8].

As of November 1, 2025, there were 12 regional projects in the social impact sphere at various stages of implementation in Russia *(Tab. 2)*.

Despite the relative novelty of this instrument, its successful approbation can be noted (Andreev, Boush, 2024). As of mid-2025, out of 12 launched projects, 7 had been completed, of which 5 were deemed successful based on independent evaluation.

A key institutional feature of regional social impact projects in Russia is the central role of the state corporation VEB.RF, which serves as the operator for such projects. VEB.RF is responsible for methodological support, monitoring, and organizing independent assessments of whether social outcomes have been achieved. At the same time, the participation of companies such as Russian Copper Company, SIBUR, and Russian Post as investors and organizers highlights the interest of businesses in implementing social impact projects.

An analysis of completed projects shows that the actual returns for investors range from 3 to 6% per year – lower than bank deposits or corporate bonds under current macroeconomic conditions. Nevertheless, all projects have attracted investors. This is explained by motivations that go beyond purely financial considerations: major companies view participation in SIBs as part of their sustainable development strategy, allowing them to systematically address social issues in the regions where they operate, improve human capital quality (health of workers, quality of education for potential future employees), and strengthen their reputation. Development institutions, particularly VEB.RF, participate in projects as part of their mission to support social innovation. Thus, despite their modest financial appeal, SIBs are in demand among investors focused on long-term non-financial outcomes.

A distinctive feature of the Russian model for implementing regional social impact projects

[7] According to the Government Outcomes Lab (GO Lab) of Oxford University. Available at: https://golab.bsg.ox.ac.uk/knowledge-bank/indigo/impact-bond-dataset-v2/ (accessed: 14.10.2025)

[8] A project of the Higher School of Economics and the VEB.RF Group. The Russian Federation and the government of Yakutia have improved the educational outcomes of schoolchildren by more than 10%. Available at: https://www.hse.ru/news/community/807197380.html (accessed: 15.11.2024).

**Table 2. Experience in implementing regional social impact projects in Russia**

| Project area | Region | Organizer / Investor | Timeline | Funds raised / Payment upon achievement of results, million RUB | Implementation specifics |
|---|---|---|---|---|---|
| Social services | Primorye Territory | Khabarovsk Organization for People with Disabilities (autonomous non-profit) | 2022–2026 | 42.7 / 48.4 | Development of alternative care models for people with mental disabilities |
| | Chelyabinsk Region | Russian Copper Company | 2021–2023 | 29.2 / 30.9 | Improving quality of life for people with mental disabilities. Project successfully completed |
| | Republic of Sakha (Yakutia) | VEB.DV JSC | 2021–2024 | 68.7 / 77.0 | Improving quality of life for people with disabilities. Project successfully completed |
| | Khabarovsk Territory | VEB.DV JSC | 2022–2026 | 42.7 / 48.4 | Development of alternative care models for people with mental disabilities |
| | Kemerovo Region | Center for Support and Social Services (autonomous non-profit) | 2023–2026 | 30.0 / 30.0 | Assistance for visually impaired individuals |
| | Republic of Bashkortostan | SIBUR | 2023–2026 | 35.0 / 35.0 | Improving quality of life for people with disabilities and their families |
| Healthcare | Sverdlovsk Region | Pyaterochka retail chain | 2022–2024 | 17.2 / 17.2 | Implementation of a comprehensive approach to preventing overweight and obesity in children |
| | Primorye Territory | Russian Post | 2021–2022 | 36.17 / 36.17 | Expanding access to health assessments and home-based medication support. Project successfully completed |
| Education | Kostroma Region | AFK Sistema through its subsidiary Segezha Group (timber industry holding) | 2022–2024 | 35.0 / 35.0 | Training personnel for the timber industry. Project successfully completed |
| | Kamchatka Territory | VEB.DV JSC | 2023–2026 | 65.6 / 75.33 | Enhancing the effectiveness of general education as a social and professional mobility pathway |
| | Republic of Sakha (Yakutia) | VEB.DV JSC | 2019–2022 | 60.0 / 68.0 | Improving educational outcomes for school students. Project successfully completed |
| Employment support | Kamchatka Territory | VEB.DV JSC | 2023–2026 | 20.0 / 22.2 | Employment support for individuals with criminal records |

Source: compiled from data from VEB.RF. Available at: https://xn--90ab5f.xn--p1ai/agent-pravitelstva/psv (accessed: 03.11.2025).

is its experimental and adaptive nature. Unlike the practice in some foreign countries, where ready-made solutions are often replicated, social impact projects in Russia tend to be developed as pilot initiatives aimed at testing new social technologies and models, with the most effective ones then being scaled up (Karmina, Kurakov, 2025).

***Conditions and factors for effective issuance of social impact bonds in Murmansk Region***

The Murmansk Region is one of the regions where using social impact bonds to attract extrabudgetary funds for addressing key social issues appears highly promising. This is due to several factors.

First, the region lies entirely within the AZRF, whose development is a strategic priority for achieving national goals. At the same time, the Murmansk Region, like most Arctic regions, faces a number of social challenges. Among the most significant are population outflows, especially of young people, inadequate healthcare services, insufficient provision of sports, cultural, and leisure facilities, and several other issues (Gushchina et al., 2023; Toropushina, 2023; Samarina et al., 2024). Meanwhile, declining funding under the state program "Socio-Economic Development of the AZRF"[9] and the growing regional budget deficit in recent years make it uncertain whether existing social challenges can be resolved through government funding alone.

Second, the Murmansk Region is home to four cities and agglomerations – the largest number among all AZRF regions – that were included in the list of support settlements in the Russian Arctic (Murmansk agglomeration, Kirovsk–Apatity agglomeration, Monchegorsk agglomeration, and Polyarnye Zori). In October 2025, long-term comprehensive socio-economic development plans through 2035 were adopted for these support settlements, requiring significant financial resources. As a result, substantial efforts will be needed in the coming years to mobilize the necessary funds to implement the full range of projects and achieve the goals set out in the master plans and long-term development plans for these cities and agglomerations[10].

Third, major Russian corporations operate in the Murmansk Region, with mining and large-scale production facilities located in the region. Currently, seven localities in the Murmansk Region – Kirovsk, Kovdor, Revda, Nikel, Monchegorsk, Olenegorsk, and Zapolyarny – hold the status of single-industry towns. In several other cities, the activities of large enterprises significantly shape their development, economic structure, and employment (Monchegorsk, Polyarnye Zori, Kandalaksha, and others). Moreover, the level of public-private partnership development in the Murmansk Region can be characterized as high. Agreements on the socio-economic development of host territories have been signed between the regional government, municipal authorities, and companies such as Nornickel, PhosAgro, Novatek, and Rosatom State Corporation. Enterprises

[9] Kryuchkova E. (2020). The Arctic will share the money. The Ministry of Regional Development simplifies the state program for its development. Analytical material in the electronic edition of the newspaper "Kommersant". Available at: https://www.kommersant.ru/doc/4269792 (accessed: 18.10.2025).

[10] Investments in the development of the support cities of the Arctic region were estimated at 4 trillion rubles. Available at: https://tass.ru/ekonomika/21246391 (accessed: 19.10.2025).

actively participate in developing the region's cities through corporate social responsibility standards and sustainable development strategies, funding social projects and engaging in various municipal and regional programs (Toropushina, 2022). A wide range of public-private partnership models is currently being applied. Based on the results of 2024, Murmansk Region ranked 34th in the corresponding rating of Russian regions. The total value of projects implemented through various forms of PPP agreements with businesses in the region exceeded 140 billion rubles[11].

However, despite positive trends in the development of PPP mechanisms in the region, certain challenges remain. In particular, concession agreements are primarily used for regional infrastructure projects and those in commercially attractive sectors such as tourism, leisure, and industry. At the same time, far fewer projects are implemented in social sectors such as education, healthcare, and physical education and sports.

In addition to these objective conditions, prominent researchers in Arctic studies have pointed to the potential of using social impact bonds to address socio-economic challenges in the AZRF regions. A.M. Vorotnikov and K.A. Agadzhanova argued that "in the context of international sanctions, slowing economic growth, and worsening social problems, social impact bonds will become one of the mechanisms for developing social entrepreneurship in Russia and will help develop the social infrastructure of the AZRF" (Vorotnikov, Agadzhanova, 2019, p. 34).

***Potential effective social impact projects in the Murmansk Region***

Implementing social impact projects in the Murmansk Region requires an integrated approach that accounts for regional specificities. The region is characterized by unique socio-economic conditions, including the concentration of industrial production in urban areas, unfavorable demographic trends driven by population outflows and high natural decline rates, and a challenging environmental situation in many municipalities. These factors make it necessary to adapt the standard social impact mechanism to local realities.

Potential participants in social impact projects in the Murmansk Region could include regional government authorities – represented by relevant ministries – which would identify priority social problems and act as commissioners of results. Investors could be corporations operating in the Arctic zone (such as PhosAgro, Nornickel, Novatek, and others) that are interested in advancing their ESG agendas and developing human capital. Project management, methodological support, and documentation preparation functions could be entrusted to VEB.RF, which has experience implementing social impact projects and actively supports their replication across Russian regions. The implementation role could be assigned to professional non-profit organizations with expertise in addressing specific social challenges in the Far North. To verify the achievement of target indicators, an expert commission should be established, including both direct participants (representatives of government authorities

[11] The cost of PPP projects in the Murmansk Region has exceeded 140 billion rubles. Available at: https://murmansk.rbc.ru/murmansk/23/05/2024/664f40789a79478a708eeeb8?ysclid=m3d2oj1ba991750967 (accessed: 20.10.2025)

and corporate investors) and independent experts.

The choice of target social outcomes to serve as the foundation for implementing social impact projects in the Murmansk Region can be based on an assessment of the specific characteristics of individual municipalities and their socio-economic development goals. For municipalities designated as support settlements in the Arctic Zone of the Russian Federation, it seems advisable to consider the following areas and target outcomes when assessing the feasibility of social impact projects *(Tab. 3)*.

**Table 3. Potential social impact projects in support settlements of the Murmansk Region**

| Support settlement | Potential projects | Potential investor | Target indicators | Project description |
|---|---|---|---|---|
| Kirovsk–Apatity Agglomeration | Digital educational platform for schools in the agglomeration | Apatit JSC | • 15% improvement in student performance in natural sciences<br>• 100% of schools in the agglomeration equipped with modern IT infrastructure<br>• At least 30 teachers trained in digital competencies | Development and implementation of a unified educational platform using virtual reality technologies for teaching natural sciences. The project draws on the successful experience of Siemens Corporation in Germany in establishing STEM laboratories |
| | Prevention of occupational diseases among mining industry workers | Apatit JSC | • 30% reduction in occupational disease cases<br>• 25% reduction in costs for treating occupational diseases<br>• 5% of workers enrolled in annual medical check-up programs | Creation of a continuous worker health monitoring system using wearable devices and predictive analytics. The experience of LUKOIL in implementing similar programs demonstrates their cost-effectiveness |
| Monchegorsk Agglomeration | Environmental rehabilitation and health of an industrial city | Kola MMC | • 20% reduction in respiratory disease incidence among the population over 5 years<br>• Remediation of at least 50 hectares of industrial land<br>• 30% reduction in heavy metal concentrations in soils of residential areas | The project includes the creation of a real-time air quality monitoring system, greening of industrial areas using phytoremediation technologies, and installation of modern filters at production facilities. The experience of Nornickel in implementing environmental programs in Norilsk demonstrates the potential for achieving significant results |
| | Development of industrial tourism and museum cluster | Kola MMC | • Creation of at least 50 new jobs in tourism<br>• 30% increase in tourist flow<br>• Attraction of least 10,000 visitors annually to the museum complex | Creation of a museum of metallurgical history, development of industrial tourist routes, and organization of exhibition spaces. The project is based on successful industrial tourism experiences in Germany and Sweden |

End of Table 3

| Support settlement | Potential projects | Potential investor | Target indicators | Project description |
|---|---|---|---|---|
| Murmansk Agglomeration | Center for adaptation of migrant workers in the Arctic | Novatek PJSC | • 40% reduction in interethnic tensions according to sociological surveys<br>• Reduction in the number of offenses committed by migrants<br>• 30% reduction in staff turnover among migrant workers | Establishment of a multifunctional center offering legal support services, language courses, and cultural integration programs. The experience of the Norwegian company Equinor in adapting foreign specialists will be adapted to the conditions of Murmansk |
| | Preventive medicine for rotational shift workers | Novatek PJSC | • 30% reduction in occupational morbidity<br>• Implementation of a real-time worker health monitoring system<br>• Increase in the workplace well-being index to 80% | Creation of a corporate health center with preventive programs, implementation of wearable devices for monitoring worker health, and development of individualized rehabilitation programs. The experience of Total in protecting worker health at Arctic fields will be adapted to the conditions of the Kola Peninsula. |
| Source: own compilation. | | | | |

The projects presented take into account the specific characteristics of the Kirovsk–Apatity agglomeration as a territory with a high concentration of industrial production and a need for high-quality medical and educational services. Investment by Apatit JSC in these projects aligns with ESG principles and corporate social responsibility, and will help create favorable conditions for attracting and retaining skilled personnel.

Implementing projects in the Monchegorsk agglomeration will allow Kola MMC not only to meet its environmental commitments but also to create new drivers of economic growth and improve quality of life in the industrial agglomeration. The projects are in line with the company's sustainable development strategy and take into account the specific characteristics of a single-industry town with a core metallurgical enterprise.

Implementing the proposed projects in the Murmansk agglomeration will allow Novatek to strengthen its position in the Arctic region by developing sustainable social infrastructure. Investments in migrant adaptation and healthcare will create favorable conditions for attracting the skilled personnel needed to implement the company's large-scale projects in the Arctic.

The choice of the social impact bond mechanism for the proposed projects is not coincidental. Unlike traditional public-private partnership models, which focus on creating physical assets without always ensuring clear oversight of outcomes by the investor, SIBs are designed to achieve specific social changes. Payment for these outcomes from the budget is made only after they have been verified, which incentivizes the investor to effectively monitor how funds are spent. Direct funding from the regional budget or corporate social investments lack such incentives and do not guarantee that goals will be achieved. Moreover, for the investor, participating in a SIB is preferable to non-recoverable spending, because if the project succeeds, the funds are returned with a return, and the reputational benefits are amplified by public recognition of the results achieved.

From the perspective of impact on territorial development, the key criterion for selecting projects is their strategic coherence. This means that priority in the Murmansk Region should be given to projects that:

1) are initiated in coordination with investors already integrated into the region's economy. In the Murmansk Region, the sources of financing are not abstract portfolio investors but the largest taxpayers and employers (PhosAgro, Nornickel, Novatek). Their participation in SIBs allows corporate social investments to be transformed from one-off charitable contributions into a systematic mechanism linked to their own workforce needs and long-term development strategies;

2) align with priorities established in the strategic development documents of the municipalities. The project selection method should involve verifying their contribution to achieving the targets set in the strategic planning documents of the municipalities and the region as a whole – in particular, the long-term socio-economic development plans for the support municipalities of the Arctic Zone of the Russian Federation;

3) are aimed at creating public goods that reduce future budget expenditures. Project selection should be based on their potential to generate "budget savings" in the long term. The projects presented have a significant multiplier effect on territorial development (enhancing the attractiveness of living in the implementing municipalities, improving the population's quality of life, addressing labor market challenges, etc.) and free up budget resources to address other priorities.

Thus, the proposed approach to selecting projects and investors ensures a synergy of corporate, regional, and municipal interests, transforming SIBs from a mere financial instrument into a tool for implementing a coordinated territorial development policy.

**Conclusions and recommendations**

With thorough and careful development of the conditions, proper assessment of objectives, and ensured engagement of all participants in implementing the social impact bond mechanism, this tool can attract significant financial resources and substantially address several acute problems in the social sectors of the Murmansk Region. Moreover, using the social impact bond mechanism can generate positive outcomes for all key actors in the regional economic system *(Tab. 4)*.

At present, however, certain difficulties and challenges remain, and addressing them would help increase the effectiveness of social impact bond issuance and their use in solving the most pressing social problems.

One of the main challenges in implementing the social impact bond mechanism today is the fragmentary nature of the regulatory framework governing this instrument. Current budget and civil legislation does not directly reference social impact bonds or projects, creating a certain legal vacuum. The Budget Code of the Russian Federation is oriented toward financing processes (procurement of services) rather than outcomes. There are no mechanisms for multi-year budget planning or for setting aside funds for future payments for successful projects.

Another issue is the underdevelopment of the social investment market. Russia lacks a sufficiently established class of investors ready to invest in projects with deferred and conditional returns, which involve high social, rather than purely financial risks.

**Table 4. Positive effects from implementing social impact projects in the Murmansk Region**

| Regional authorities | Large business entities as investors | The region and society |
|---|---|---|
| – Access to additional extrabudgetary funding for regional social sectors<br>– Repayment of funds only when invested resources achieve high effectiveness in social sectors<br>– Expansion of tools and directions for regional social system development<br>– Strengthened cooperation with regional businesses | – Opportunity to recover funds invested in regional social sectors and earn additional returns upon achieving target indicators<br>– Improved image as socially responsible companies working for the benefit of the Murmansk Region<br>– Strengthened ties with authorities and potential for additional benefits<br>– Creation of conditions to reduce employee morbidity and enhance the region's attractiveness for attracting labor resources | – Development of healthcare, education, solutions to environmental and migration challenges<br>– Improved quality of services in key social sectors: healthcare and education<br>– Creation of conditions to reduce population outflows and increase life expectancy by addressing critical social issues |
| Source: own compilation. | | |

Additional factors currently limiting the issuance of social bonds in the Russian Federation include: high upfront costs due to the complex process of preparing documentation and concluding necessary agreements for social impact projects; the absence of unified standards and a shortage of methodologies for assessing social outcomes that could serve as target criteria for social bond issuance; weak information support for the functioning of the social impact project framework.

The solution lies in adopting government measures aimed at further developing the social impact bond segment and creating conditions that make it more attractive to potential investors. Specific measures could include the following:

Developing a regulatory mechanism for social impact projects. Pilot projects have been implemented since 2019 with the model participation of VEB.RF and could serve as the basis for issuing social bonds in the Russian Federation. It is advisable to codify at the legislative level the conceptual framework for social impact bonds, the model of interaction between parties, the project selection procedure, and the mechanism for budget payments. It is also necessary to introduce provisions allowing constituent entities of the Russian Federation and municipalities to allocate targeted budget appropriations to pay for successful social outcomes under multi-year contracts. Federal authorities, together with the expert and academic communities, should develop and approve standard methodologies for assessing social outcomes in priority areas (employment, education, healthcare).

Establishing a system of incentives for investors willing to commit to this development tool on a long-term basis.

Developing and implementing mechanisms for information support for social bonds as an instrument that can not only provide a return on investment but also enable participation in addressing the most critical social challenges in the regions. Implementing and widely publicizing the results of pilot social impact projects at the regional level, in close collaboration with interested regions, will help accumulate practical experience and demonstrate the effectiveness of the tool. Additionally, it is necessary to organize professional development programs

for state and municipal employees, as well as for representatives of non-profit organizations and potential investors, covering the fundamentals of project management and the implementation of social impact projects. Support should be provided for the creation of professional associations and working groups that bring together representatives of government, business, non-profit organizations, and the academic community to exchange experience and develop consensus-based solutions in the implementation of the social impact bond mechanism.

Implementing these measures will create conditions for the development of the social bond institution in the Russian context and significantly expand the appeal of this financial instrument for addressing the most pressing social problems in the regions.

In conclusion we note that the scientific novelty of this study lies in the development of a theoretical and applied approach to integrating social impact bonds into the strategic management system of an Arctic region. The authors' contribution to knowledge consists of the following:

1) the specific characteristics of applying SIBs in the Arctic Zone of the Russian Federation are identified and conceptualized; these characteristics are shaped by the high concentration of large businesses, the single-industry nature of several cities' economies, and the presence of government support mechanisms such as the master plans for support settlements;

2) criteria for project selection are substantiated to ensure maximum impact on territorial development; these criteria include strategic coherence, contribution to economic diversification, and reduction of future budget expenditures;

3) it is established that in the Arctic context, the key motivation for investors is not primarily financial but rather long-term non-financial outcomes – ESG reputation, human capital quality, and the stability of the social environment; this provides a new perspective on the structure of tensions within the "state–investor" relationship when implementing social projects.

The results obtained lay the groundwork for replicating the proposed model in other regions of the AZRF and can serve as a methodological basis for adjusting regional policy aimed at attracting extrabudgetary investment into the social sphere.

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## ПРОЕКТ СОЦИАЛЬНОГО ВОЗДЕЙСТВИЯ КАК ИНСТРУМЕНТ РАЗВИТИЯ РЕГИОНА (НА МАТЕРИАЛАХ МУРМАНСКОЙ ОБЛАСТИ)

*Статья посвящена вопросам поиска новых инструментов привлечения финансовых ресурсов для финансирования социальных проектов и решения наиболее острых социальных проблем на региональном уровне. Объектом исследования выступают облигации социального воздействия как потенциальный механизм финансирования реализации проектов в социальных сферах Мурманской области. В работе рассмотрены понятие и особенности использования облигаций социального воздействия, определены основы нормативно-правового регулирования обращения данного инструмента в зарубежной практике и в России. На базе опыта использования социальных облигаций в России и за рубежом установлено, что данный инструмент имеет широкие перспективы применения в практике решения социальных задач на региональном уровне. Проведен анализ условий для реализации проектов социального воздействия в Мурманской области. Даны рекомендации по целям проектов социального воздействия в Мурманской области, предложены субъекты, которые потенциально могут быть задействованы в качестве участников проектов, и определены положительные эффекты от реализации механизма облигаций социального воздействия для различных категорий субъектов. Выявлены проблемы, сдерживающие развитие механизма облигаций социального воздействия в России, и даны рекомендации по развитию этого инструмента. Научная новизна исследования состоит в разработке и апробации на примере конкретного арктического региона подхода к стратегическому сопряжению механизма SIB с документами территориального планирования и интересами ключевых корпоративных игроков в условиях Арктики. Практическая значимость работы базируется на возможности использования представленных результатов в системе реализации региональной экономической политики в Мурманской области, а также возможной их адаптации в других субъектах РФ.*

*Облигации социального воздействия, SIB-облигации, проекты социального воздействия, арктический регион, Мурманская область, социальная сфера.*

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## ИНФОРМАЦИЯ ОБ АВТОРАХ

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# SUSTAINABLE DEVELOPMENT OF TERRITORIES, BRANCHES, AND PRODUCTION COMPLEXES

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## THE INFLUENCE OF THE CHEMICAL INDUSTRY AND FERTILIZER PRODUCTION ON THE DEVELOPMENT OF TERRITORIES: TRENDS AND PROSPECTS AT THE MACRO-LEVEL

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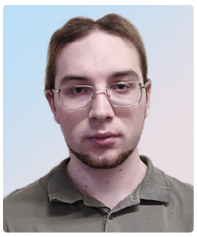

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*In the current context of sanction pressures and geopolitical turbulence, mobilizing all available resources is essential for ensuring territorial development. One such resource is the chemical industry, which produces a wide range of products: from low-value-added, large-volume construction materials, mineral fertilizers, and plastics to knowledge-intensive, high-cost pharmaceuticals, cosmetics, electronic components, and household appliances. The study aims to identify the impact of the chemical industry on territorial development at both the global and national levels, as*

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*well as its future growth prospects in the Russian economy. The analysis shows that the chemical industry's share of global GDP increased from 1.6% in 1994 to 2.7% in 2022, while the nominal value of output grew approximately sevenfold – from USD 400 billion to USD 2.8 trillion. The most intensive development is observed in China, where the industry's share of GDP rose from 2.7% in 1994 to 4.8% in 2023, while the value of export-import operations increased eight- to tenfold. In Russia, the chemical industry is most developed in the mineral fertilizer segment, which serves as a driver of export revenues. However, the positive trade balance generated by fertilizer exports is offset by substantial imports of pharmaceutical products, resulting in a negative balance in this segment. This underscores the need to develop domestic pharmaceutical production to reduce import dependence and contribute to stable foreign trade accounts. The study also reveals the growing role of the chemical industry in generating tax revenues for the regions hosting fertilizer production facilities – from 6–13% in 2009 to 9–33% by 2023. In addition, several other channels through which the chemical industry influences territorial development are identified. The results may be useful for students, researchers, educators, and government officials interested in the development patterns of specific sectors of the national economy.*

*Chemical industry, territorial development, global corporations, industrial economics, mineral fertilizers.*

**ACKNOWLEDGMENT**

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## Introduction

Currently, the Russian Federation is facing a number of geopolitical challenges that not only exacerbate accumulated socio-economic imbalances, but also exacerbate the issues of finding new and improving existing sources of economic growth. One of these sources is the chemical industry, which serves as a key link in the production chain of related sectors of the economy: pharmaceuticals, agriculture, textile industry, food industry, construction, plastics production and others. At the same time, in recent years, the chemical industry market has become one of the world's leading markets in terms of output[1], continuing to grow due to demand for chemical products. So, today, in everyday life, people have become accustomed to using personal hygiene products or detergents, and in agriculture, they use highly effective mineral fertilizers that can affect the qualitative and quantitative characteristics of the crop *(Tab. 1)*.

[1] According to data for 2023, the oil and gas market is 6.7 trillion U.S. dollars (6,4% of GDP), car market is 3.6 trillion U.S. dollars (3.4% of GDP), household appliances and electronics market – 1.9 trillion U.S. dollars (1.8%), ferrous metals market – 1.2 trillion U.S. dollars (1.2% of GDP), non-ferrous metals market – 1.1 trillion U.S. dollars (1.1% of GDP) (According to: Oil and Gas Market Size, Share, Growth & Industry Analysis. Available at: https://www.kingsresearch.com/oil-and-gas-market-177; Global Automotive Industry Market Size. Available at: https://finance.yahoo.com/news/global-automotive-industry-market-size; Global Consumer Electronics Market Size, Share, Trends, & Growth Forecast Report. Available at: https://www.marketdataforecast.com/market-reports/consumer-electronics-market; Metal and Metal Ore Market Research Report. Available at: https://www.marketresearchfuture.com/reports/metal-and-metal-ore-market-32628; Non-Ferrous Metals Market Report. Available at: https://www.imarcgroup.com/non-ferrous-metals-market; Global GDP for 2023. Available at: https://ru.tradingeconomics.com/world/gdp).

However, despite the wide range of products in the industry, the contribution of chemistry to the development of territories is multifaceted. Large chemical corporations are key taxpayers and employers in their home regions. Due to the instability of the geopolitical situation, it is advisable to update data on the impact of the chemical industry on the development of the Russian economy. Thus, based on the identification of key trends, it is possible to determine the prospects for the development of the chemical industry, which will contribute to strengthening the positive impact on the development of territories in the future.

The aim of the study is to determine the impact of the chemical industry on the development of territories on a global and national scale, as well as its growth prospects. The research objectives are: to characterize the economic content of the chemical industry; to analyze key industry trends at the global and Russian levels; to identify the most significant segments of the industry; to determine the industry's contribution to territorial development; to identify the growth prospects of the chemical industry.

The object of the study is the global and national chemical industry. The subject of the paper is the influence of the chemical industry on the development of territories.

## Literature review on the topic under consideration

The Russian economic literature presents many publications devoted to the study of the peculiarities of the development of the chemical industry both at the national and global levels. Many Russian authors note that the chemical industry and the petrochemical industry are the basic industries in the Russian economy. For instance, the level of chemicalization of

**Table 1. Examples of applications of chemical industry products**

| Area of application | Product examples |
|---|---|
| Agriculture and farming | Mineral fertilizers: nitrogen, phosphorus and potash; plant protection products; greenhouses |
| Medicine and healthcare | Pharmaceutical products, cotton wool, gauze, bandages, etc. |
| Construction and renovation | Paints, varnishes, mastics, putties, mixtures, sprayed thermal insulation, polyurethane foam, sealants, plastic building materials, other silicate products: glass, ceramics, etc. |
| Mechanical engineering and transport | Tires and other rubber products for machinery, corrosion-resistant compounds, lubricants, alkaline and synthetic degassing agents, self-adhesive tinting films, washing fluids and de-icing agents for glass |
| Defense production | Gunpowder, explosives, elements of atomic weapons, fuel, high-density oxidizing agents, energy-intensive polymers |
| Perfumery, cosmetology and personal care products | Soaps, creams, extracts and oils, deodorants and other synthetic aromatic compounds, absolutes, gels, shampoos, varnishes, scrubs, masks, etc. |
| Household chemicals | General-purpose detergents, cleaning products, detergents for washing dishes, cleaning stoves, ovens, grills and removing grease, products for glasses and mirrors, formulations for washing and caring for clothes and shoes, washing powders, gels, capsules and tablets, bleaches and stain removers, conditioners for clothes and shoes, shoe care products |
| Computer equipment | Monitor care products, thermal pastes, refilling powders and liquids for printer cartridges |
| Food industry | Preservatives: citric acid, sodium benzoate, potassium sorbate; flavor enhancers: monosodium glutamate, hydrolyzed vegetable protein, yeast extract; artificial sweeteners: aspartame, saccharin; emulsifiers: lecithin, soy lecithin, gum arabic |
| Sports nutrition | Proteins, amino acids, protein-carbohydrate mixtures, vitamins and minerals; special additives, etc. |
| Source: own compilation. | |

the national economy is a criterion of scientific and technological progress, which contributes to accelerating the pace of its development (Tal'berg, 2016). The importance of developing the chemical industry is also due to the introduction of innovations in areas such as energy, ecology and health. It is worth noting that among the important areas, scientists highlight the creation of environmentally friendly materials, such as bioplastics, which reduce dependence on fossil raw materials (Allanazarova et al., 2024).

In the publications of scientists of Vologda Research Center of RAS, economic research on the chemical industry includes consideration of the financial activities of producers of mineral fertilizers (Kopytova, 2017) and their contribution to the regions of their base (Malyshev, 2021b). Considerable attention is paid to the issues concerning interaction of chemical industry corporations with the state (Malyshev, 2021a), research of factors regarding formation of financial results and peculiarities of distribution policy of chemical corporations (Malyshev, 2024), analysis of export-import operations of the industry (Malyshev, Pechenskaya-Polishchuk, 2024). Thus, we can emphasize that the chemical industry in Russia is based on the production of mineral fertilizers.

The research of foreign authors has not ignored the features of the development of the chemical industry. A team of researchers from China notes that the sustainability of the chemical industry is crucial for achieving global sustainable production. In their opinion, from 2004 to 2014, the indicators of the sustainable development of the global chemical industry as a whole improved, in particular, due to technological processes (Yang et al., 2022). Other authors agree on the trends with the increasing role of science and industry interaction in creating a sustainable, safe and innovative chemical industry of the future (Valencia, 2013).

The monograph of American and Italian scientists proves that the chemical industry was significantly transformed in the 20th century under the influence of the petrochemical revolution. For example, in Germany, by 1960, oil had become a key raw material sent to European countries. In turn, the chemical industry has shifted to the creation of plastics, synthetic fibers, fertilizers, medicines and other mass chemicals (Galambos et al., 2007). Today, the chemical industry is one of the key consumers of oil. According to various estimates, chemical production accounts for up to 14% of the world's oil (Lopez et al., 2023). At the same time, the issue of environmental impact is raised, since processing industries often have a negative impact on the atmosphere and hydrosphere of the territory (Lopez et al., 2023). In this regard, long-term proposals for the development of alternative sources of raw materials for the production of chemical products are being updated (Darkow, Gracht, 2013).

Thus, the chemical industry in modern economic literature is characterized as a fundamental knowledge-intensive industry, the level of development of which serves as a key indicator of scientific and technological progress and technological sovereignty. In particular, the Russian Federation tends to produce mineral fertilizers as its main product.

**Research methods**

The methodological basis of the study is a systematic approach that allows considering the chemical industry as an integral element of the national and global economy. To achieve this aim and solve the tasks of the work, a set of general scientific and special economic methods has been applied, providing a multidimensional analysis of the industry's impact on the development of territories. The study used economic and statistical methods, in particular dynamic time series analysis, to assess long-term trends in industry development over

the period 1994–2023, including calculating the growth rate of global output and changes in the industry's share in global GDP. The structural analysis was used to determine the contribution of the chemical industry to the gross domestic product of individual countries, as well as to calculate the industry's share in the structure of investments in fixed assets and tax revenues of the home regions, such as the Vologda, Novgorod, and Smolensk regions. It is worth noting that the choice of these regions is justified, first of all, by the availability of accessible and complete financial statements. In addition, PJSC PhosAgro, PAO Acron and PAO Dorogobuzh, based in these regions, are comparable in terms of scale of activity with market leaders such as PJSC Uralkali and JSC EuroChem. The statistical grouping method is implemented when aggregating data over five-year periods to offset cyclical fluctuations and identify stable trends in investment, employment, and tax revenue.

The information base of the study is based on data from international statistics (World Bank, UN Comtrade, FAO, IFA, International Labor Organization), official materials from federal government agencies of the Russian Federation (Rosstat, Federal Tax Service, Ministry of Industry and Trade, Ministry of Agriculture), reports from specialized associations (RAPU) and analytical agencies (Grand View Research, Statista). It is important to note that data on Russia's foreign economic activity (FEA) is limited to 2021, due to the transition to a policy of limiting information related to the protection of FEA participants under sanctions pressure. The regulatory framework was formed by strategic documents for the development of the chemical industry and the agro-industrial complex of the Russian Federation and foreign countries. The theoretical basis of the research was determined by the works of Russian and foreign scientists devoted to the problems of sustainable development of the chemical industry, technological sovereignty and economic security.

## Results of the study

Over the previous 30 years, a characteristic feature of the development of the chemical industry has been its progressive growth rate. From 1994 to 2023, the global output of the industry increased 7-fold in value terms, from 0.4 trillion U.S. dollars to 2.8 trillion U.S. dollars, and the industry's share in global gross product increased from 1.6% to 2.7% *(Fig. 1)*.

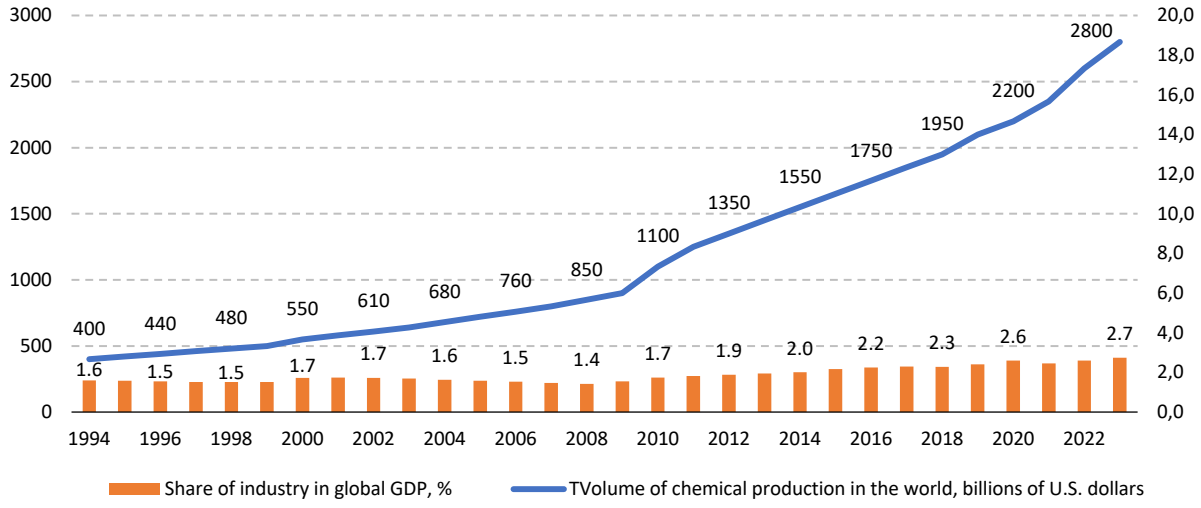


**Figure 1. Dynamics of chemical industry output (billion U.S. dollars) and its share in global GDP (%) for 1994–2023**

According to: Global chemical products market: current state and prospects. Available at: http://vestkhimprom.ru/posts/mirovoj-rynok-khimicheskoj-produktsii-sostoyanie-i-perspektivy; World GDP History 1960–2023. Available at: https://countrycassette.com/world-gdp-history/

In many countries with developed market economies and high-tech industries, such as China, Japan, and Germany, the average share of the chemical industry in GDP is at the level of 4% or more. Over the previous 30 years, the share of the chemical industry in Russia has increased from 1.6% to 2.8% of GDP, mainly due to the sustainable development of mineral fertilizer production and the creation of polymer facilities. In addition, Russia's undoubted competitive advantage in the development of the industry remains cheap oil and gas raw materials for wholesale consumers, in particular for domestic production *(Fig. 2)*.

However, in the modern economic system of developed and developing countries, the contribution of the chemical industry is regulated not only by macroeconomic indicators. Let us look at the channels through which the industry influences the development of the country.

1. Source of attraction of investment resources.

At its core, the chemical industry, as a manufacturing industry, is an industry that creates products with various added values. For example, the coal and chemical sector is highly dependent on technology, but produces complex products with high performance characteristics (Xu, 2020). The German chemical concern BASF invested in the development of biological fertilizers and plant protection products to increase crop resistance to stressful conditions, which, in turn, led to a 15%[2] increase in revenue in the company's agricultural segment in 2022. Investments of the American chemical company

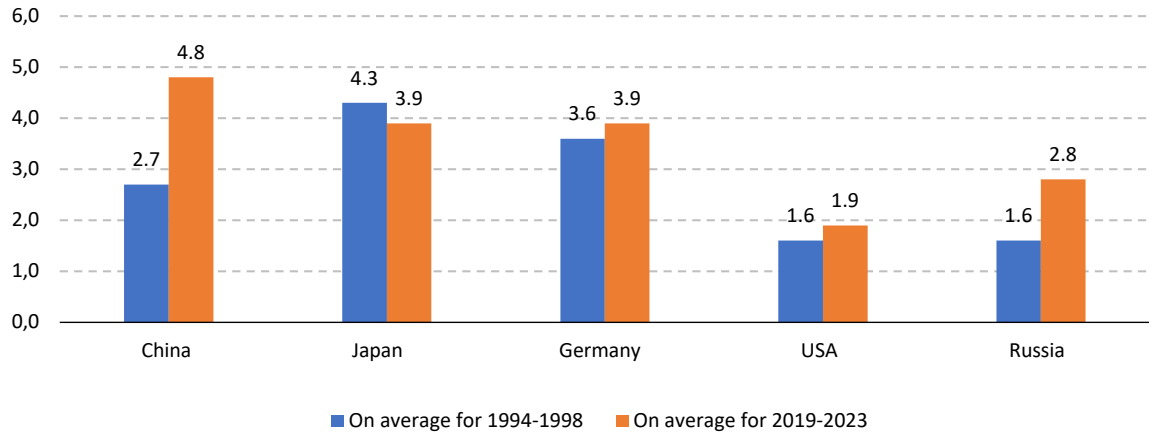


**Figure 2. Average annual contribution of the chemical industry to the GDP of different countries in 1994–1998 and 2019–2023, %**

According to: World Bank – World Development Indicators (WDI). URL: https://databank.worldbank.org/source/world-development-indicators; China Petroleum and Chemical Industry Association (CPCIA) – Annual Report 2023. URL: https://www.cpcia.org.cn; OECD.Stat – Gross value added by industry (Historical Data for Japan). URL: https://stats.oecd.org; METI – White Paper on Manufacturing Industries (2023). URL: https://www.meti.go.jp/english/statistics/index.html; Destatis – Statistisches Bundesamt Deutschland. URL: https://www.destatis.de/EN/Home/_node.html; Destatis – Volkswirtschaftliche Gesamtrechnungen (VGR), 2023. URL: https://www.destatis.de/DE/Themen/Wirtschaft/Volkswirtschaftliche-Gesamtrechnungen/_node.html; BEA – Industry Eco-nomic Accounts. Value Added by Industry. 325 – Manufacturing: Chemicals. URL: https://www.bea.gov/data/industry/gross-output; American Chemistry Council – Economic Impact Reports (2023). URL: https://www.americanchemistry.com/Economic-Center; Russian Statistical Yearbook (section: "Sectoral structure of GDP"). Available at: https://www.sci.bas.bg/ssc/Statistical_yearbook_of_Russia_1994.pdf; Ministry of Industry and Trade of the Russian Federation – Annual report 2023 on the chemical industry. Available at: https://minpromtorg.gov.ru

[2] BASF continues expanding its global biologics development strategy. Available at: http://www.abercade.ru/research/analysis/15862.html

Dow Inc. in the production of materials with a low carbon footprint allowed to increase revenues from sales of environmentally friendly products for 2019–2023 by 25%, or +5 billion U.S. dollars[3]. Thanks to the development of a new line of biodegradable plastics, the Belgian chemical company Solvay increased revenue from this activity by 10% in 2022, which brought the company an additional 300 million euros[4]. These and other corporate examples from different countries demonstrate active investment in the technological improvement of chemical production.

In Russia, the average annual volume of investments in fixed assets in the chemical industry increased 3.8 times, from 167 billion rubles in 2009–2013 to 638 billion rubles by 2019–2023. At the same time, the industry's share of capital investments among manufacturing industries increased from 11% to 18%, and in the total amount of investments of all types of activities – from 1.5% to 2.5% *(Tab. 2)*.

2. Formation of the trade balance.

For many countries, the chemical industry is an important part of exports, influencing the growth of their economies, foreign exchange earnings, as well as international relations and cooperation. The positive trade balance in the chemical industry is characterized by China (exports exceed imports by 3 times), India and Australia (by 2 times), Japan (by 18%), the countries of North America (by about 14%) and Europe (by an average of 7%)[5].

The situation in the Russian Federation is different: imports of chemical products (about 56 million U.S. dollars) are approximately twice as high as exports (at 27 million U.S. dollars), which creates a trade deficit. The key factor

**Table 2. Investments in fixed assets of chemical industries in the Russian Federation as a whole for 2009–2023**

| Period | Volume of investments in the chemical industry | Total investments in manufacturing | Share* | Investments in fixed assets of all types of activities | Share** |
|---|---|---|---|---|---|
| | billion rubles | | % | billion rubles | % |
| **Average for 2009–2013** | **167** | **1,479** | **11.0** | **10,840** | **1.5** |
| **Average for 2014–2018** | **366** | **2,247** | **16.1** | **15,234** | **2.4** |
| 2019 | 472 | 2,708 | 17.4 | 19,329 | 2.4 |
| 2020 | 481 | 2,984 | 16.1 | 20,394 | 2.4 |
| 2021 | 551 | 3,428 | 16.1 | 23,240 | 2.4 |
| 2022 | 731 | 3,733 | 19.6 | 27,865 | 2.6 |
| 2023 | 924 | 4,363 | 21.2 | 33,438 | 2.8 |
| **Average for 2019–2023** | **638** | **3,443** | **18.1** | **24,853** | **2.5** |
| 2019–2023 to 2014–2018 | 1.7 times | 1.5 times | +2 p. p. | 1.6 times | +0.1 p. p. |
| 2019–2023 to 2009–2013 | 3.8 times | 2.3 times | +7.1 p. p. | 2.3 times | +1 p. p. |

* The share of investments in fixed assets of the chemical industry in manufacturing industries.
** The share of investments in fixed assets of the chemical industry among all types of economic activity.
According to: Investments in Russia. Available at: https://rosstat.gov.ru/folder/210/document/13238

[3] Investing in Decarbonization Across Dow. Available at: https://www.centralcharts.com/en/1115434-dow-inc/news/4380985-investing-in-decarbonization-across-dow

[4] Belgium›s Solvay hikes 2022 profit forecast after first-quarter beat. Available at: https://www.yahoo.com/tech/belgiums-solvay-hikes-2022-profit-050456872.html

[5] UN Comtrade Database. Available at: https://comtradeplus.un.org/

in this is the purchase of high-tech chemical products (mainly pharmaceuticals), while the Russian chemical industry receives its main income from the sale of mainly low-grade products to the world market, in particular mineral fertilizers *(Fig. 3)*.

At the same time, a positive trade balance is typical for Russian regions where large chemical enterprises are based. For example, a significant volume of exports in the Vologda and Novgorod regions, exceeding 2 billion U.S. dollars, is associated precisely with the concentration of large mineral fertilizer production assets in their territories. In the Vologda Region, the excess of chemical exports over imports has increased from 21 times in 2009 to almost 37 times by 2021. In the Novgorod Region, the positive balance of payments increased 4.6 times in the same period, from 421 million U.S. dollars to 1939 million U.S. dollars. Despite the increased demand for imports in the Smolensk Region, in 2021 its value was 3% less than export sales *(Fig. 4)*.

3. Creation of jobs in the regions where chemical industries are based.

The chemical industry plays an important role in the economy in generating employment. The industry employs almost 10 million people worldwide (Abedsoltan, 2023). According to the International Labor Organization, the average

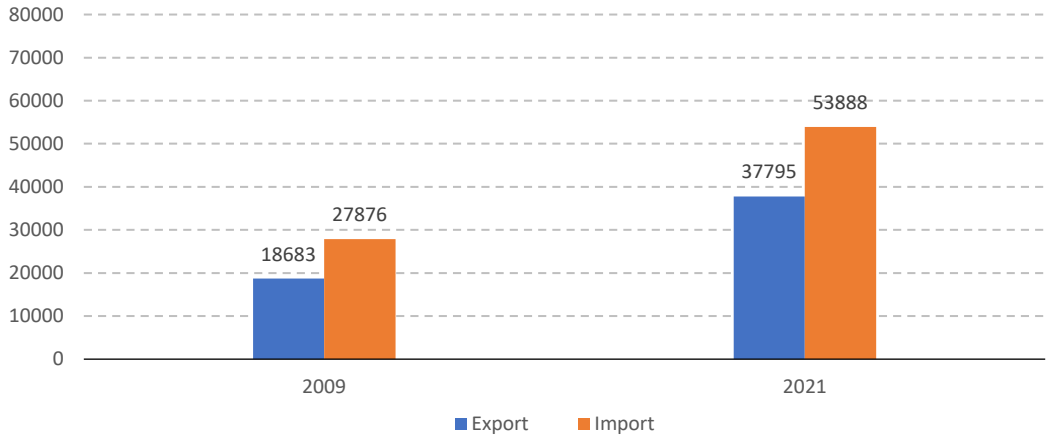


**Figure 3. Valuation of exports and imports of chemical products Russia in 2009 and 2021, million U.S. dollars**
According to: data from the yearbook "Regions of Russia".

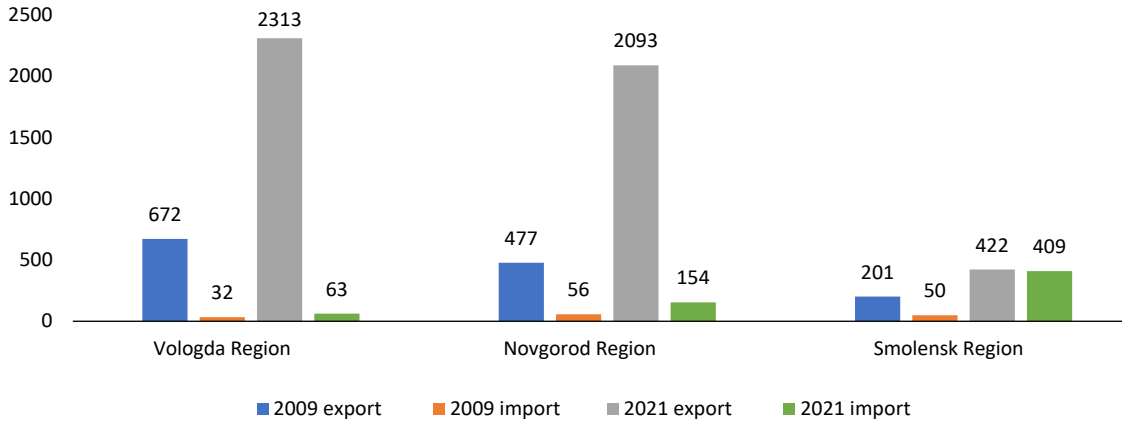


**Figure 4. Valuation of exports and imports of chemical products of the Vologda, Novgorod, and Smolensk regions in 2009 and 2021, million U.S. dollars**
According to: data from the yearbook "Regions of Russia".

annual number of employees in the chemical industry increased by 21% from 8.1 million to 9.9 million in 1994–2023.

The share of workers in the chemical industry in the Russian Federation as a whole for the period amounted to 5.4% in manufacturing industries. In dynamics (2009–2023), the number of chemical industry workers decreased by 11% – from 415.4 to 370.3 thousand people. To a greater extent, the reduction in personnel was influenced by the educational factor and current employment trends: a shortage of qualified personnel, insufficient compliance of curricula with the technological processes of real industries, as well as growing social and professional mobility[6].

Geographically, the average number of employees has decreased even more. Let's consider this indicator by comparing the dynamics of the national average and in one of the regions where large-scale chemical production is based. *Table 3* shows that the deployment of PJSC Apatit in the Vologda Region contributes to the formation of more than 5.8% of employment among all manufacturing industries. The average Russian value is 5.5%. There is no significant discrepancy between the indicators, but the availability of detailed structured information on the number of employees by type of economic activity in the Vologda Region indicates that the negative trend has affected it more (43% in the region versus 11% in the country). Consequently, even with fourfold gaps in dynamics, the home region is able to generate an outstripping development trend. It is worth noting that the key reasons for the reduction in personnel, on the one hand, include the optimization of production

**Table 3. Average annual dynamics of the number of chemical industry workers in Russia and the Vologda Region in 2009–2023**

| Период | Total in Russia | | | Vologda Region | | |
|---|---|---|---|---|---|---|
| | Number of em-ployees in the chemical indus-try | Share in manufacturing industries | Share among all types of activities | Number of em-ployees in the chemical indus-try | Share in manufacturing industries | Share among all types of activities |
| | people | % | | people | % | |
| **Average for 2009–2013** | **415,360** | **5.3** | **4.0** | **7,420** | **7.7** | **1.8** |
| **Average for 2014–2018** | **371,225** | **5.3** | **3.7** | **3,875** | **4.9** | **1.0** |
| 2019 | 365,000 | 5.4 | 3.7 | 3,500 | 4.7 | 1.0 |
| 2020 | 365,400 | 5.5 | 3.8 | 4,200 | 5.6 | 1.2 |
| 2021 | 372,100 | 5.6 | 3.9 | 4,200 | 5.8 | 1.2 |
| 2022 | 378,600 | 5.7 | 3.9 | 4,400 | 6.2 | 1.3 |
| 2023 | no data | no data | no data | 4,700 | 6.8 | 1.4 |
| **Average for 2019–2023** | **370,275** | **5.5** | **3.8** | **4,200** | **5.8** | **1.2** |
| 2019–2023 to 2014–2018 | 1 time | +0.2 p. p. | +0.1 p. p. | 1.08 times | +0.9 p. p. | +0.2 p. p. |
| 2019–2023 to 2009–2013 | 0.89 times | +0.2 p. p. | -0.2 p. p. | 0.57 times | -1.9 p. p. | -0.6 p. p. |
| According to: Industrial production in Russia. Available at: https://rosstat.gov.ru/folder/210/document/13225 | | | | | | |

[6] Three points of growth in the shortage of personnel. Available at: https://neftegaz.ru/analisis/companies/656256-tri-tochki-rosta-defitsita-kadrov-/https://neftegaz.ru/analisis/companies/656256-tri-tochki-rosta-defitsita-kadrov-/

and production costs (including the use of automation processes), on the other hand, the shortage of highly qualified personnel[7].

4. Budget system revenue generation.

Due to the export orientation of the Russian chemical industry, its contribution to the formation of federal budget revenues is extremely small (less than 2%), and sometimes negative due to the excess of tax deductions (refunds) over value-added tax charges. However, a different situation is observed in the revenue generation of consolidated budgets of regions where chemical industries are based. Three key taxes (corporate income tax, personal income tax, and property tax) levied on chemical organizations account for up to 41.4% of individual regional budgets (PAO "Acron" in 2022). Thus, the average annual share of these budget revenues from the Vologda Region chemical industry accounted for 5–8% of the revenues of all types of activities in the region, in the Novgorod Region – from 7 to 25%, in the Smolensk Region – about 6%. It is important to note that the end of the pandemic and high fertilizer prices in the face of anti-Russian sanctions significantly expanded the tax base for implementing the fiscal function in 2011–2023 *(Tab. 4)*.

Thus, based on the presented facts and trends, we can conclude that the chemical industry plays an important role at the national and regional levels. It promotes the creation of jobs, including highly qualified ones, increases labor productivity and reduces costs in related

**Table 4. Taxes paid by the largest chemical industry manufacturers to the budgets of their home regions* for 2009–2023**

| Период | Total in Russia | | PJSC PhosAgro (Vologda Region) | | PAO Acron (Novgorod Region) | | PAO Dorogobuzh (Smolensk Region) | |
|---|---|---|---|---|---|---|---|---|
| | Taxes to the regions from the chemical industry** | Share*** | Taxes to the regions from the chemical industry** | Share*** | Taxes to the regions from the chemical industry** | Share*** | Taxes to the regions from the chemical industry** | Share*** |
| | million rub. | % | million rub. | % | million rub. | % | million rub. | % |
| **Average for 2009–2013** | **66,787** | **1.6** | **2,403** | **7.8** | **1,754** | **11.9** | **1,046** | **5.8** |
| **Average for 2014–2018** | **101,703** | **1.7** | **2,049** | **5.0** | **1,344** | **6.8** | **1,702** | **6.4** |
| 2019 | 119,954 | 1.5 | 398 | 0.6 | 2,915 | 12.3 | 1,344 | 4.3 |
| 2020 | 95,848 | 1.2 | 420 | 0.7 | 842 | 4.1 | 825 | 2.6 |
| 2021 | 229,929 | 2.2 | 9,398 | 9.5 | 10,704 | 33.3 | 4,171 | 11.3 |
| 2022 | 249,403 | 2.3 | 14,385 | 17.2 | 15,252 | 41.4 | 2,219 | 5.8 |
| 2023 | 292,636 | 2.0 | 10,174 | 8.7 | 13,677 | 32.0 | 2,465 | 4.4 |
| **Average for 2019–2023** | **197,554** | **1.8** | **6,955** | **7.4** | **8,678** | **24.6** | **2,205** | **5.7** |
| 2019–2023 to 2014–2018 | 1.94 times | +0.1 p. p. | 3.39 times | +2.3 p. p. | 6.46 times | +17.8 p. p. | 1.30 times | -0.7 p. p. |
| 2019–2023 to 2009–2013 | 2.96 times | +0.2 p. p. | 2.89 times | -0.5 p. p. | 4.95 times | +12.7 p. p. | 2.11 times | -0.1 p. p. |

* They are indicated in parentheses after the name of the largest chemical industry manufacturer.
** Income tax, personal income tax and property tax.
*** Share of the chemical industry among all types of economic activity.
According to: Federal Tax Service data.

[7] Analysis of the impact of industry on the financial stability of the Vologda Region budget system. Available at: https://web.snauka.ru/issues/2013/12/29748

sectors of the economy, acts as an engine of scientific and technological progress, generates investment flows for the development of new technologies, materials and the introduction of innovative solutions.

**Prospects for the development of the chemical industry**

The chemical industry is of particular importance for the economy against the background of the actualization of the problem of food security, which is common to all world farms (Chen, Reniers, 2020). Hunger remains one of the main problems of humanity, and the world is moving away from achieving the UN goal of eliminating hunger by 2030, formulated in 2015[8]. Thus, according to estimates by the Food and Agriculture Organization of the United Nations, an average of 733 million people were malnourished in 2023, which is 26% more than in 2019[9]. According to the Eurasian Development Bank, global food security is deteriorating – every ninth inhabitant of the Earth is hungry or malnourished.

The key specialization of the Russian chemical industry, as noted earlier, is the production of mineral fertilizers. According to Roscongress, the country's share in the global market of mineral fertilizers is close to 1/5, which is comparable to providing fertilizers to more than 1.5 billion people[10]. Among the main sub-sectors of the chemical industry *(Fig. 5)*, the production of mineral fertilizers is more related to ensuring food security.

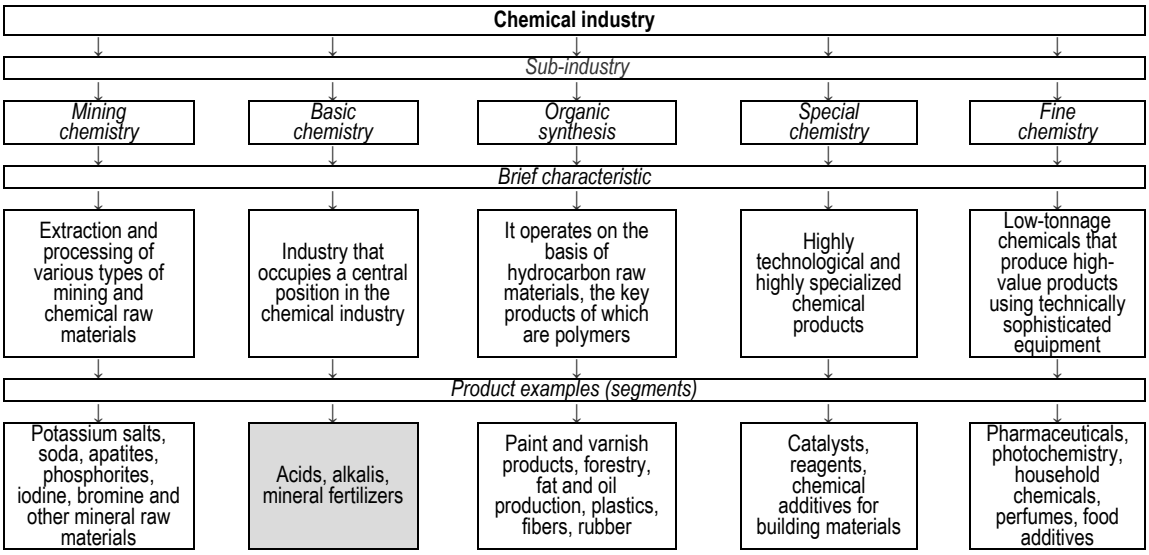


**Figure 5. Industrial structure of the chemical industry**

According to: Industrial structure of the chemical industry. Available at: https://www.chemistry-expo.ru/ru/articles/otraslevaya-struktura-himicheskoj-promyshlennosti; Chemical industry of Russia. Structure of the chemical industry. Available at: https://spravochnick.ru/geografiya/hozyaystvo_rossii/himicheskaya_promyshlennost_rossii

[8] Food security and unlocking the agro-industrial potential of the Eurasian region. Available at: https://eabr.org/analytics/special-reports/prodovolstvennaya-bezopasnost-i-raskrytie-agropromyshlennogo-potentsiala-evraziyskogo-regiona/

[9] The state of food security and nutrition in the world in 2024. Available at: https://www.fao.org/publications/fao-flagship-publications/the-state-of-food-security-and-nutrition-in-the-world/ru

[10] Expert opinion on the results of the SPIEF-2023 session "Ensuring global food security in modern conditions". Available at: https://roscongress.org/materials/eda-i-my-problema-prodovolstvennoy-bezopasnosti-v-mire/

In this regard, solving the problem of ensuring food security has become an obvious impetus for the development of the mineral fertilizers segment based on three key groups of factors:

– *demographic*: against the background of an increase in population at the global level, the area of land suitable for cultivation has remained virtually unchanged; therefore, ensuring global food security is impossible without increasing soil yields;

– *environmental*: due to climate change, urbanization processes, as well as in the process of growing cultivated plants, land depletion inevitably occurs, and artificial fertilization is a key way to maintain and increase soil fertility;

– *economic*: from the point of view of production costs, it is more profitable for agricultural enterprises to increase soil fertility and harvest high yields in a small area than the opposite.

This is due to a more than threefold increase in the global total consumption of mineral fertilizers per arable area, from 42 to 140 kg per 1 hectare in 1966–2021. Nitrogen consumption increased 5.7 times in the same period, and the use of phosphate and potassium tripled *(Fig. 6)*.

A number of countries that focus on agriculture may exceed the global average consumption of mineral fertilizers per arable area by one and a half times or more. For example, since 2015, Indonesia has been characterized by the use of significant amounts of fertilizers – over 270 kg per hectare of arable land, for India – 193 kg per hectare, for Brazil – 369 kg, for China – 374 kg. We should note that the global average is about 140 kg per hectare *(Tab. 5)*.

Back in 1840, a German scientist, one of the founders of agrochemistry, Ju. von Liebig wrote in his work on the application of chemistry in agriculture: "One day, the time will come when every field, according to the plant that will be grown on it, will be fertilized with a proper fertilizer prepared in chemical plants"[11]. In modern agriculture, the use of fertilizers is an obligatory agrotechnical initiative and is considered as one of the most effective methods of intensive agriculture, due to the close direct relationship between soil replenishment

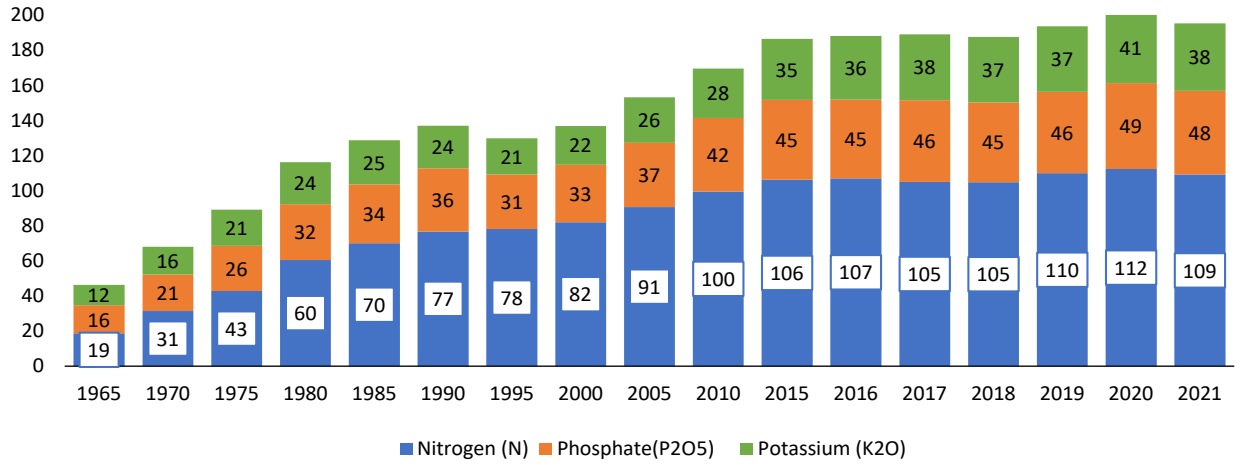


**Figure 6. Dynamics of global consumption of mineral fertilizers in 1965–2021, million tons**

According to: Global consumption of agricultural fertilizers from 1965 to 2021 by nutrients. Available at: https://www.statista.com/statistics/438967/fertilizer-consumption-globally-by-nutrient/

[11] Liebig von Ju. (1936). Chemistry as applied to agriculture and physiology. Moscow – Leningrad: Gosudarstvennoe izdatel'stvo kolkhoznoi i sovkhoznoi literatury "Sel'khozgiz". 406 p.

**Table 5. Use of fertilizers per 1 hectare of arable land in key importing countries, Indonesia and Russia for 1994 and 2021**

| Country | 1994 | | 2021 | | 2021 to 1994 | |
|---|---|---|---|---|---|---|
| | Use of fertilizers per 1 ha of arable land, kg | Place in the world | Use of fertilizers per 1 ha of arable land, kg | Place in the world | times | positions |
| China | 238 | 28 | 374 | 13 | 1.57 | +15 |
| Brazil | 117 | 48 | 369 | 15 | 3.15 | +33 |
| Indonesia | 144 | 43 | 279 | 24 | 1.94 | +19 |
| India | 83 | 62 | 193 | 40 | 2.33 | +22 |
| USA | 108 | 52 | 128 | 64 | 1.19 | -12 |
| Russia | 11 | 99 | 25 | 107 | 2.27 | -8 |
| **On average in 182 countries of the world** | **91** | **x** | **140** | **x** | **1.54** | **x** |

According to: Fertilizer use per 1 hectare of arable land by country. Available at: https://statbase.ru/datasets/agriculture/fertilizer-consumption/; Fertilizer consumption per arable area in the world from 1966 to 2021. Available at: https://www.statista.com/statistics/1287873/global-consumption-of-fertilizer-per-area/

with inorganic compounds and the degree of resistance of crops to climatic conditions, etc.

Grand View Research's forecast estimates indicate that, against the background of a doubling of global GDP, the further growth of the mineral fertilizers market by 2035 will amount to approximately 61% with an average annual growth rate of 4.1% *(Fig. 7)*.

Nitrogen fertilizers, which are in the highest demand, will continue to generate a significant share of the increase[12]. According to the International Fertilizers Association (IFA), the share of nitrogen fertilizers in 2023 reached 60% of total consumption, while the share of demand for phosphorus and potash fertilizers was 25% and 15%, respectively. For comparison, in 1994 nitrogen fertilizers were used less frequently – 55%, and phosphorous fertilizers more often – 30% *(Fig. 8)*.

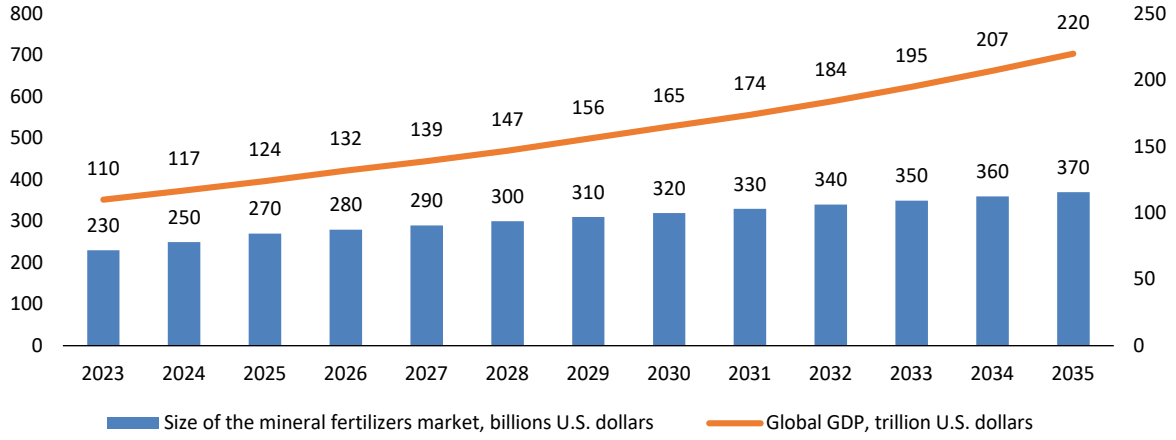


**Figure 7. Projected values of the size of the mineral fertilizers market and global GDP until 2035**

According to: Grand View Research. Available at: https://www.marketresearch.com/Grand-View-Research-v4060/

[12] The most common nitrogen fertilizers are carbamide, potassium chloride, phosphorous monoammonium phosphate, diammonium phosphate and triple superphosphate.

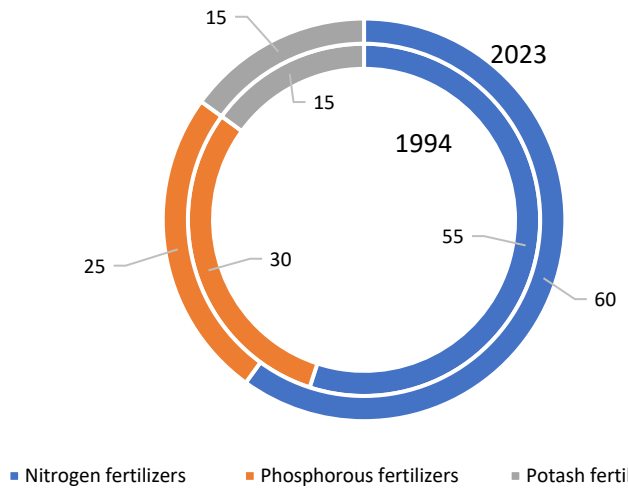


**Figure 8. Trends in the global demand for mineral fertilizers in 1994 and 2023, %**
According to: International Fertilizer Industry Association. Available at: https://www.fertilizer.org/

The key consumers of agricultural fertilizers in the world in 1994–2023 were the countries of Asia and Africa, where the total use of nitrogen, phosphorus and potassium increased by more than 2–3 times. While Europe, on the contrary, reduced consumption by 28% to 18 million tons.

In its annual reports on food security in recent years, the World Bank cites insufficient availability of fertilizers due to stable price increases as one of the major obstacles to food production[13]. The report of the Eurasian Development Bank also predicts a period of high food prices due to the pricing policy for fertilizers[14], the cost of which increased 2.7–9.5 times[15] depending on the type in 1994–2023. As a result, the 30-year dynamics of rising prices for mineral fertilizers directly affected the cost of key types of agricultural products *(Fig. 9)*: the cost of 1 ton of corn increased 3.4 times, wheat – 2.4 times, rice – by 93%.

When faced with issues of ensuring food security, agricultural countries are developing strategic documents for the development of the agro-industrial complex, in which the production of mineral fertilizers is among the most important areas.

In the Address to the Federal Assembly, Russian President V.V. Putin stressed that "today the agro-industrial complex is a successful industry that feeds the country and conquers international markets"[16]. For its development, the country has adopted a Strategy for the development of the agro-industrial and fisheries complexes of Russia until 2030, in which it is proposed to solve the tasks of strengthening food security by increasing yields and involving at least 13.2 million hectares of land in

[13] For instance: Food Security. 21.01.2025. Available at: https://www.worldbank.org/en/topic/agriculture/brief/food-security-update

[14] Food security and unlocking the agro-industrial potential of the Eurasian region. Available at: https://eabr.org/analytics/special-reports/prodovolstvennaya-bezopasnost-i-raskrytie-agropromyshlennogo-potentsiala-evraziyskogo-regiona/

[15] For example, for carbamide – by 4 times (from 90 U.S. dollars to 358 U.S. dollars per ton), for diammonium phosphate – by 2.7 times (from 203 U.S. dollars to 550 U.S. dollars per ton), for phosphate ore – by 9.5 times (from 34 U.S. dollars to 324 U.S. dollars per ton), for potassium chloride – by 3.4 three times (from 113 U.S. dollars to 383 U.S. dollars per ton), for triple superphosphate – 3.1 times (from 153 U.S. dollars to 480 U.S. dollars per ton) (Commodity Prices. Available at: https://www.indexmundi.com/commodities/).

[16] The President's Address to the Federal Assembly on February 29, 2024. Available at: http://www.kremlin.ru/events/president/transcripts/73585

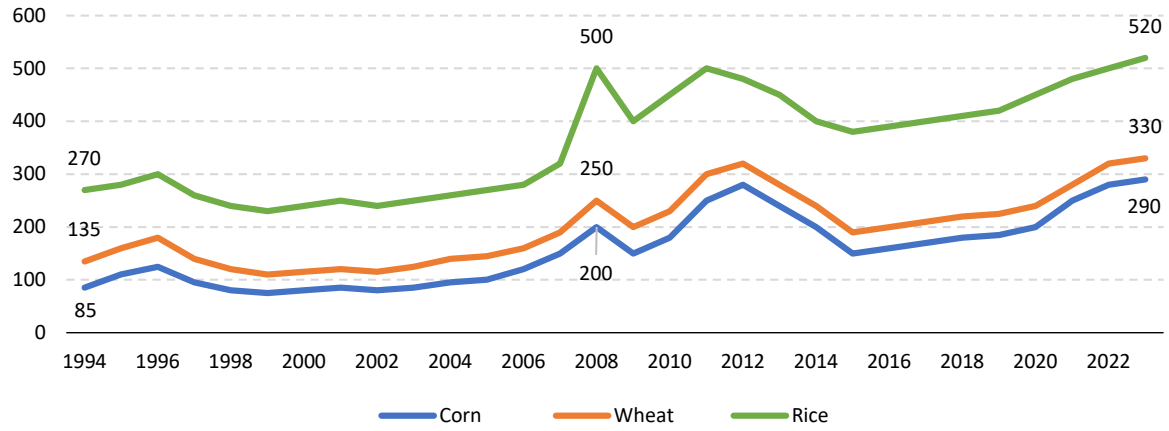


**Figure 9. Dynamics of average annual world prices for corn, wheat and rice in 1994–2023, U.S. dollars per ton**

According to: Food and Agriculture Organization of the United Nations. Available at: https://www.fao.org/

agricultural turnover by increasing soil fertility[17]. In fulfillment of strategic objectives, in October 2024, the Ministry of Agriculture of the Russian Federation approved a plan to increase purchases of mineral fertilizers by farmers until 2030, according to which the use of mineral fertilizers in the Russian Federation for 2024-2030 should increase by 24% to 6.7 million tons under the baseline scenario, and by 52% to 8.2 million tons under the optimistic scenario. tons[18]. The Russian Association of Fertilizer Producers has predicted a 35% increase in the volume of mineral fertilizer production in the country in 2023–2030 to almost 80 million tons[19].

China, which is actively developing in this area, focuses on the production of mineral fertilizers while minimizing the negative impact on the environment: for nitrogen fertilizers, maintaining a stable production level, but focusing on improving product quality and reducing energy intensity; for phosphorus fertilizers, reducing production by optimizing the use of phosphorus and limiting the extraction of raw materials; for potash fertilizers – an increase of 10–15% by 2030 due to the development of new deposits and technological innovations[20].

In the United States, according to key strategic documents related to the activities of mineral fertilizer producers[21], the main changes by 2040 should be an increase in domestic production, a reduction in the carbon footprint, non-dependence on foreign policy factors and ensuring food security.

[17] The strategy for the development of agro-industrial and fisheries complexes until 2030: Government Decree 2567-R, dated 08.09.2022. Available at: http://static.government.ru/media/files/G3hzRyrGPbmFAfBFgmEhxTrec694MaHp.pdf

[18] Ministry of Agriculture of Russia: A new strategic plan to increase purchases of mineral fertilizers until 2030. Available at: https://graininfo.ru/news/minselkhoz-rossii-novyy-strategicheskiy-plan-po-narashchivaniyu-zakupok-mineralnykh-udobreniy-do-2030/

[19] RAPU: By 2030, Russia will increase the production of fertilizers to almost 80 million tons. Available at: https://ria.ru/20241227/rapu-1991685375.html; Fertilizer production in Russia increased by 10% in 2023: what awaits the industry in 2024. Available at: https://www.forbes.ru/prodovolstvennaya-bezopasnost/505396-proizvodstvo-udobrenij-v-rossii-v-2023-godu-vyroslo-na-10-cto-zdet-otrasl-v-2024-m

[20] The main strategic documents defining the objectives of the production of mineral fertilizers in China: "Strategy for the development of agriculture until 2035", "Sustainable Development Goals until 2030" (Corresponding to the UN SDG).

[21] The main strategic documents defining the goals of the production of mineral fertilizers in the USA: "Bipartisan Infrastructure Law", "Inflation Reduction Act", "National Defense Authorization Act", "U.S. Fertilizer Industry Roadmap to Net Zero Emissions by 2040" and "National Security Strategy of the United States".

The strategy for the development of mineral fertilizers production in Indonesia is aimed at the sustainable development of agriculture and improving food security[22]. According to it, the country aims to reduce dependence on imported fertilizers, increase their efficiency and protect the environment. Through investments in technological development, modernization and expansion of production capacities, the Indonesian government aims to increase production of urea and ammonia by 20–25%, phosphorous fertilizers by 15–20%, and potash fertilizers by 10–15% by 2030.

Summing up the study of the prospects for the development of the chemical industry, it is worth noting that its future is determined by the transition from an extensive raw material model to a high-tech transformation, the key driver will remain the critical role of mineral fertilizers in ensuring global food security. In the Russian context, the strategic vector of development is shifting toward achieving technological sovereignty and eliminating the structural imbalance between export-oriented low-conversion production and the scarce segment of low-tonnage chemicals. At the meso-level, the industry secures the status of a fundamental stabilizer of regional socio-economic systems, ensuring the stability of territories even during periods of acute geopolitical turbulence through ultra-high budgetary efficiency and concentration of investment capital.

**Conclusion**

We briefly list the main results obtained at the end of the study on the trends in the development of the global and Russian chemical industry and its impact on the development of territories.

1. The Russian chemical complex maintains a pronounced focus on the production of low-grade fertilizers, primarily mineral fertilizers, which generates a significant influx of export revenues. However, at the macro level, there is a trade deficit due to high import dependence in the segments of fine and specialty chemicals, in particular pharmaceuticals.

2. In contrast to the global trend of employment growth in the industry (+21% over 30 years), Russia is experiencing a decrease in the number of employees in it (-11%). Nevertheless, the industry retains a high share in the employment structure of manufacturing industries (5.4% in the Russian Federation), and in some regions remains one of the key employers.

3. The production of mineral fertilizers plays a critical role in ensuring global food security. The increase in global fertilizer consumption (from 42 to 140 kg/ha in 1966–2021) is associated with the need to increase yields against the background of limited land resources and population growth. Russia, controlling about 20% of the global fertilizer market, provides food security to about 1.5 billion people in terms of calories.

4. Despite the sanctions pressure, the industry demonstrates high investment activity: the share of chemicals in the investments of manufacturing industries in the Russian Federation increased from 11 to 18%.

5. Strategic documents from Russia, China, the USA, and Indonesia emphasize the importance of the fertilizer segment. In Russia, it is planned to increase the use of fertilizers by 24–52% by 2030.

6. In the regions where the largest holdings are based (PJSC PhosAgro, PAO Acron, etc.),

[22] The main strategic documents defining the goals of mineral fertilizers production in Indonesia: "Master Plan for the development of the agro-industrial complex (Rencana Induk Pengembangan Pertanian)", "Plan for National Energy and Industry until 2050 (RUEN – Rencana Umum Energi Nasional)", "Strategy for the Development of Sustainable Agriculture (Strategi Pembangunan Pertanian Berkelanjutan)", "Sustainable Development Goals until 2030 (Sustainable Development Goals – SDGs)".

the industry demonstrates extremely high fiscal importance, generating up to 33–41% of regional budget tax revenues during peak periods.

Thus, the scientific novelty of the work lies in a comprehensive study of the influence of the chemical industry on the development of territories through the prism of modern geopolitical challenges and sanctions pressure. The results can be used as a factual basis for subsequent research, as well as to inform authorities about the current state of the industry, and to develop and adjust industry strategic planning documents.

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# ВЛИЯНИЕ ХИМИЧЕСКОЙ ПРОМЫШЛЕННОСТИ И ПРОИЗВОДСТВА УДОБРЕНИЙ НА РАЗВИТИЕ ТЕРРИТОРИЙ: ТЕНДЕНЦИИ И ПЕРСПЕКТИВЫ НА МАКРОУРОВНЕ

*В современных условиях санкционного противостояния и геополитической турбулентности для обеспечения развития территорий необходима активизация всевозможных имеющихся ресурсов. Одним из них является химическая промышленность, обладающая широким перечнем сфер использования получаемой продукции: от низкопередельных и крупнотоннажных строительных материалов, минеральных удобрений и пластмасс до наукоемкой и дорогостоящей фармацевтики, косметики, элементов электроники и бытовой техники. Цель исследования заключается в определении влияния химической отрасли на развитие территорий в глобальном и национальном масштабе и дальнейших перспектив ее роста в отечественной экономике. Результаты анализа показывают, что вклад химической отрасли в мировой ВВП вырос с 1,6% в 1994 году до 2,7% в 2022 году, при номинальном стоимостном увеличении объема выпуска продукции примерно в 7 раз – с 400 млрд до 2,8 трлн долларов. Наиболее интенсивное развитие отрасли наблюдается в Китае – рост вклада отрасли в ВВП с 2,7% в 1994 году до 4,8% в 2023 году, тогда как стоимостной объем экспортно-импортных операций увеличился в 8–10 раз. В России химическая промышленность наиболее развита в сегменте производства минеральных удобрений, являющихся акселератором формирования экспортных доходов. Определено, что формируемое экспортом минеральных удобрений положительное сальдо платежного баланса нивелируется значительными объемами импорта фармацевтической продукции, тем самым создавая отрицательный платежный баланс. В связи с этим актуализируется вопрос*

*развития производства отечественной фармацевтики, способной нивелировать импортную зависимость и содействовать формированию устойчивых внешнеэкономических расчетов. Выявлена возрастающая роль химической отрасли в формировании налоговых доходов регионов базирования производств минеральных удобрений – с 6–13% в 2009 году до 9–33% к 2023 году. Помимо этого, определен ряд других каналов влияния химической отрасли на развитие территорий. Результаты исследования могут быть полезны студентам, научным работникам, преподавателям и представителям органов власти, проявляющим интерес к особенностям развития отдельных отраслей отечественного национального хозяйства.*

*Химическая промышленность, развитие территорий, глобальные корпорации, экономика отраслей, минеральные удобрения.*

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# TERRITORIAL INTEGRATION OF SCIENTIFIC AND INNOVATIVE CRITERIA OF ECONOMIC SECURITY OF OIL AND GAS REGIONS

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*Scientific and innovative activity is an important component of the economic security of the oil and gas region, creating opportunities to offset the risks of oil and gas exports by high-tech deep chemical processing of hydrocarbons and the redistribution of financial flows to high-value-added products in other industries. The aim of the research is to find approaches to improving the economic security of the oil and gas region based on its scientific and innovative potential in the context of the oil and gas embargo, limited access to global technologies and financial resources, transformation of the global fuel and energy balance and high volatility of oil and gas quotations in global commodity markets. The main scientific problem of the study is the development of territorial aspects of ensuring meso-level economic security based on the increased economic security of the system of interacting regions using the advantages of their industrial specialization and rational spatial integration of scientific and innovative potential to adapt the administrative-territorial division of the country to the challenges of the new economy. To achieve this aim, we identified and solved the following main tasks: to carry out an economic and theoretical review of possible ways to improve regional economic security based on new forms of territorial integration of the scientific and innovative potential of the oil and gas industry, the development of import-substituting high-tech oil and gas*

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*equipment and services, and the intersectoral expanded reproduction of fixed assets; to carry out an economic and theoretical review of threats to the economic security of the innovative and industrial development of the oil and gas region, the effectiveness of its technological entrepreneurship and venture business, the sustainability of the financial and investment policy of replacing critical imports, the balance of resource and processing capabilities of regional producers with domestic and external demand; to develop scientific and innovative criteria for regional economic security and conduct their structural, dispersion, cluster analysis. As a result of the research, we presented a model of hierarchical cluster interregional integration of the oil and gas regions of the Volga Federal District according to the developed criteria of economic security. It is aimed at developing scientific and methodological foundations for increasing the protection of national economic interests while smoothing regional spatial polarization and rational territorial distribution of innovative and industrial resources in the system of interacting regions.*

*Regional economy, economic security, oil and gas region, economics of innovation, economics of industry, regional finance, economics of environmental management.*

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## Introduction

The economic security of an oil and gas region is largely determined by the level of its scientific and innovative potential in the production activities of extracting and processing oil and gas resources. To enhance this potential under conditions of sanctions restrictions, interregional integration of investment activity in knowledge-intensive, high-tech projects and developments is required[1].

The oil and gas industry, as one of the main sources of federal budget revenue, exhibits properties of resilience and revitalization, with a multidirectional impact on regional economic security. As the scientific and innovative component in the production activities of extracting and processing hydrocarbon raw materials grows, the value added of products based on them increases, new international and interregional markets for their sale are developed, and transnational economic ties are formed, creating opportunities and mechanisms for circumventing sanctions.

Stagnation in the innovative development of the oil and gas industry reduces technological and financial independence, creating preconditions for the vulnerability of the economic systems of oil and gas regions and the state to embargoes on major export types, volatility of assets in global commodity markets, and the agreements of the OPEC+ alliance.

This vulnerability can manifest itself in a reduction in export duties directed to the federal budget, as well as in profits and, consequently, in corporate profit taxes of oil and gas companies and related industries, which flow to both the federal and regional budgets. There is also a decline in income and, consequently, in personal income tax (which primarily goes to regional budgets) in the corresponding economic sectors. In the oil

[1] On the Strategy for Scientific and Technological Development of the Russian Federation: Presidential Decree 145 dated February 28, 2024.

and gas sector, along with the financial and IT sectors, wages have been recognized for many years as among the highest.

Accordingly, addressing the issues of protecting the economic interests of oil and gas regions by leveraging national science and innovative achievements can enhance the sectoral, functional, institutional, and other aspects of their industrial, financial, fuel and energy, trade and logistics, and other forms of independence[2].

A new era of oil and gas is dawning, and it must be far more complex than the last hundred years, during which fossil fuels were synonymous with wealth, a complex geopolitical tool, and a driver of economic development. Currently, the structure of the global fuel and energy balance is increasingly influenced by renewable energy sources, a resurgent nuclear energy sector, and evolving socio-economic and ideological trends.

**Contemporary theoretical aspects**

The contemporary significance of scientific and innovative activity in Russian regions with developed industries and endowed with their own mineral resources is widely covered in a number of authoritative studies, primarily from the perspectives of such scientific fields as innovation economics, economic security, regional economics, industrial economics, environmental economics, territorial finance, and corporate finance. It has been demonstrated that neo-industrialization in the oil and gas sector – driven by the development of import-substituting modern equipment and services, as well as the innovative and resource potential of the industry – can serve as a driver for creating new forms of spatial economic interactions. This is essential for protecting national interests in the global competition of high-tech, knowledge-intensive industries, especially amid growing structural imbalances in international financial and economic relations (Kryukov, Borisova, 2024; Kryukov, Tokarev, 2025; Kryukov, Kryukov, 2025).

Under conditions of expanding sanctions, institutional mechanisms to enhance regional economic security in areas of "old" extraction and processing –specifically for hard-to-recover, high-viscosity, high-sulfur oil and associated petroleum gas with a wide fractional composition – can be developed by strengthening the innovative and industrial sector of the oil and gas region. This can serve as a counterweight to the spread of the costs associated with an oil embargo (Karavaeva, Lev, 2024; Malkina, 2024; Kryukov, Tokarev, 2023; Malkina, 2024). For instance, according to data from the Ministry of Natural Resources and Environment of the Russian Federation[3], in the Volga Federal District, the share of oil reserves with high density (over 0.9 g/cm$^3$ and 0.87–0.9 g/cm$^3$) stands at 26.7 and 30.9%, respectively; with high viscosity (over 30 mPa*s) – 25.2%; and with low permeability (less than 0.05 μm$^2$) – 27.9%. Given the technical and economic challenges of extracting and processing such oil, and its presence in the main Urals export blend, Russia's oil and gas sector requires proactive measures to reduce its vulnerability to restricted access to foreign scientific, technological, investment, and financial resources, as well as to the growing conflictual atmosphere in key areas of the country's economic interests. This can be achieved through interregional material, technical, financial, and industrial integration within a framework that combines spatial development and fiscal federalism, leveraging the advantages of the digital transformation of innovation ecosystems in oil

[2] On the Strategy for Economic Security of the Russian Federation for the Period up to 2030: Presidential Decree 208 dated May 13, 2017.

[3] State Report on the State and Use of Mineral Resources of the Russian Federation in 2023. Ministry of Natural Resources and Environment of the Russian Federation. Moscow, 2024. 716 p.

and gas regions (Akberdina, Smirnova, 2023; Akberdina, Vasilenko, 2023; Lavrikova et al., 2024; Lavrikova et al., 2025).

In planning the algorithms for strategic industrial development during the technological transition to Industry 5.0 and the digital infrastructure of the regional economy, a cluster-based model for organizing interregional scientific and innovative activity in the oil, gas, and petrochemical complex can improve the economic security of an oil and gas region against fluctuations in international commodity and financial markets (Glukhov et al., 2024; Glukhov et al., 2023; Babkin et al., 2025). The impact of structural transformations in the fuel and energy balance on the economic security of an oil and gas region can be mitigated through the development and application of a range of Russian critical technologies[4] in the fields of deep hydrocarbon processing and closed-loop production cycles. Transitioning to these technologies requires building portfolios of regional investment projects based on available resource potential (Akaev et al., 2024; Vasil'eva et al., 2025; Buchwald, Bessonov, 2025).

Enhancing regional economic security through the achievements of technological sovereignty – amid the transition to noonomics, combined with neo-industrialization and the variability of oil and gas revenues in federal and regional budgets – is constrained by Russia's spatial heterogeneity in scientific and innovative activity, as well as by the regulatory frameworks of intergovernmental economic associations that govern innovation markets and venture capital (Bodrunov, 2023; Bodrunov, Zolotarev, 2024; Filimonova et al., 2024; Bufetova, 2025). The scientific and technological development level of Russian regions shows some correlation with their endowment of mineral resources and industrial capacity for deep processing. This is likely due to a distinct "institutional code" in regional economic systems with highly profitable oil and gas production activities, which both creates the need and provides the means for increased corporate spending on research and development (Lazhentsev, 2023; Myslyakova, 2023; Myslyakova, Martynenko, 2024; Uskova, Ustinova, 2025).

The strategic importance of the fuel and energy sector in the context of a future multipolar geopolitical landscape and slowing export-driven economic dynamics – rooted in scientific and innovative achievements – is likely to persist. Maintaining high levels of economic security for oil and gas regions amid global risks posed by speculative foreign capital is possible by reducing vulnerabilities in the infrastructure of technological entrepreneurship, particularly in the area of accelerated import substitution of critical goods (Aganbegyan, 2022; Dmitrievskii et al., 2021; Frolov et al., 2023a). Achieving this requires that Russian non-resource companies maintain strong positions in international business. This, in turn, depends on developing scientific approaches to fostering a favorable innovation and investment climate. Such approaches can also form the basis for nationally oriented structural and technological shifts in industry, high-tech modernization of R&D implementation in small and medium-sized enterprises, and the reduction of excessive organizational and administrative barriers (Frolov et al., 2023; Porfir'ev, Shirov, 2024; Terebova, Borisov, 2019).

In the oil and gas regions of the Volga

[4] List of Critical Technologies of the Russian Federation. Approved by Presidential Decree 529 dated June 18, 2024.

Federal District, innovative production clusters[5] in the field of oil, gas, and petrochemicals have existed for over a decade. Their purpose is to achieve breakthroughs in creating new and promising high-tech developments, enhance key competencies and workforce qualifications using regional scientific and educational resources, boost the competitiveness of non-resource exports, and increase integration into global value chains. Such regional growth poles can serve as anchor points for interregional innovation and industrial integration. This would help reduce the heterogeneity of the economic space caused by the asymmetric effects of state monetary policy under sanctions pressure. In these circumstances, fiscal decentralization appears to be the primary option for smoothing territorial disparities in the country's scientific and technological infrastructure and for ensuring long-term financial mechanisms for the expanded reproduction of fixed assets in the oil and gas industry across regions (Demidova et al., 2021; Pyankova, Kombarov, 2023; Kurilova, 2024; Izmodenova, Khromtsova, 2024; Lev, 2025).

Based on the review of the scientific literature, it can be clarified that the theoretical significance of this research direction lies in its attempt to link the category of regional economic security with parameters of scientific and innovative activity, interpreting them as elements of regional resilience and adaptation to new challenges. The practical significance may be found in developing a typology of oil and gas regions in the Volga Federal District and creating a basis for discussing options for interregional coordination of innovation and industrial policy, grounded in a logical connection between innovation activity and economic security. The theoretical foundations of spatial and regional economics reveal mechanisms for the rational territorial distribution of tangible and intangible assets to maintain high levels of economic security in regions, considering their sectoral specialization. These foundations help create optimal conditions for adapting regional poles of industrial growth and scientific-innovation development to the new economic geography.

Proactive territorial planning of interregional integration associations focused on the scientific and innovative renewal of economic systems at both primary and aggregated stages of production activity can support the competitive advantages of Russia's export-oriented sectors. Increasing economic integration among regions can serve functions related to organizational and managerial support for the transfer and implementation of advanced and promising technological achievements. This, in turn, leads to diversification and expansion of non-resource export areas, thereby contributing to enhanced economic security.

A review of the extensive scientific literature reveals no generally accepted system of criteria for the economic security of Russian regions or macro-regions with specific economic specializations. Widely known and legally established macroeconomic indicators of economic security include "physical volume index of gross domestic product", "gross domestic product per capita (at purchasing power parity)", "share of Russian gross domestic product in world GDP", "share of fixed capital investment in GDP"[6], among others. However, it is not obvious which of these are

[5] List of Innovative Territorial Clusters (Instruction of the Government of the Russian Federation DM-P8-5060 of August 28, 2012).

[6] On the Strategy for Economic Security of the Russian Federation for the Period up to 2030: Presidential Decree 208 dated May 13, 2017.

most appropriate to use at the regional level (for instance, replacing GDP with GRP, etc.), given the specific features of how regional and federal budgets are formed from revenues of the oil and gas industry – an industry that remains highly profitable but faces unique challenges. In this study, we propose using the following indicators: "ratio of organizations' expenditure on scientific and innovation activities to total volume of goods shipped, work performed, and services rendered" and "ratio of the volume of scientific and innovative goods, works, and services to the total volume of goods shipped, work performed, and services rendered". The rationale for these indicators is presented in the analytical section of the article. The scientific literature also contains attempts to develop criteria for the economic security of the Russian oil and gas industry as a whole, or for individual oil and gas enterprises. However, the results of these studies have not been systematized within the context of current sanctions restrictions, do not address issues of regional economic development and economic security, and, in our view, have not yet achieved a stable scientific consensus. The passport of the Higher Attestation Commission (VAK) scientific specialty 5.2.3 – Regional and Sectoral Economics (Economic Security) – does not elaborate on the conceptual category "Criteria for Economic Security" included within it.

## Materials and methods

The object of the study is the economic systems of regions in the Volga Federal District that have a budget-forming oil and gas complex: the Republic of Bashkortostan (RB), the Republic of Tatarstan (RT), the Udmurt Republic (UR), Perm Territory (PT), Orenburg Region (OR), and Samara Region (SR) *(Tab. 1)*.

**Table 1. Volumes of oil and gas activity in the regions of the Volga Federal District in 2024**

| Region | Volume of goods of own production, work and services performed in house for the economic activity "Mining and quarrying", million RUB | Structure of the volume of shipped products (work, services) for the economic activity "Mining and quarrying", % | | | |
|---|---|---|---|---|---|
| | | Extraction of crude petroleum and natural gas | Mining of metal ores | Mining of other minerals | Support services for mining |
| Republic of Bashkortostan | 506 407 | 60.5 | 9.9 | …* | 28.0 |
| Republic of Mari El | 2 137 | – | – | … | … |
| Republic of Mordovia | 334 | – | – | 100.0 | – |
| Republic of Tatarstan | 1 309 946 | 86.9 | … | … | 12.5 |
| Udmurt Republic | 442 484 | 90.8 | – | 0.4 | 8.8 |
| Chuvash Republic | 583 | – | – | 100.0 | – |
| Perm Territory | 796 222 | 93.3 | 0.1 | 2.3 | 4.3 |
| Kirov Region | 1 989 | 10.8 | – | 74.4 | 14.8 |
| Nizhny Novgorod Region | 6 537 | – | – | 99.0 | 1.0 |
| Orenburg Region | 997 365 | 86.5 | 5.0 | … | 6.7 |
| Penza Region | 3 960 | … | – | … | – |
| Samara Region | 746 335 | 89.6 | – | 0.9 | 9.5 |
| Saratov Region | 70 358 | 87.4 | – | 8.9 | … |
| Ulyanovsk Region | 35 383 | 81.8 | – | 17.9 | 0.3 |

* Data are not published to ensure the confidentiality of primary statistical data obtained from organizations, in accordance with Federal Law 282-FZ of November 29, 2007, "On Official Statistical Accounting and the System of State Statistics in the Russian Federation" (Clause 5, Article 4; Part 1, Article 9).
Source: Compiled from: Regions of Russia. Socio-Economic Indicators. 2024: Statistical Compendium. Rosstat. Moscow, 2024. 1081 p.

The oil and gas regions of the Volga-Ural oil and gas province share similar challenges in the extraction and processing of viscous and high-sulfur oil, as well as in the efficient use of associated petroleum gas. They are characterized by the near depletion of large deposits and a significant number of small and medium-sized reserves[7]. This makes it necessary to actively involve small and medium-sized innovative, high-tech oil and gas businesses in the processes of extracting and deeply processing hydrocarbon resources in these territories[8].

At the same time, the manufacturing industries of the oil and gas regions in the Volga Federal District are highly differentiated, and their levels of economic dynamics and sustainable development relative to one another vary widely. This leads to asymmetric effects in terms of threats to their economic security *(Tab. 2)*.

The subject of the study is the system of economic relations between the budget-forming regional oil and gas industry and the region's scientific and innovation potential. This potential includes the full range of human resources, information and communication capabilities, resource base, material and technical facilities, financial and economic resources, and infrastructural support for the region's innovation policy. Regression, structural, variance, and cluster analysis were used as the main methods of economic and statistical analysis.

**Results and discussion**

The need for expanded state support for scientific and innovation activity – aimed at reducing critical dependence on foreign trade turnover and imports of high-value-added products – is steadily growing. To a large extent, this support can be offset by the collective high-tech achievements developed and applied by regions with a highly profitable oil and gas industry. These regions act as important drivers of territorial development through technology implementation activities and improved innovation commercialization systems. Interregional integration processes in scientific and innovation activity – driven

**Table 2. Structure of main types of shipped products (works, services) by economic activity "Manufacturing" in 2024, %**

| Region | Food products, beverages, tobacco products | Coke and petroleum products, rubber and plastic products | Chemical substances, pharmaceutical products | Metallurgy, fabricated metal products | Machinery and equipment |
|---|---|---|---|---|---|
| Volga Federal District | 13.5 | 17.9 | 13.4 | 14.6 | 21.6 |
| Republic of Bashkortostan | 9.3 | 39.7 | 17.0 | 6.0 | 15.8 |
| Republic of Tatarstan | 9.3 | 35.0 | 13.0 | 6.7 | 23.1 |
| Udmurt Republic | 13.1 | 1.6 | 1.7 | 33.6 | 23.7 |
| Perm Territory | 7.4 | 9.8 | 31.2 | 14.7 | 10.6 |
| Orenburg Region | 12.0 | 26.0 | 3.3 | 44.0 | 4.9 |
| Samara Region | 13.6 | 8.5 | 13.4 | 14.1 | 39.5 |
| Source: compiled from Rosstat data. | | | | | |

[7] State Report on the State and Use of Mineral Resources of the Russian Federation in 2023. Ministry of Natural Resources and Environment of the Russian Federation. Moscow, 2024. 716 p.

[8] Strategy for the Development of the Mineral Resource Base of the Russian Federation until 2035, approved by RF Government Resolution 2914-r dated December 22, 2018.

by the development of efficient methods for extracting and processing energy resources based on modernized oil, gas, and petrochemical machinery – can help achieve a level of economic security that supports Russia's technological and energy independence. This is accomplished by creating new sources of venture investment and new innovation markets.

Over the observed period, domestic spending on research and development (R&D) carried out by regional organizations shows steady growth and correlates well with the increase in the number of advanced production technologies developed and used. Average R&D spending, as well as the number of advanced production technologies developed and used, is higher in oil and gas regions than the average for the Volga Federal District as a whole. At the same time, the Orenburg Region and the Udmurt Republic show the lowest levels and growth rates across all indicators under consideration *(Fig. 1–3)*. This may be explained by the significant share of raw materials in their gross regional product and points to the need for mechanisms to enhance their regional economic security by stimulating scientific and innovation activity.

Up until 2022, the level of innovation activity of organizations was growing; thereafter, growth persisted only in the Republic of Tatarstan. For the oil and gas regions of the Volga Federal District on average, and for the district as a whole, a subsequent decline was observed. The decline was more pronounced in the oil and gas regions, likely due to sanctions restricting exports of oil, gas, and petroleum products, as well as imports of high-tech machinery, equipment, and components widely used in oil and gas extraction and processing. Domestic oil, gas, and petrochemical machinery manufacturing has not yet achieved full, high-quality import substitution.

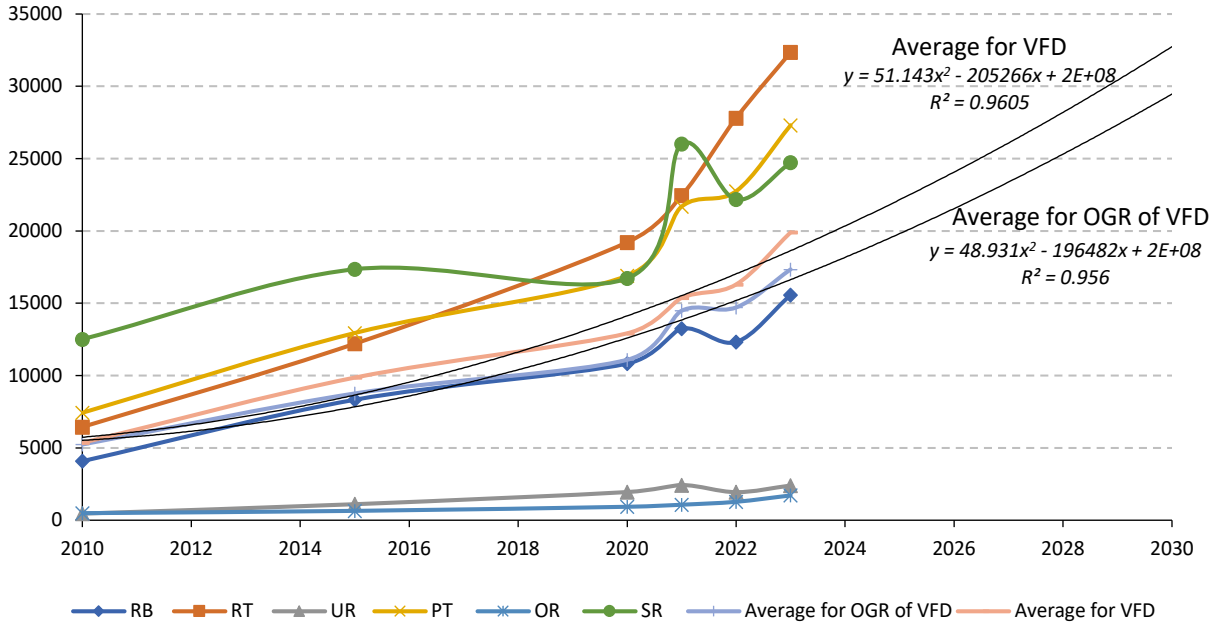


**Figure 1. Dynamics and forecast of domestic* R&D spending in the oil and gas regions of the Volga Federal District, million RUB**

*Domestic R&D spending refers to expenditures on research and development carried out by organizations in-house, including current and capital expenditures, during the reporting year, regardless of funding source.

Source: compiled from Rosstat data.

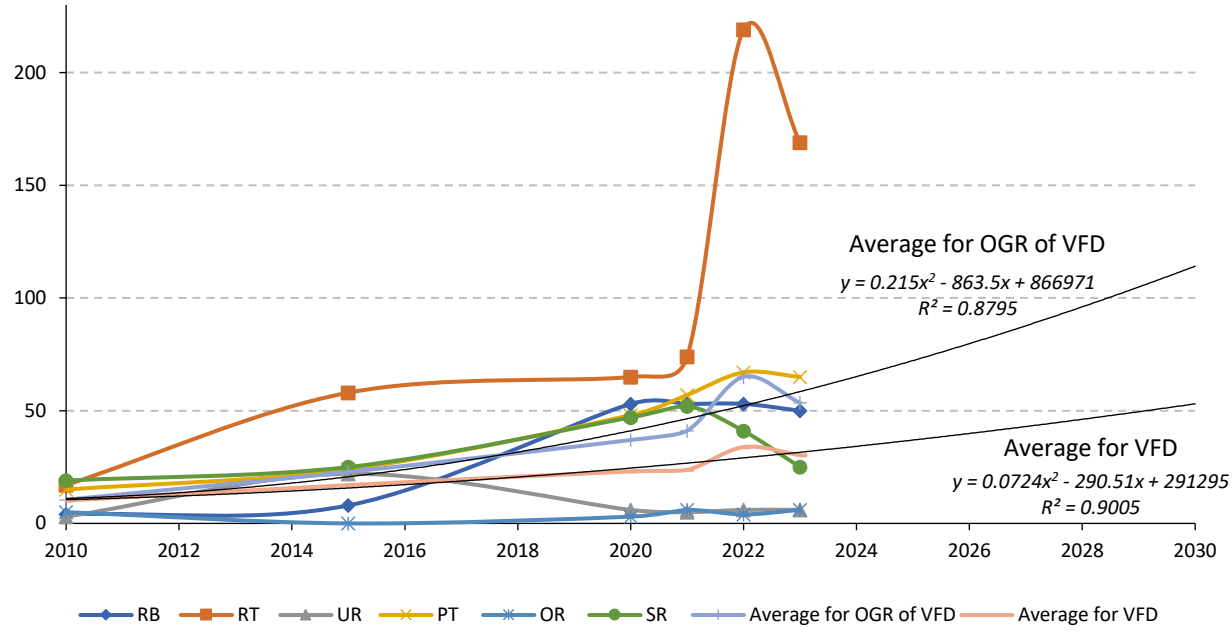


**Figure 2. Dynamics and forecast of the number of advanced production technologies developed in the oil and gas regions of the Volga Federal District**

Source: compiled from Rosstat data.

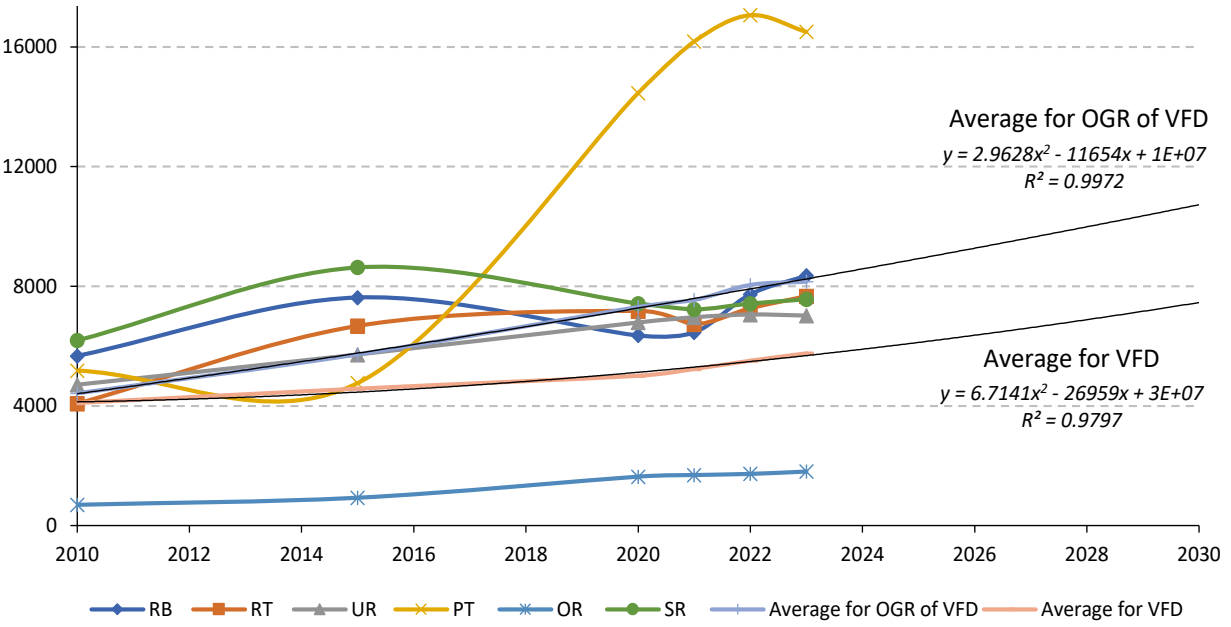


**Figure 3. Dynamics and forecast of the number of advanced production technologies used in the oil and gas regions of the Volga Federal District**

Source: compiled from Rosstat data.

A similar pattern is seen in the share of organizations engaged in technological innovation: growth until 2022, with no subsequent decline in the Republic of Tatarstan. However, the differences between oil and gas regions and non-oil-and-gas regions largely disappear. This may be because engagement in technological innovation is not so closely tied

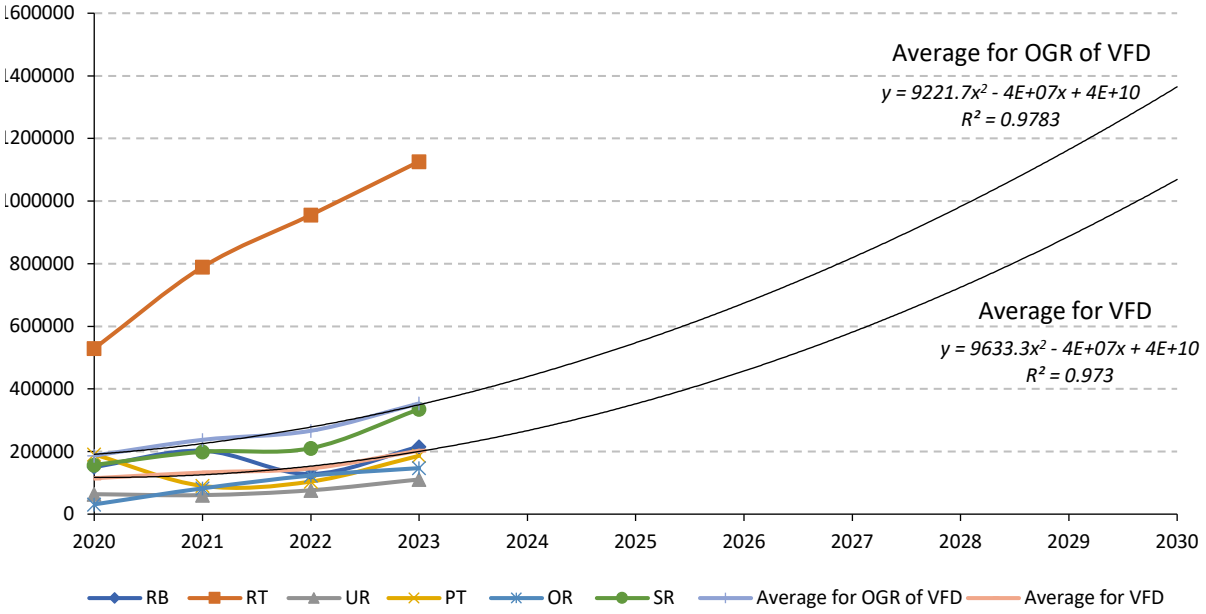


**Figure 4. Dynamics and forecast of the level of innovation activity of organizations in the oil and gas regions of the Volga Federal District, %**

Source: compiled from Rosstat data.

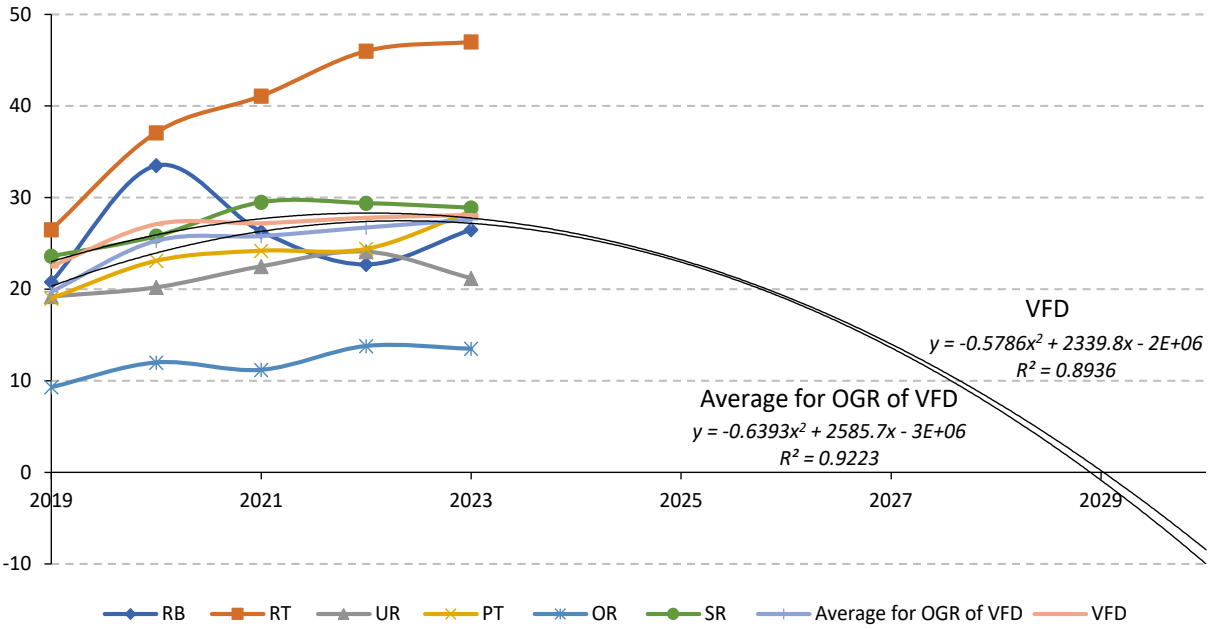


**Figure 5. Dynamics and forecast of the share of organizations engaged in technological innovation in the oil and gas regions of the Volga Federal District, %**

Source: compiled from Rosstat data.

to a region's sectoral specialization, but rather to unified state programs[9] and mechanisms[10] for supporting scientific and innovation activity. Under sanctions, these activities are constrained by limited access to foreign capital and international cooperation *(Fig. 4, 5)*.

[9] List of State Programs of the Russian Federation, approved by RF Government Resolution 1950-r dated November 11, 2010 (as amended on July 14, 2025): V. Development of Science, Industry, and Technology; VII. Balanced Regional Development; VIII. Ensuring National Security and International Cooperation.

[10] On the Strategy for Scientific and Technological Development of the Russian Federation: Presidential Decree 145 date February 28, 2024.

Despite the decline in the level of innovation activity among organizations and the share of organizations engaged in technological innovation relative to the total number surveyed[11], both innovation expenditure and the volume of innovative goods, works, and services increased during the period under review. This holds true both for the oil and gas regions and for the Volga Federal District average. This trend may be explained by the fact that small and medium-sized innovative businesses – most vulnerable to sanctions – were disproportionately affected, while large companies, in contrast, scaled up their innovation efforts in response to import substitution goals and the drive for technological sovereignty. The fact that innovation expenditure and the volume of innovative goods, works, and services in the oil and gas regions exceed the district average can be attributed to the highly profitable activities of large vertically integrated oil and gas companies and their affiliated service providers operating in these territories: Rosneft in the Samara Region, the Republic of Bashkortostan, and the Udmurt Republic; Lukoil in the Perm Territory; Gazprom in the Orenburg Region; and Tatneft in the Republic of Tatarstan *(Fig. 6, 7)*.

The scientific and innovation criteria for the economic security of a region should include indicators that reflect the state of the region's scientific and innovation sphere relative to the scale of its productive activity and its contribution to ensuring economic security. These criteria are justified by the fact that science and innovation are among the main drivers of economic development. They can enhance the economy's competitiveness, its resilience to threats, and its ability to transition to new, highly efficient technological solutions. In the oil and gas regions of the Volga Federal District, with the exception of the

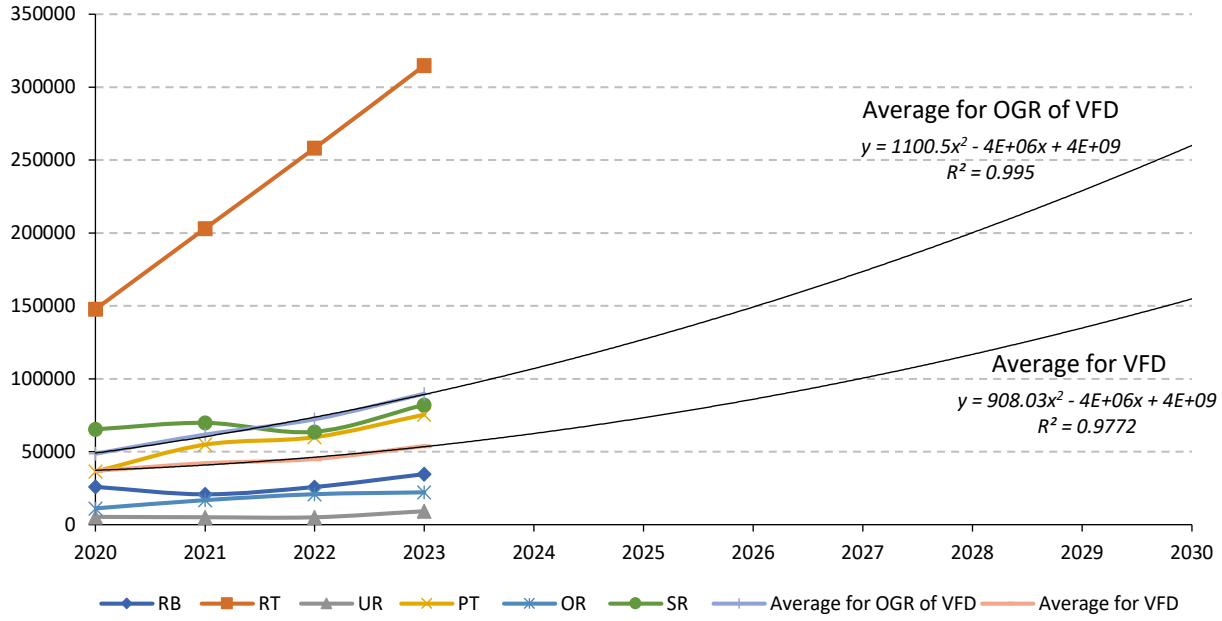


**Figure 6. Dynamics and forecast of innovation expenditure by organizations in the oil and gas regions of the Volga Federal District, million RUB**

Source: compiled from Rosstat data.

[11] The indicator "Share of organizations engaged in technological innovation in the total number of surveyed organizations" is calculated in accordance with the methodology approved by Rosstat Order 788 dated December 20, 2019, as amended by Order 813 dated December 18, 2020.

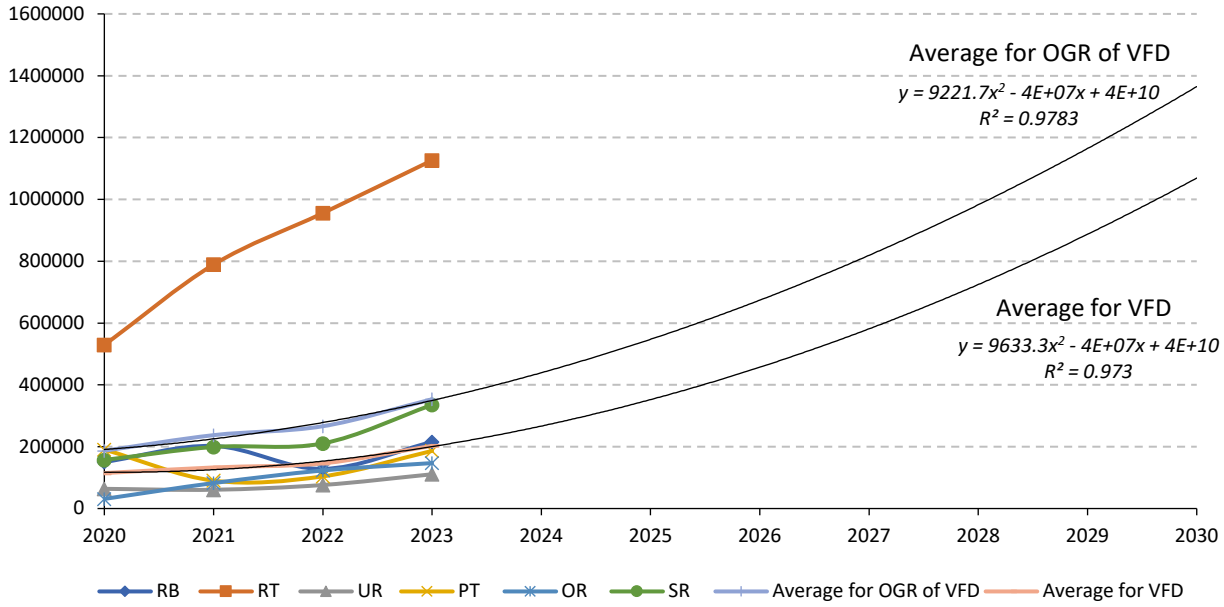


**Figure 7. Dynamics and forecast of the volume of innovative goods, works, and services in the oil and gas regions of the Volga Federal District, million RUB**

Source: compiled from Rosstat data.

Republic of Tatarstan, the ratio of innovation expenditure to total value of goods shipped, work performed, and services rendered, as well as the ratio of innovative goods, works, and services to that same total, are significantly lower than the district average. This is likely due to the influence of factors such as oil and gas embargoes, speculative manipulation of derivative financial instruments on global commodity markets, OPEC+ agreements, the energy transition, and other powerful forces affecting the oil and gas industry. Given the dominant role of this industry in the productive activity of oil and gas regions, its specific development and functioning characteristics are closely intertwined with the region's scientific and innovation potential. This suggests that the proposed scientific and innovation criteria are appropriate for investigating possible ways to enhance the economic security of oil and gas regions. Such efforts would be based on the rational spatial distribution and efficient use of the region's natural and economic resources, combined with targeted scientific and innovation activity *(Tab. 3)*.

Analysis of variance (ANOVA) for the scientific and innovation criteria of economic security of the oil and gas region revealed statistically significant differences between groups for both criteria. The largest difference between the calculated and critical F-values was observed for the ratio of innovation expenditure to total goods shipped, work performed, and services rendered *(Tab. 4)*.

The statistically significant differences found between oil and gas regions of the Volga Federal District with respect to the scientific and innovation criteria of economic security necessitated a cluster analysis. The purpose was to identify options for pursuing interregional industrial policy based on scientific and innovation activity, drawing on the material, technical, financial, and economic potential of the highly profitable oil and gas industry *(Tab. 5, Fig. 8)*.

**Table 3. Scientific and innovation criteria for the economic security of an oil and gas region**

| Region | 2020 | 2021 | 2022 | 2023 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|
| | Ratio of innovation expenditure by organizations to total volume of goods shipped, work performed, and services rendered in oil and gas regions of the Volga Federal District, % | | | | Ratio of the volume of innovative goods, works, and services to total volume of goods shipped, work performed, and services rendered in oil and gas regions of the Volga Federal District, % | | | |
| RB | 1.4 | 0.8 | 1 | 1.2 | 7.9 | 8 | 5.1 | 7.4 |
| RT | 5 | 4.7 | 5.1 | 5.5 | 18.1 | 18.3 | 19 | 19.8 |
| UR | 0.9 | 0.7 | 0.6 | 0.9 | 10.4 | 7.9 | 8.8 | 11.4 |
| PT | 2.1 | 2.7 | 2.7 | 3.1 | 11 | 4.4 | 4.7 | 7.6 |
| OR | 1.2 | 1.3 | 1.3 | 1.4 | 3.4 | 6.3 | 7.6 | 9.1 |
| SR | 3.8 | 3.1 | 2.9 | 3.2 | 9.2 | 8.9 | 9.5 | 12.9 |
| Average for OGR of VFD | 2.4 | 2.2 | 2.3 | 2.6 | 10.0 | 9.0 | 9.1 | 11.4 |
| VFD | 3.6 | 3.3 | 3.1 | 3.3 | 11.3 | 10.3 | 10.2 | 12.5 |
| Source: compiled from Rosstat data. | | | | | | | | |

**Table 4. Results of ANOVA for the scientific and innovation criteria of economic security of oil and gas regions in the Volga Federal District, 2023**

| Source of variation | SS | df | MS | F | p-value | F-critical |
|---|---|---|---|---|---|---|
| Ratio of innovation expenditure by organizations to total volume of goods shipped, work performed, and services rendered in oil and gas regions of the Volga Federal District, % | | | | | | |
| Between groups | 53.88 | 5 | 10.78 | 123,16 | 0,00 | 2,77 |
| Within groups | 1.58 | 18 | 0.09 | | | |
| Total | 55.46 | 23 | $\eta^2$=97.15% | | | |
| Ratio of innovative goods, works, and services to total volume of goods shipped, work performed, and services rendered in oil and gas regions of the Volga Federal District, % | | | | | | |
| Between groups | 427.63 | 5 | 85.53 | 21,64 | 0,00 | 2,77 |
| Within groups | 71.14 | 18 | 3.95 | | | |
| Total | 498.78 | 23 | $\eta^2$=85.74% | | | |
| Source: compiled from Rosstat data. | | | | | | |

**Table 5. Data for cluster analysis of oil and gas regions in the Volga Federal District by scientific and innovation criteria of economic security**

| Region | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| | RB | RT | UR | PT | OR | SR |
| Ratio of innovation expenditure by organizations to total volume of goods shipped, work performed, and services rendered in oil and gas regions of the Volga Federal District, % | 1.2 | 5.5 | 0.9 | 3.1 | 1.4 | 3.2 |
| Ratio of innovative goods, works, and services to total volume of goods shipped, work performed, and services rendered in oil and gas regions of the Volga Federal District, % | 7.4 | 19.8 | 11.4 | 7.6 | 9.1 | 12.9 |
| Source: compiled from Rosstat data. | | | | | | |

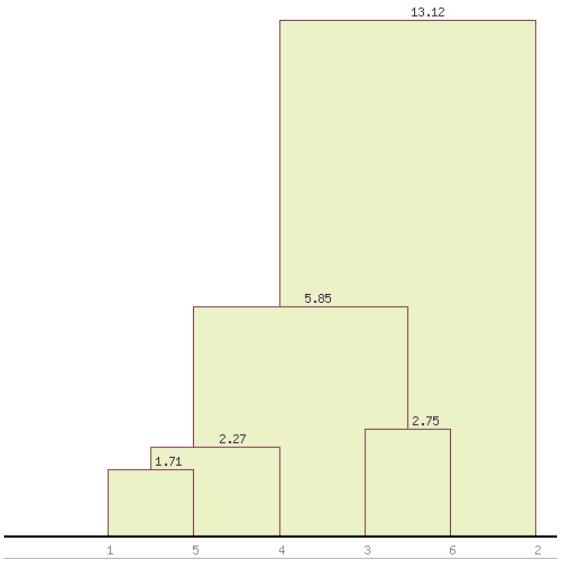


**Figure 8. hierarchical territorial clustering of oil and gas regions in the Volga Federal District by scientific and innovation criteria of economic security**

Source: compiled from Rosstat data.

The results of the cluster analysis show that, in terms of the ratio of innovation expenditure and the ratio of innovative goods, works, and services to total output, the Republic of Bashkortostan (1) and the Orenburg Region (5) are the closest, with a similarity score of 1.71. The Perm Territory (4) can also be included in this cluster, with a similarity score of 2.27. Another pair of oil and gas regions suitable for pursuing a coordinated scientific and innovation policy are the Udmurt Republic (3) and the Samara Region (6), with a similarity score of 2.75. The Republic of Tatarstan (2) stands relatively far apart from the others in terms of the need for interregional integration, with a similarity score of 13.12. This likely reflects the high degree of self-sufficiency of the region in terms of economic security, achieved through highly effective organization of innovative industrial development. Its capabilities are underpinned by active coordination among the region's largest company, Tatneft, the entire regional oil, gas, and petrochemical complex, and related key industries, as well as scientific and educational activities, carried out by regional government authorities. Supporting this ecosystem are the Kamsky Innovation Territorial Production Cluster "Innokam", the Investment and Venture Fund of the Republic of Tatarstan, the Khimgrad technopolis, Innopolis University, the Innopolis Special Economic Zone, and the Alabuga Special Economic Zone.

## Conclusion

Under conditions of sanctions restricting oil and gas exports and high-tech imports, the transformation of the global fuel and energy balance, and other external threats, the state of economic security in the innovative and industrial development of an oil and gas region requires continuous organizational and managerial monitoring. Its level must be adapted to global trends in neo-industrialization. Scientific and innovation activity is a crucial component of the economic security of oil and gas

regions, because the oil and gas business is knowledge-intensive and high-tech, and sanctions primarily target its most critical elements – namely, imports of innovative equipment and components and exports of hydrocarbon raw materials and petroleum products. Enhancing the economic security of an oil and gas region is possible through horizontal innovation and industrial integration with regions that also engage in highly profitable oil and gas activities. Such activities can cover the costs of developing import-substituting innovative technologies aimed at increasing value added. The resulting rise in tax revenues at both the federal and regional levels can then be used to support the economic security of non-oil-and-gas regions. To realize these opportunities, further research is planned into the strategic development of investment and financial mechanisms for ensuring regional economic security, taking into account increasing social and environmental responsibility, geographical location, the composition of the resource and material-technical base, and innovation-industrial potential. In addition, there is a need to develop scientific mechanisms and tools to enhance the economic security of resource-rich regions through economic integration, considering their production specialization, the share of strategic mineral reserve growth relative to total reserves depleted, and the ratio of resource-based to non-resource-based regional exports.

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## ТЕРРИТОРИАЛЬНАЯ ИНТЕГРАЦИЯ НАУЧНО-ИННОВАЦИОННЫХ КРИТЕРИЕВ ЭКОНОМИЧЕСКОЙ БЕЗОПАСНОСТИ НЕФТЕГАЗОВЫХ РЕГИОНОВ

*Научно-инновационная активность является важной компонентой экономической безопасности нефтегазового региона, создавая возможности компенсации рисков нефтегазового экспорта высокотехнологичной глубокой химической переработкой углеводородов и перераспределением финансовых потоков на продукцию с высокой добавленной стоимостью в других отраслях промышленности. Целью исследования является поиск подходов к повышению уровня экономической безопасности нефтегазового региона на основе его научно-инновационного потенциала в условиях нефтяного и газового эмбарго, ограничения доступа к мировым технологиям и финансовым ресурсам, трансформации мирового топливно-энергетического баланса и высокой волатильности нефтегазовых котировок на мировых товарно-сырьевых рынках. Основной научной проблемой исследования выступает разработка территориальных аспектов обеспечения мезоуровневой экономической безопасности на основе повышенной экономической защищенности системы взаимодействующих регионов с использованием преимуществ их про-*

*изводственной специализации и рациональной пространственной интеграции научно-инновационного потенциала для адаптации административно-территориального деления страны к вызовам новой экономики. Для достижения заданной цели были определены и решены следующие основные задачи: осуществить экономико-теоретический обзор возможных путей повышения региональной экономической безопасности на основе новых форм территориальной интеграции научно-инновационного потенциала нефтегазовой отрасли, развития импортозамещающего высокотехнологичного нефтегазового оборудования и сервиса, межотраслевого расширенного воспроизводства основных фондов; произвести экономико-теоретический обзор угроз экономической безопасности инновационно-промышленного развития нефтегазового региона, эффективности его технологического предпринимательства и венчурного бизнеса, устойчивости финансово-инвестиционной политики замещения критического импорта, сбалансированности ресурсных и перерабатывающих возможностей региональных производителей с внутренним и внешним спросом; разработать научно-инновационные критерии региональной экономической безопасности и провести их структурный, дисперсионный, кластерный анализ. В результате исследования была представлена модель иерархической кластерной межрегиональной интеграции нефтегазовых регионов Приволжского федерального округа по разработанным критериям экономической безопасности. Она направлена на развитие научно-методологических основ повышения защищенности национальных экономических интересов при сглаживании региональной пространственной поляризации и рациональном территориальном распределении инновационно-промышленных ресурсов в системе взаимодействующих регионов.*

*Региональная экономика, экономическая безопасность, нефтегазовый регион, экономика инноваций, экономика промышленности, региональные финансы, экономика природопользования.*

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## ИНФОРМАЦИЯ ОБ АВТОРЕ

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# LIFE QUALITY AND HUMAN POTENTIAL OF TERRITORIES

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## EDUCATIONAL COMPONENT OF HUMAN CAPITAL: SPATIAL DIFFERENTIATION OF RUSSIAN REGIONS AND THE FORECAST SCENARIO (CASE STUDY OF THE REPUBLIC OF UDMURTIA)

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*The educational component of human capital is a key factor in sustainable regional development. However, the development of regional education policy and forecasting of its territorial potential are hampered by pronounced spatial heterogeneity and lack of consideration of the structural features of the educational component of the human capital of the constituent entities of the Russian Federation. The lack of methodological tools that make it possible to classify regions according to the structure of the educational component of human capital and predict the development of its types determines the aim of the study, which is to identify stable clusters of regions according to appropriate indicators to typify existing structural problems and build a medium-term forecast of the dynamics of the indicators under consideration for a typical representative of one of the clusters. The scientific novelty of the work consists in the application of clustering methods to typologize regions according to the educational*

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*component of human capital and predictive modeling of the development of a typical representative of a cluster. Clustering was performed using two methods: k-means and hierarchical (Ward's method), followed by checking the consistency of the results using the adjusted Rand index (ARI). The cluster analysis revealed five homogeneous groups of subjects of the Russian Federation with different structures of the educational component of human capital: the country's educational centers, regions with a predominance of higher, secondary vocational and general education, as well as regions with a shortage of vocational education. For a typical representative of the third cluster (Republic of Udmurtia), forecasts of six indicators up to 2030 have been made with high accuracy (the average relative error is ⩽ 5.3%). We have been established that the region is expected to increase the specialization of mid-level personnel training (an increase in the proportion of students in secondary vocational education institutions to 38.9%). For further research, it is proposed to include indicators characterizing the effectiveness of educational systems within the selected clusters, and to analyze the inter-cluster dynamics of the educational component of human capital to form differentiated recommendations for regional educational policy.*

*Human capital, educational component, regional clustering, forecasting, autoregressive models, Republic of Udmurtia.*

## Introduction

The rational use of resources, ensured by competent regional governance, makes it possible to achieve the goals and objectives of a territory's socio-economic development. One of the most important development resources is human capital (HC) (Mazelis et al., 2020; Frolov et al., 2025). In economic theory, human capital is understood as the body of knowledge, skills, competencies, and abilities of the population that can be used to produce goods and generate economic growth (Lutz, Butz, 2014). It is human capital, or more precisely its qualitative characteristics, that takes center stage, determining the innovative potential of regions.

Within the structure of human capital, the educational component occupies a special place. Education serves as the foundation for its formation, because it is through the education system that knowledge, skills, and competencies are transmitted, which in turn lead to higher labor productivity and economic growth. Researchers note that education is a key institution for the reproduction of human capital, and investment in it yields long-term economic and social dividends (Leonidova, Golovchin, 2019). A high level of education among the population correlates with higher innovation activity and greater economic adaptability to technological change (Supaeva et al., 2024). Quality education expands opportunities for personal fulfilment, helps build civil society, and reduces social tension (Napso, 2022).

Studying the educational component of human capital is arguably the most significant factor in the socio-economic development of territories (Baranova, 2022; Danova, Sira, 2023). The effects of accumulating the educational component of human capital are seen not only in improved macroeconomic indicators but also in a better quality of life for the population, making it a priority area for regional policy.

There are several approaches to measuring the educational component of human capital. According to Chinese researchers, the evolution of measurement methods has moved from simple indicators (years of schooling) to

complex composite indicators that account for education quality (Tang et al., 2025). In global practice[1], certain approaches to measuring the educational component of human capital have been established, using the following types of indicators:

1) stock indicators, which measure the accumulated educational potential of the population: average years of schooling, distribution of the population by education level, etc.;

2) flow indicators, which reflect current investments in human capital and the scale of training: enrollment rates, number of students and teachers per capita, etc. (these indicators form the information base of this study, as they allow for an assessment of the current reproduction of human capital across regions);

3) quality indicators, which capture learning outcomes: cognitive skills, literacy, results of comparative assessments;

4) composite indicators, which combine various aspects of the educational component of human capital (e.g., the World Bank's Human Capital Index[2] includes an education component measured as the product of expected years of schooling and standardized test scores).

Given the significant spatial heterogeneity of the Russian Federation – characterized by differences in socio-economic development, demographic structure, and historically established regional specializations – a differentiated approach to analyzing the educational component of human capital is necessary. Averaging indicators at the national level conceals substantial interregional disparities and makes it impossible to formulate effective policy decisions. Therefore, research that not only assesses the current state of the educational component of human capital but also predicts its dynamics while accounting for regional specificities is highly relevant.

When studying spatial differentiation, it is important to identify broad, relatively homogeneous groups of regions – clusters. This approach is widely used by both Russian and international researchers to overcome the limitations of aggregate regional analysis (Dobrokhleb, Kondakova, 2022; Korir, 2024). Clustering makes it possible to pinpoint problem areas and subsequently design targeted policies to enhance regional human capital (Murgante et al., 2025). Despite the widespread use of clustering methods in regional analysis (Leonidova et al., 2022; Ketova et al., 2021), approaches specifically focused on the educational component of human capital remain significantly limited. Existing studies tend to focus either on integral assessments of the socio-economic situation of regions, where education is only one of many factors, or on analyzing isolated statistical indicators without identifying stable structural relationships among them. This approach fails to fully account for the inertial nature of educational systems and their role in shaping long-term development trajectories of territories.

Beyond territorial analysis, it is also necessary to assess the situation within homogeneous groups and to build scientifically grounded forecasts of human capital dynamics (Jagodka, 2025). Regression and autoregressive models (Vavilova, 2023), as well as various machine learning methods – including clustering algorithms – remain the most widely used tools in econometric modelling, often applied to simulate complex, structured processes (Kitova et al., 2020). This suggests the promise of a hybrid

[1] Mind the Learning Gap: A Methodological Look into World Bank's New Human Capital Index. NORRAG. 2018. Available at: https://www.norrageducation.org/mind-the-learning-gap-a-methodological-look-into-world-banks-new-human-capital-index-by-ji-liu/ (accessed: 10.03.2026).

[2] Human Capital Project. World Bank Group. Available at: https://www.worldbank.org/en/publication/human-capital (accessed: 10.03.2026).

approach that leverages the strengths of different methods: machine learning effectively identifies stable clusters, while econometrics enables reliable forecasting. Despite the existence of these well-developed strands of research, no studies have yet used clustering of regions based specifically on the educational component of human capital as a basis for regional typology and for constructing predictive models of human capital development within specific clusters.

The specificity of the educational component of human capital lies in the fact that it not only reflects the current state of a region but also shapes its future potential. Moreover, Russia's high spatial differentiation manifests itself not only in quantitative differences (e.g., the share of students) but also in structural ones – namely, the balance between different levels of education (general, vocational secondary, and higher education). Existing typologies often ignore this heterogeneity, grouping regions with fundamentally different educational strategies together based on general socio-economic development levels. Thus, the task of identifying homogeneous groups of regions according to the educational component of human capital – and assessing the stability of this structure over time – remains unresolved.

The statement of the scientific problem stems from the contradiction between the need to account for the structural features of the educational component of human capital when designing regional policy, and the lack of methodological tools that would not only classify regions according to this characteristic but also predict the development of the identified types. This leads to the formulation of the following scientific hypotheses.

1. Hypothesis of structural heterogeneity: the constituent entities of the Russian Federation form stable typological groups that differ not so much in scale as in the structure of the educational component of human capital (i.e., the balance between different levels of education and training).

2. Hypothesis of inertia: the identified types of regions exhibit a high degree of stability over time, and the dynamics of indicators within a cluster follow common patterns, making it possible to construct forecasts for a typical representative of that cluster.

The aim of the study is to identify stable clusters of regions based on indicators of the educational component of human capital, in order to typify existing structural problems and to construct a medium-term forecast of the dynamics of the selected indicators for a typical representative of one of the resulting clusters – an average Russian region (Udmurt Republic).

The methodological framework of the study comprises modern methods of applied statistics, multivariate data analysis, and econometrics, including clustering techniques, regression analysis, and predictive modelling. The practical significance of the work lies in creating a tool for typologizing regions and forecasting the development of the educational component of human capital in the regions of the Russian Federation. The results can be used by governing bodies for evidence-based planning and the design of differentiated socio-economic development policies.

**Materials and methods**

There is a fairly wide set of indicators that characterize the educational component of human capital. We propose to consider six key per-capita indicators, presented in *Table 1*. They can be described as indicators of the development of the education sector in a region (the share of students, teachers, etc.). At the same time, they reflect the current flow of educational services and serve as proxy variables for investment in human capital. The indicators (X1–X6) make it possible to assess both the scale

**Table 1. Indicators used to analyze the educational component of human capital**

| No. | Indicator code | Indicator name | Explanation of calculation |
|---|---|---|---|
| 1 | X1 | Share of school teachers in the population, ‰ | Ratio of the number of teachers in organizations providing educational programs for primary, basic, and secondary general education to the total population |
| 2 | X2 | Share of teachers in secondary vocational institutions in the population, ‰ | Ratio of the number of teachers delivering educational programs for secondary vocational education to the total population |
| 3 | X3 | Share of university teaching staff in the population, ‰ | Ratio of the number of academic staff in organizations providing educational programs for bachelor's, specialist, and master's degrees to the total population |
| 4 | X4 | Share of school students in the population, ‰ | Ratio of the number of students enrolled in educational programs for primary, basic, and secondary general education to the total population |
| 5 | X5 | Share of students in secondary vocational institutions in the population, ‰ | Ratio of the number of students enrolled in secondary vocational education programs to the total population |
| 6 | X6 | Share of university students in the population, ‰ | Ratio of the number of students enrolled in bachelor's, specialist, and master's degree programs to the total population |
| Source: own compilation. | | | |

and the structure of current education and training across regions. All indicators are standardized by the population size of the region and expressed in per mille (‰), which ensures their comparability across regions with different demographic situations.

However, the assessment of the educational component of human capital is not exhausted by the indicators presented (qualitative characteristics, results of independent assessments, data on additional education and retraining are also important). The study is limited by the availability and comparability of official statistics at the regional level. As the information base expands (for example, with the emergence of regular data on education quality assessment results across Russian regions), the set of indicators may be supplemented.

The study uses panel data provided by the Federal State Statistics Service of the Russian Federation (Rosstat)[3] and the Ministry of Education of Russia[4] for the period 2000–2023, disaggregated by constituent entity of the Russian Federation. To describe, summarize, and visualize the available information, descriptive statistics were calculated (Vorokova, Sennikova, 2021): mean, median, mode, range, variance, standard deviation, skewness, and kurtosis.

Next, clustering was performed, which involves partitioning the set of Russian regions under study into groups (clusters) that are homogeneous with respect to the indicators of the educational component of human capital.

[3] Regions of Russia. Basic characteristics of the constituent entities of the Russian Federation. Federal State Statistics Service. Available at: https://rosstat.gov.ru/folder/210/document/13205 (accessed: 25.09.2025).

[4] Information on students in grades 1–12. Ministry of Education of the Russian Federation. Available at: https://edu.gov.ru/activity/statistics/actual_statistical_information (accessed: 25.10.2025).

Various clustering algorithms exist (Shamray-Kurbatova et al., 2021; da Silva, Soares, 2025), and their results are highly consistent when analyzing data of a similar nature. This study applies Ward's method of hierarchical clustering (Mouronte-Lopez, Savall, 2024), in which, at each step, the two clusters whose merger leads to the smallest increase in total within-cluster variance (the sum of squared Euclidean distances from points to their cluster centroid) are combined. The output of the hierarchical algorithm is a tree-like structure (dendrogram).

The stability and statistical significance of the cluster solution are tested using an empirical rule: a stable grouping should persist when clustering methods are changed. The assumption of stability is accepted if the proportion of agreement between clustering results exceeds 70%. In addition to this approach, the Adjusted Rand Index (ARI) is also used (Dubravskaya, 2020; Struzhko et al., 2018).

Modelling and forecasting of the educational component indicators for one of the constituent entities of the Russian Federation is carried out using an autoregressive model based on annual data of the human capital educational component indicators for the period 2000–2023. The model form is ARIMA (p, d, q), where p is the autoregressive order, q is the moving average order, and d is the order of differencing required to achieve a stationary series. The use of the ARIMA (p, d, q) model is motivated by the non-stationarity of time series, which is characteristic of most socio-economic indicators (Zou, 2024; Sinu et al., 2024). The best model specification is selected by minimizing the corrected Akaike Information Criterion (AICc).

Forecast quality is evaluated using two metrics: RMSE (root mean square error) and MAPE (mean absolute percentage error):

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}, \quad (1)$$

$$MAPE = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{y_i - \hat{y}_i}{y_i}\right| \cdot 100\%, \quad (2)$$

where $n$ is the number of observations, $y_i$ is the actual value, and $\hat{y}_i$ is the predicted value. These metrics are widely used to assess the accuracy of predictive models in socio-economic research (Yan, 2024).

The analysis of the initial statistical dataset, subsequent clustering, modelling, and forecasting are carried out in the RStudio development environment using the R programming language. For visualization of the territorial distribution of the educational component of human capital across Russia and the clustering results, the Yandex.Maps JavaScript API web map was used.

**Results**

During the study, descriptive statistics were calculated for the indicators of the educational component of human capital across the constituent entities of the Russian Federation. The results are presented in *Table 2*.

A significant differentiation in the values of all indicators of the educational component of human capital across the constituent entities of the Russian Federation is observed. This is confirmed by the large range, which is particularly pronounced for the share of university students (X6: 70.7‰), the share of school students (X4: 124.8‰), and the share of students in secondary vocational education (SVE) programs (X5: 27.5‰). High coefficients of variation indicate substantial differences in the development of the education sector between regions. The greatest differences are observed in the higher education system, as the corresponding indicators (X3 and X6) have the highest coefficients of variation (0.6 and

0.5, respectively). The skewness coefficients for the share of teachers (X1), university teaching staff (X3), school students (X4), and university students (X6) are positive. This means that in most regions, the values of these indicators are below the average, with higher values concentrated in a minority of regions.

Based on a visual analysis of the dendrogram obtained using Ward's method, it was decided to distinguish five clusters *(Fig. 1)*. To test the stability of the obtained solution, the *k*-means method was also applied: the groupings of regions using the two methods coincide by 93%, which exceeds the empirical threshold

**Table 2. Descriptive statistics of educational component indicators of human capital by constituent entities of the Russian Federation, 2023, ‰**

| Characteristic | X1 | X2 | X3 | X4 | X5 | X6 |
|---|---|---|---|---|---|---|
| Minimum | 4.8 | 0.3 | 0.0 | 91.3 | 11.1 | 0.0 |
| Maximum | 16.0 | 1.7 | 3.7 | 216.1 | 38.6 | 70.7 |
| Range | 11.2 | 1.4 | 3.7 | 124.8 | 27.5 | 70.7 |
| Arithmetic mean | 8.2 | 1.0 | 1.2 | 129.0 | 26.4 | 24.1 |
| Median | 7.6 | 1.0 | 1.1 | 126.3 | 26.6 | 23.0 |
| Mode | 7.5 | 1.0 | – | – | 23.9 | – |
| Corrected variance | 4.7 | 0.0 | 0.4 | 428.5 | 17.2 | 131.5 |
| Standard deviation | 2.2 | 0.2 | 0.6 | 20.7 | 4.1 | 11.5 |
| Coefficient of variation | 0.3 | 0.2 | 0.6 | 0.2 | 0.2 | 0.5 |
| Skewness | 1.8 | -0.2 | 1.7 | 1.5 | -0.8 | 1.2 |
| Kurtosis | 6.7 | 4.7 | 8.4 | 7.1 | 5.1 | 7.0 |
| Source: own compilation. | | | | | | |

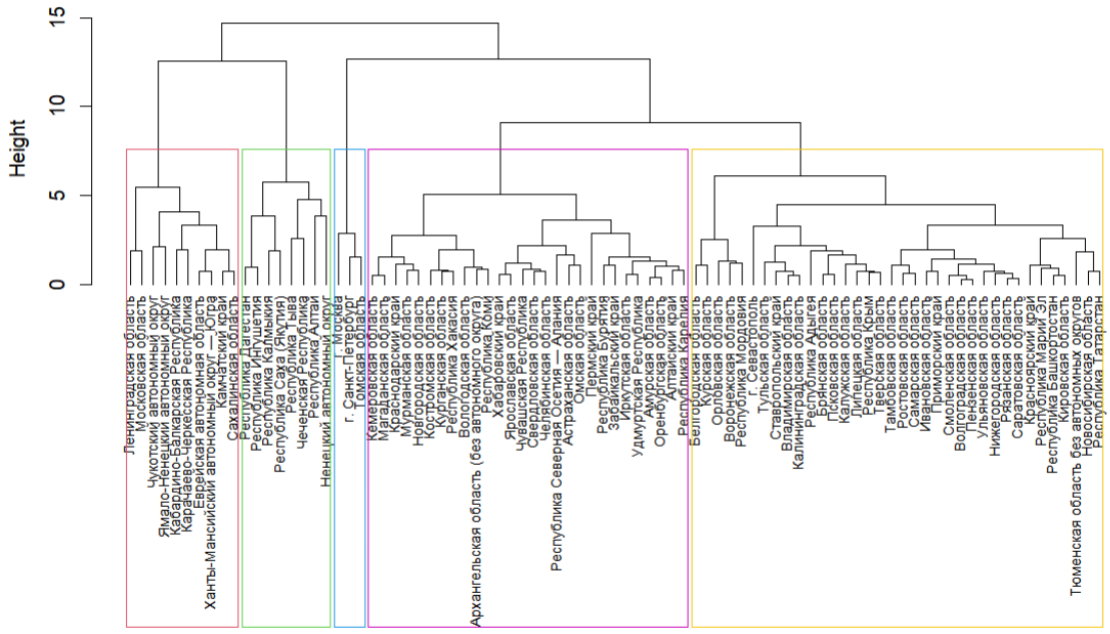



**Figure 1. Dendrogram of hierarchical clustering of the constituent entities of the Russian Federation by indicators of the educational component of human capital, 2023**

Source: own compilation.

of 70%, confirming the stability and statistical significance of the five identified clusters. The Adjusted Rand Index (ARI) was 0.782, also demonstrating strong agreement. Thus, regions consistently group into the same types regardless of the algorithm used.

The results of clustering based on the indicators of the educational component of human capital are presented in *Table 3*.

The characteristics of the five typologically homogeneous groups of constituent entities of the Russian Federation are presented in *Table 4*.

***Cluster 1 "Higher Education Leaders".*** The first cluster includes Moscow, Saint Petersburg, and the Tomsk Region. This group is characterized by high values of indicators related to higher education. The share of university students (X6 = 64.1‰) in this cluster is 2.6 times higher than the national average (24.1‰). The share of university teaching staff (X3 = 3.6‰) in these regions is also the highest, exceeding the national average (1.2‰) by a factor of three. This identifies these regions as unique educational hubs that function as centers for the reproduction and attraction of

**Table 3. Clusters of constituent entities of the Russian Federation by indicators of the educational component of human capital, 2023**

| Cluster | Constituent entities of the Russian Federation |
|---|---|
| 1 | Moscow, Saint Petersburg, Tomsk Region |
| 2 | Republic of Adygea, Republic of Bashkortostan, Belgorod Region, Bryansk Region, Vladimir Region, Volgograd Region, Voronezh Region, Ivanovo Region, Kaliningrad Region, Kaluga Region, Kirov Region, Krasnoyarsk Territory, Republic of Crimea, Kursk Region, Lipetsk Region, Republic of Mari El, Republic of Mordovia, Nizhny Novgorod Region, Novosibirsk Region, Oryol Region, Penza Region, Primorye Territory, Pskov Region, Rostov Region, Ryazan Region, Samara Region, Saratov Region, Sevastopol, Smolensk Region, Stavropol Territory, Tambov Region, Republic of Tatarstan, Tver Region, Tula Region, Tyumen Region (without autonomous areas), Ulyanovsk Region |
| 3 | Altai Territory, Amur Region, Arkhangelsk Region (without autonomous area), Astrakhan Region, Republic of Buryatia, Vologda Region, Trans-Baikal Territory, Irkutsk Region, Republic of Karelia, Kemerovo Region, Komi Republic, Kostroma Region, Krasnodar Territory, Kurgan Region, Magadan Region, Murmansk Region, Novgorod Region, Omsk Region, Orenburg Region, Perm Territory, Sverdlovsk Region, Republic of North Ossetia – Alania, Udmurt Republic, Khabarovsk Territory, Republic of Khakassia, Chelyabinsk Region, Chuvash Republic, Yaroslavl Region |
| 4 | Republic of Altai, Republic of Dagestan, Republic of Ingushetia, Republic of Kalmykia, Nenets Autonomous Area, Republic of Sakha (Yakutia), Republic of Tyva, Chechen Republic |
| 5 | Jewish Autonomous Region, Kabardino Balkarian Republic, Kamchatka Territory, Karachay Cherkess Republic, Leningrad Region, Moscow Region, Sakhalin Region, Khanty Mansi Autonomous Area – Yugra, Chukotka Autonomous Area, Yamal-Nenets Autonomous Area |
| Source: own compilation. | |

**Table 4. Average values of educational component indicators in clusters of constituent entities of the Russian Federation, 2023**

| Cluster | Number of regions in the cluster | Average value of indicator in the cluster, ‰ | | | | | |
|---|---|---|---|---|---|---|---|
| | | | X2 | X3 | X4 | X5 | X6 |
| 1 | 3 | 6.4 | 0.9 | 3.6 | 107.1 | 22.7 | 64.1 |
| 2 | 36 | 7.2 | 1.0 | 1.3 | 116.8 | 25.3 | 27.0 |
| 3 | 28 | 8.0 | 1.1 | 1.1 | 133.9 | 29.9 | 22.7 |
| 4 | 8 | 13.6 | 1.1 | 0.8 | 169.1 | 28.1 | 18.0 |
| 5 | 10 | 8.3 | 0.6 | 0.5 | 133.7 | 20.1 | 10.4 |
| Average for Russia | | 8.2 | 1.0 | 1.2 | 129.0 | 26.4 | 24.1 |
| Source: own compilation. | | | | | | | |

human capital in the sphere of higher education for the entire country.

***Cluster 2 "Regions with an Emphasis on Higher Education (HE)".*** This cluster includes 36 constituent entities of the Russian Federation. The key feature of this cluster is the high share of university teaching staff (X3 = 1.3‰), which exceeds the national average, combined with the second-highest share of university students (X6 = 27.0‰). This indicates not only a high demand for higher education but also a comparable development of the human resources needed to deliver it. Thus, the regions in the second cluster act as local hubs for attracting students to higher education.

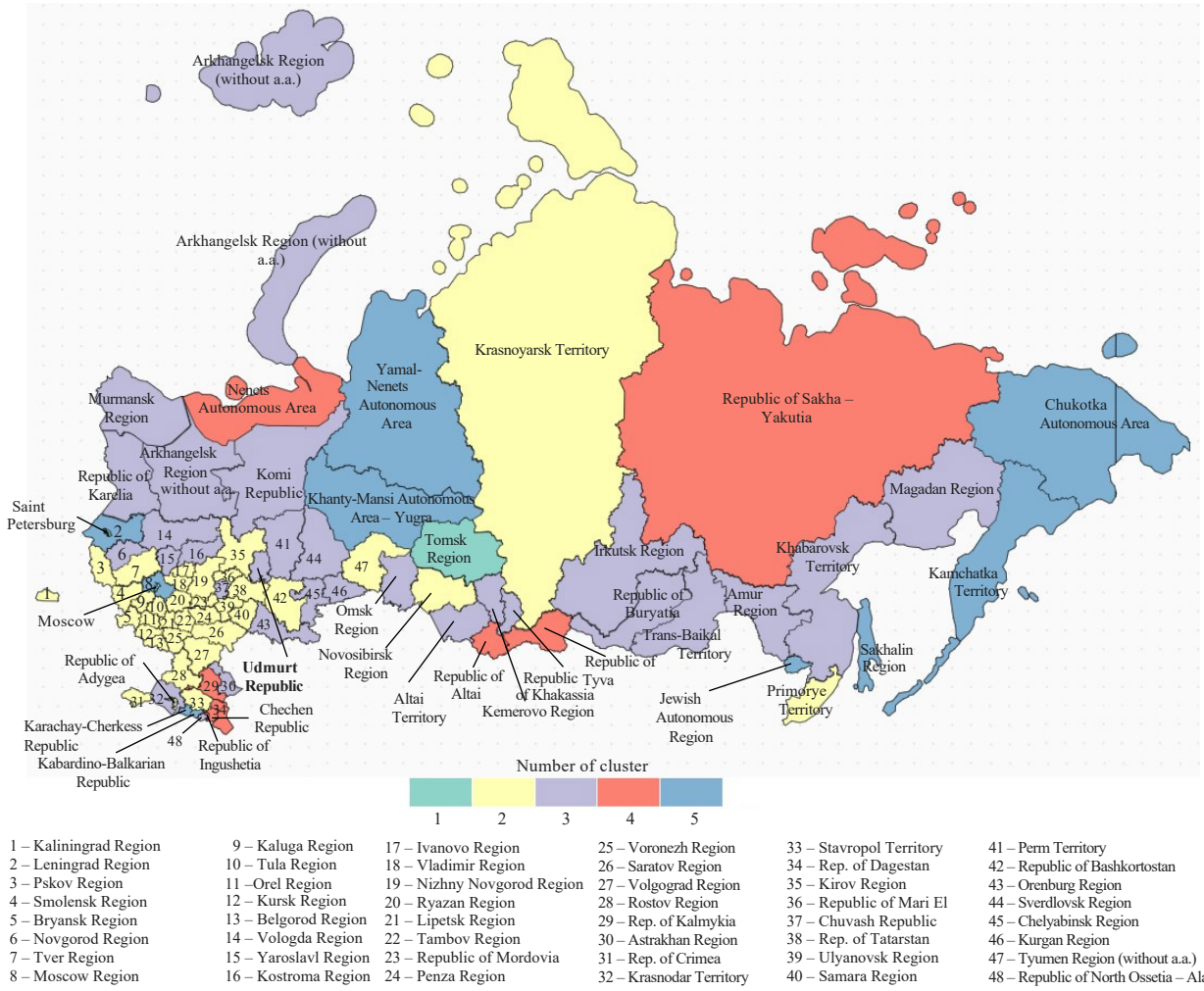
***Cluster 3 "Regions with an Emphasis on Secondary Vocational Education (SVE)".*** This cluster comprises 28 constituent entities of the Russian Federation, including the Udmurt Republic. The profile of the third cluster is shaped around secondary vocational education. Regions in this group have the highest share of SVE students among all clusters (X5 = 29.9‰). They also have a high share of school students (X4 = 133.9‰), exceeding the national average. Higher education indicators (X3, X6) are somewhat below the national average. This cluster consists of regions whose educational strategy focuses on providing the economy with mid-level professionals.

***Cluster 4 "Regions with a High Share of General Education".*** This cluster includes eight constituent entities. This group is characterized by a pronounced demographic specificity, reflected in the highest values among all clusters for the share of teachers (X1 = 13.6‰) and the share of school students (X4 = 169.1‰). At the same time, the indicators for SVE and HE are at or below the national average. This points to a structural imbalance: the educational systems of these regions experience an increased burden at the general education level while the development of subsequent educational pathways is relatively insufficient.

***Cluster 5 "Regions with a Deficit of Vocational Education".*** This cluster includes 10 constituent entities. It unites regions that have recorded the lowest values for indicators related to vocational training (X2, X3, X5, X6). At the same time, general education parameters (X1, X4) are close to the national average. This profile indicates a systemic weakness in the SVE and HE sectors, which creates constraints on the formation of regional human capital and may stimulate the out-migration of young people to regions with more developed educational infrastructure.

*Figure 2* visualizes the results of clustering the constituent entities of the Russian Federation according to the indicators of the educational component of human capital.

The absence in the typology of a cluster with a balanced ratio of all levels of education (general, SVE, HE) is, in our view, due to several reasons arising from the actual regional differentiation of the Russian Federation. First, the term "balance" implies the existence of some optimal ratio of indicators. However, in the analysis, clusters are formed based on actually observed statistical structures, not on normative ideas about what the structure should be. The k-means and Ward methods objectively group regions according to the actual proximity of indicators; we believe that if balanced regions existed as a stable group, they would have formed a separate cluster. Second, the results obtained indicate that in contemporary Russia, specialization of regions in specific educational levels is the rule, whereas balance is the exception. Empirically, groups with pronounced specialization emerged. Consequently, the institutional structure of educational systems in regions has historically developed under the influence of economic specialization, demographic factors,




1 – Kaliningrad Region
2 – Leningrad Region
3 – Pskov Region
4 – Smolensk Region
5 – Bryansk Region
6 – Novgorod Region
7 – Tver Region
8 – Moscow Region
9 – Kaluga Region
10 – Tula Region
11 –Orel Region
12 – Kursk Region
13 – Belgorod Region
14 – Vologda Region
15 – Yaroslavl Region
16 – Kostroma Region
17 – Ivanovo Region
18 – Vladimir Region
19 – Nizhny Novgorod Region
20 – Ryazan Region
21 – Lipetsk Region
22 – Tambov Region
23 – Republic of Mordovia
24 – Penza Region
25 – Voronezh Region
26 – Saratov Region
27 – Volgograd Region
28 – Rostov Region
29 – Rep. of Kalmykia
30 – Astrakhan Region
31 – Rep. of Crimea
32 – Krasnodar Territory
33 – Stavropol Territory
34 – Rep. of Dagestan
35 – Kirov Region
36 – Republic of Mari El
37 – Chuvash Republic
38 – Rep. of Tatarstan
39 – Ulyanovsk Region
40 – Samara Region
41 – Perm Territory
42 – Republic of Bashkortostan
43 – Orenburg Region
44 – Sverdlovsk Region
45 – Chelyabinsk Region
46 – Kurgan Region
47 – Tyumen Region (without a.a.)
48 – Republic of North Ossetia – Alania

**Figure 2. Visualization of the clustering results of the constituent entities of the Russian Federation by indicators of the educational component of human capital, 2023**

Source: own compilation.

and migration flows, which has led to shifts in one direction or another (i.e., belonging to a particular cluster).

The next stage of the research is to forecast the indicators of the educational component of human capital for a representative of a typical cluster. The Udmurt Republic (UR) was chosen as the object for predictive modelling for several reasons. First, the third cluster is one of the largest (28 constituent entities) and represents an "average cross-section" of the Russian economy. The values of the indicators (X1–X6) in the UR are very close to the centroid of the third cluster, allowing this region to be considered a typical representative of the cluster. Second, the region's economy has a pronounced industrial specialization (defense-industrial complex, mechanical engineering), making the study of the dynamics of the educational component (especially the SVE level) particularly relevant for understanding the staffing of priority industries. Choosing a typical representative makes it possible to extrapolate the identified patterns to the entire group with a certain degree of statistical reliability.

For each of the six indicators of the educational component of human capital in the UR, the best specification of an autoregressive model was selected based on minimizing

the corrected Akaike Information Criterion (AICc). Using the selected ARIMA model specifications, forecasts of the dynamics of the educational component indicators for the UR were constructed up to 2030. Visualization of the obtained trajectories, along with 80% and 95% confidence intervals, is presented in *Figure 3*. The MAPE values for the models do not exceed 5.3%, indicating their predictive ability and the validity of using them to construct a medium-term forecast.

Analysis of the forecast values reveals trends in the development of the region's education sector. Of greatest interest is the dynamics of training indicators for secondary vocational and higher education, since these largely determine the Udmurt Republic's belonging to the third cluster. In the UR, a steady increase in the share

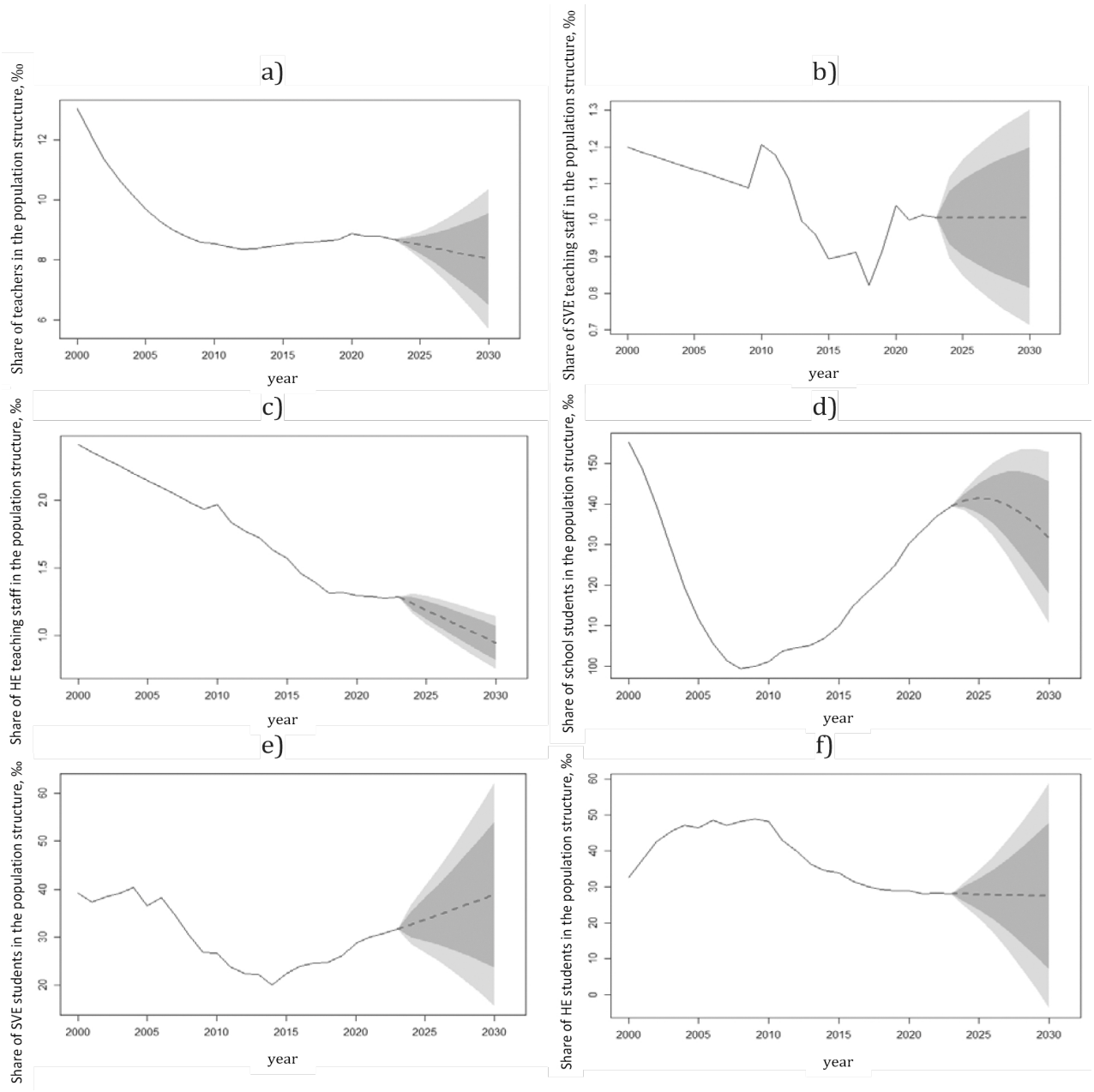



**Figure 3. Forecast of the educational component indicators of human capital for the Udmurt Republic up to 2030**

Note: a) share of teachers; b) share of SVE teaching staff; c) share of HE teaching staff; d) share of school students; e) share of SVE students; f) share of HE students

Source: own compilation.

of SVE students is expected, reaching 38.9‰ by 2030 (an increase of 6.2‰ compared to 2024). At the same time, the share of university students will slowly decline from 28.0‰ to 27.5‰ over the same period. This trend indicates a strengthening of the region's specialization in training mid-level professionals and, consequently, a consolidation of its position in the cluster with an emphasis on SVE. The forecast confirms that the UR's typological belonging to the third cluster will persist and deepen in the medium term.

The projected increase in the share of SVE students occurs against a background of low unemployment. According to data from early 2026, the actual unemployment rate in the UR is 0.3%, more than seven times lower than the national average (2.2%)[5]. At the same time, enterprises in the region face an acute labor shortage, with the number of open vacancies reaching 12,000[6]. The most sought-after specialists are in engineering and technical fields, as well as skilled trades: drivers, mechanics, electricians, lathe operators, and machine operators. Under these conditions, the projected increase in mid-level professional training is an adequate response to the current needs of the regional economy.

The decline in the share of HE students forecast for the period up to 2030 is largely due to demographic factors: over the past five years, the region's permanent population has decreased by 38,000 people, and as of early 2026 stood at 1.427 million[7]. Consequently, the observed trend may reflect not only the region's structural specialization but also the out-migration of young people to larger educational centers.

**Conclusions**

The conducted study of spatial differentiation of the educational component of human capital in the regions of Russia has yielded a number of significant results. The application of a hybrid approach combining cluster analysis and econometric modelling made it possible not only to identify stable typological groups of regions but also to assess the development prospects of educational systems within the identified clusters.

The methodological significance of the work lies in substantiating the effectiveness of applying autoregressive models for medium-term forecasting of educational component indicators of human capital. The ARIMA models constructed for the Udmurt Republic as a typical representative of the third cluster demonstrated high forecast accuracy (the average relative error MAPE does not exceed 5.3%). Using the corrected Akaike Information Criterion in model specification made it possible to account for the limited length of the time series and avoid over-parameterization, which is particularly important when working with small-sample regional statistical data.

The hypotheses formulated in the introduction have been confirmed. The hypothesis of structural heterogeneity is confirmed by the identification of five stable clusters that differ not in scale but in the very structure of the educational component of human capital (i.e., the balance between different levels of education and training). The high Adjusted Rand Index (ARI = 0.782) and the 93% agreement between the results of two different clustering methods (hierarchical and k-means) statistically prove that Russian regions objectively group into types with unique educational profiles – from educational hubs

[5] Actual unemployment rate in Udmurtia amounted to 0.3%. Komsomolskaya Pravda. Izhevsk. 2026. January 12. Available at: https://www.izh.kp.ru/online/news/6760524/ (accessed: 10.03.2026).

[6] 12,000 vacancies open at Udmurtia's factories. Gorod Glazov. 2026. January 20. Available at: https://gorodglazov.com/news/37981 (accessed: 10.03.2026).

[7] Steps toward a decent life: How is the economy recovering? Federation of Trade Unions of the Udmurt Republic. Available at: https://www.fpur.ru/news/ehkonomika/2026-01-19-2885 (accessed: 10.03.2026).

(Cluster 1) to regions with a deficit of vocational education (Cluster 5). The hypothesis of inertia has also been confirmed. First, the ability to construct accurate forecasts for a typical cluster representative (the Udmurt Republic) using ARIMA models (MAPE ⩽ 5.3%) indicates the presence of stable temporal patterns within the group. Second, the forecast up to 2030 shows a strengthening of the region's specialization, pointing to the preservation and deepening of its typological belonging to the SVE-oriented cluster.

It can be stated not only that the Udmurt Republic's specialization in training mid-level professionals persists, but also that this trend can be interpreted as an adaptation of the regional educational system to the structural features of the economy and the current labor market situation. Against the backdrop of record-low unemployment (0.3%) and an acute shortage of skilled workers (12,000 vacancies), the projected growth in the SVE student cohort to 38.9‰ by 2030 represents a response to the labor needs of enterprises in the defense-industrial complex and mechanical engineering. At the same time, maintaining this development trajectory requires complementary measures to improve the quality of life and wage levels in the region in order to retain trained specialists – a necessary condition for the realization of accumulated human capital.

The obtained results allow us to formulate a number of recommendations for regional policy. First, for regions of the third cluster (SVE-oriented), of which the Udmurt Republic is a typical representative, the strategic task is not simply to increase the share of SVE students, but to align the training structure with the current and prospective demand of the regional economy. Given the acute labor shortages, for example in the industry of the UR, it is recommended to strengthen targeted enrolment and deepen cooperation between colleges and city-forming enterprises (defense-industrial complex, mechanical engineering) to adjust curricula to production needs.

Second, for regions of the fourth cluster (with a high share of school students and teachers), the priority should be not so much increasing the number of schools as optimizing the existing infrastructure and investing in the quality of education to ensure that school graduates successfully transition to the next levels of education. This implies developing career guidance programs and creating specialized classes (engineering, medical, etc.) on the basis of existing schools, which would help compensate for the structural imbalance without extensive network growth.

Third, for regions of the fifth cluster (with a deficit of vocational education), measures for the accelerated development of SVE and HE institutions are needed. This could be implemented through the creation of branches of sought-after universities and colleges, the development of educational voucher systems for applicants, and the introduction of regional allowances for vocational teaching staff. Such measures would make these territories more attractive to young people and help prevent out-migration.

Further research prospects include incorporating indicators that characterize the performance of educational systems (education quality, alignment of training structures with regional labor market needs, graduate migration flows, etc.). Analyzing the inter-cluster dynamics of the educational component of human capital also appears to be a relevant task. Solving this task would create a scientific basis for formulating differentiated recommendations to improve regional educational policy, aimed at overcoming existing imbalances and enhancing the contribution of educational potential to sustainable socio-economic development of territories.

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**Вавилова Д.Д., Бархатова Е.В.**

## ОБРАЗОВАТЕЛЬНАЯ СОСТАВЛЯЮЩАЯ ЧЕЛОВЕЧЕСКОГО КАПИТАЛА: ПРОСТРАНСТВЕННАЯ ДИФФЕРЕНЦИАЦИЯ РЕГИОНОВ РОССИИ И ПРОГНОЗНЫЙ СЦЕНАРИЙ (КЕЙС УДМУРТСКОЙ РЕСПУБЛИКИ)

*Образовательная составляющая человеческого капитала выступает ключевым фактором устойчивого регионального развития. Однако разработка региональной политики в области*

*образования и прогнозирование его территориального потенциала затрудняются выраженной пространственной неоднородностью и отсутствием учета структурных особенностей образовательной составляющей человеческого капитала субъектов Российской Федерации. Отсутствие методического инструментария, позволяющего классифицировать регионы по структуре образовательной составляющей человеческого капитала и прогнозировать развитие его типов, определяет цель исследования, которая заключается в выявлении устойчивых кластеров регионов по соответствующим показателям для типизации имеющихся структурных проблем и построения среднесрочного прогноза динамики рассматриваемых показателей для типичного представителя одного из кластеров. Научная новизна работы состоит в применении методов кластеризации для типологизации регионов по образовательной составляющей человеческого капитала и прогнозного моделирования развития типичного представителя кластера. Кластеризация проведена с помощью двух методов: k-средних и иерархического (метод Уорда) с последующей проверкой согласованности результатов с использованием скорректированного индекса Рэнда (ARI). В ходе кластерного анализа выявлено пять гомогенных групп субъектов Российской Федерации с разной структурой образовательной составляющей человеческого капитала: образовательные центры страны, регионы с преобладанием высшего, среднего профессионального и общего образования, а также регионы с дефицитом профессионального образования. Для типичного представителя третьего кластера (Удмуртская Республика) построены прогнозы шести показателей до 2030 года с высокой точностью (средняя относительная ошибка ⩽ 5,3%). Установлено, что в регионе ожидается усиление специализации подготовки кадров среднего звена (рост доли обучающихся в организациях среднего профессионального образования до 38,9‰). Для дальнейших исследований предлагается включить показатели, характеризующие результативность образовательных систем в рамках выделенных кластеров, и провести анализ межкластерной динамики образовательной составляющей человеческого капитала с целью формирования дифференцированных рекомендаций для региональной образовательной политики.*

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# MODELING THE DEMOGRAPHIC POTENTIAL OF RUSSIAN REGIONS CONSIDERING THEIR SOCIAL AND ECONOMIC DIFFERENCES

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*One of the key problems in Russia and its regions remains the problem of demographic decline, which is reflected in the low fertility rate that has persisted for several decades and is aggravated by the high rate of premature mortality among young people and the working-age population. However, in the long term, the demographic policy measures implemented have not led to significant changes in the trend of the demographic process taking place in the country. This determines the aim of this study, which is to identify the social and economic factors that have the greatest impact on changes in the demographic potential of Russian regions using modern statistical and mathematical tools. At the same time, the problem of defining the concept of "demographic potential" is of particular importance, caused by differences in the interpretation of its content. The article provides an overview of the most common approaches to determining and assessing the demographic potential of territories. The net reproduction rate is chosen as an indicator of demographic potential, since it characterizes both the specifics of fertility and premature mortality in the Russian regions. To identify the patterns of this indicator, an econometric model is constructed that describes the dependence of demographic potential on the social and economic development of regions, the results of which are presented in this article. The main problem at this stage was to determine the set of social and economic characteristics that have the greatest impact on demographic potential, which was proposed to be solved using methods*

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*of correlation analysis, as well as a posteriori selection of factors. Based on the obtained model, a scenario analysis was carried out, confirming the high sensitivity of demographic potential to changes in socio-economic conditions in the country's regions. The practical significance of the study lies in the possibility of using the results of modeling by state and municipal authorities to assess the effectiveness of measures aimed at developing the demographic process, as well as to develop a demographic policy strategy.*

*Regional development, demographic potential, net reproduction rate, regression, multicollinearity, scenario analysis.*

**Introduction**

The demographic decline, characterized by a low birth rate, high rates of premature mortality, and, as a result, aging population, has remained one of Russia's most pressing problems over the previous few decades. The problem becomes particularly relevant given the fact that in the general population structure there is a decrease in the proportion of the population younger than the working-age and population of working-age, since these age groups form the demographic potential of the country and are the basis of its well-being.

The state implements and constantly improves demographic policy, the goals of which are to overcome depopulation, stimulate natural population growth and maintain a balance of labor resources (Arkhangel'skii et al., 2016). In particular, measures are being taken to provide social support to families with children[1], reduce premature mortality[2], including from socially significant causes of death, ensure access to high-tech medical care for the population, promote a healthy lifestyle, create conditions for physical education and sports[3], etc. However, despite all the measures taken and implemented within the framework of government programs, the population continues to decline in Russia. This indicates the insufficient effectiveness of the existing demographic policy in the country.

To implement effective measures aimed at the transition from depopulation to expanded reproduction, it is necessary, first of all, to obtain objective and adequate estimates of the level of development of the country's demographic potential, on the basis of which econometric models can later be built to identify the factors that have the greatest impact on the level of the country's demographic potential, and therefore to make informed management decisions in the field of demographic policy. The complexity of obtaining such estimates is due to the multidimensional nature of the concept of "demographic potential".

[1] State Programs of the Russian Federation (2025). Targeted state support for families with children, older citizens, as well as certain categories of citizens, as well as the modernization of social services. The state program "Social support". Available at: https://programs.economy.gov.ru/gp/-/subject/-/direction/7/gp/18/gpVersion/10374

[2] State Programs of the Russian Federation (2025). Innovative methods of diagnosis, prevention and treatment, personalized medicine, training of medical personnel, export of medical services, digitalization of healthcare. The state program "Healthcare Development". Available at: https://programs.economy.gov.ru/gp/-/subject/-/direction/7/gp/1/gpVersion/10395

[3] State Programs of the Russian Federation (2025). Development of sports infrastructure, equipping with sports equipment, mass sports and high-performance sports. The state program "Development of physical culture and sports". Available at: https://programs.economy.gov.ru/gp/-/subject/-/direction/7/gp/36/gpVersion/10400

To date, many approaches have been developed to assess the state of the demographic process, based on various principles of defining this term (Rybakovskii, 2023). The existing methods of assessing the level of demographic potential of regions allow not only recording the current state, but also making forecasts, taking into account the influence of various social, economic and environmental factors. The development of digital technologies and the working out of methods for processing and modeling big data open up new opportunities for more accurate assessment and modeling of demographic processes (Sukiasyan, 2024).

Demographic research uses the concept of potential to identify hidden resources contained in the population structure based on various demographic characteristics. The analysis of existing methods for assessing demographic potential has shown that two main approaches are used in scientific practice: one is based on obtaining estimates of the volume of demographic potential (a quantitative approach), the other is based on assessing its quality (Tikhomirov, Tikhomirova, 2022).

Quantitative approaches to assessing demographic potential make it possible to analyze demographic processes and population development trends through various statistical and mathematical tools. Demographic potential is most often associated with the influence of macro-economic factors on capital accumulation, investment, employment, and projected population growth in a particular area (Zvereva, 2006). This takes into account the relationship between employment and labor surplus with financial policy and psychological factors of migration and natural growth through the concept of "expected income" (Yakovets, Golubkov, 2018).

Statistical, econometric, and demographic methods are among the most common quantitative approaches to studying demographic potential. Statistical methods are useful for describing and monitoring demographic trends, econometric methods are useful for identifying factors and making forecasts, and demographic models are useful for studying the age structure and reproduction. These models make it possible to identify patterns, predict trends, and develop measures to stimulate fertility, reduce mortality, and regulate migration flows. To form a comprehensive understanding of these approaches, their advantages and limitations should be studied in detail.

Statistical methods are widely used in the analysis of demographic processes, as they are based on the processing of empirical data. Statistical methods allow studying demographic potential through the construction of tables of fertility, mortality, marriage, and divorce rates with the calculation of the probabilities of relevant events. Demographic grids are traditionally used, which were improved in the 20th century and used in domestic research to analyze typical demographic events. Modern three-dimensional technologies allow reflecting demographic data about a person's life cycle, including location and ethnicity.

The existing methodology of combined demographic tables enabled researchers to predict changes in family types, which was used to develop social programs, especially in the field of housing construction in large Russian cities and urban agglomerations. These tables also allow calculating mortality and life expectancy based on a person's marital status.

According to the statistical approach, fertility is a key factor in assessing demographic potential. Cole's approach is widely used in international practice, but its upper limit on fertility is controversial for Russia, since it

is based on the birth rate in the most prolific Hutterite communities, which reached 12 children per married woman over her entire life in a prosperous social environment. In this regard, an alternative method of hypothetical minimum natural fertility (HMNF) has been proposed, applicable to living conditions in the USSR. The method is based on an analysis of the fertility of Uzbek women aged 20–24 who lived in conditions of natural fertility. These women demonstrated the highest possible fertility rate in real Soviet conditions without the intervention of birth control factors. However, this method has become obsolete due to the shift in the average age of mothers to 30–34 years in large cities, as well as changes in the model of reproductive activity – women marry later and use contraception more often.

As improved statistical methods for assessing the current demographic situation in the regions of the Russian Federation, it is proposed in the scientific literature to use standardized total fertility, mortality, and migration rates, which allow for standardized depopulation indicators and are characterized by the ease of use of spreadsheets (Rybakovsky, 2024).

To date, the approach based on the construction of integral indicators has become the most widespread for assessing demographic potential, since it is based on obtaining a single quantitative assessment of the level of development of demographic potential, taking into account not only the characteristics of the demographic process, but also the possibilities of its development. One of these indicators was proposed by the French researcher L. Henri, who developed a method for estimating the intensity of generational substitution in the case of sustainable natural reproduction of the population based on the calculation of the net reproduction coefficient (Valentei, 2016; Makarov, 2019).

This technique allows estimating the average number of daughters that a woman can give birth to in her lifetime, taking into account age-related fertility and mortality rates (Tikhomirov, Tikhomirova, 2023). The net coefficient takes into account mortality in various age groups and shows how many of the girls born on average live to their mother's age (Rostovskaya, Sitkovskii, 2024; Dawidowicz, Poskrobko, 2009).

According to experts in the field of demography, it is the net coefficient that more accurately characterizes the patterns of demographic potential of the population in comparison with other proposed approaches (Rybakovsky, 2024). In addition, the values of this indicator are quite easy to interpret. For example, to achieve expanded reproduction of the population, it is necessary that the values of these coefficients exceed one, which means that on average there is more than one daughter per woman (Balbo et al., 2013). If the indicators do not reach unity, this indicates the presence of depopulation.

It is important to note the following: since age-specific mortality rates for five-year age groups are used in calculating the net reproduction rate, this indicator also characterizes the state and trends of premature mortality in the population. Given that diseases of the circulatory system, external causes and neoplasms predominate among the main causes of premature mortality in the country's regions, we can assume that their reduction can be achieved, among other things, by improving the socio-economic well-being of the regions (Tikhomirova, Sukiasyan, 2018).

The above causes the choice of the net coefficient of population reproduction in the framework of this study as an indicator of the level of demographic potential development and its quantitative assessment.

A comparative analysis of the five-year estimates of the net reproduction rate for Russia and its regions for the period from 1995 to 2023 indicates their high differentiation, which in 1995 amounted to 20.9%, and in 2023 – 16.6% *(Tab. 1)*. To identify the causes of the observed differences and identify the factors having the greatest impact It is proposed to apply econometric methods to the development of demographic potential, which is necessary when developing strategies for the socio-economic development of regions.

Econometric methods provide an opportunity not only to analyze the current state of demographic potential, but also to build forecasts based on the identified patterns, which can be obtained using time series analysis, which allows tracking changes in the level of development of demographic potential in the long term. In particular, correlation and regression analysis reveals the relationship between indicators of demographic status and socio-economic characteristics of regions. Spatial econometrics models, in turn, make it possible to assess inter-regional differences and the spread of demographic trends.

Currently, in the scientific literature, the authors propose a variety of regression models developed to assess the impact of various socio-economic factors on the level of demographic potential. In contrast to the approach presented in this study to determining and quantifying demographic potential, most studies use certain individual statistical indicators as characteristics of demographic potential: birth rates, mortality rates, population size, natural growth, etc. (Roy, 2018; Makarova, 2021), which, as already noted, cannot fully reflect the state and variability of demographic potential. At the same time, sometimes the study of this problem is limited to identifying and describing correlations between demographic indicators and socio-economic characteristics (Bezverbny et al., 2025), while a number of researchers propose to build separate econometric models for each of the characteristics of the demographic potential to analyze the demographic state of the region (Paley, Pollak, 2017; Fattakhov et al., 2020). Despite the undoubted practical value of the proposed approaches, the choice of mutually correlated indicators as explanatory factors characterizing various aspects of the socio-economic situation of the region (country) is criticized.

**Table 1. Comparative analysis of the net reproduction rate in the Russian regions**

| Year | Statistical characteristics | Net reproduction rate |
|---|---|---|
| 1995 | Arithmetic mean | 0.662 |
| | Standard deviation | 0.138 |
| | Coefficient of variation, % | 20.9 |
| 2023 | Arithmetic mean | 0.680 |
| | Standard deviation | 0.113 |
| | Coefficient of variation, % | 16.6 |

According to: Center for Demographic Research of the Russian School of Economics (2025). The Russian database on fertility and mortality (RosBRiS). Available at: https://www.nes.ru/demogr-fermort-data?lang=ru (accessed: 07.07.2025).

The above determines the scientific novelty of the presented study, which uses an integral indicator as an indicator of demographic potential – the net reproduction coefficient, which, as already noted, is a more complete description of the demographic process of the region and its development potential, and a set of socio-economic indicators explaining its variability has been previously studied to eliminate correlations. At the same time, the study pays special attention to indicators of the state of the healthcare system and its accessibility, since, according to the author, the development of the demographic potential of the country and its regions is possible, first of all, by improving the quality of public health by providing affordable and timely highly qualified medical care.

**Research methodology**

Despite the demographic policy measures being implemented in Russia, the country continues to have a declining and aging population (Rybakovsky, 2024). This, in turn, has a negative impact on the economy (Livshits et al., 2023; De Santis, Salinari, 2023), the labor market (Sukiasyan, 2024), industry and other areas of government activity, since, according to modern views of economic scientists, the population forms the development potential of the state (Rybakovskii, 2023; Baeva, Urazova, 2020). In the regions of Russia, the demographic problem is becoming particularly relevant due to their significant differentiation in terms of gender and age composition of the population and socio-economic status (Sukiasyan, 2022). This article is devoted to the problem of constructing an econometric model describing the patterns of influence of indicators of socio-economic development of Russian regions on the level of demographic potential.

The net population reproduction rate is estimated based on the following indicators for five-year age groups:

– number of children born per 1,000 women of the five-year age group $k$ in region $j$ in year $t$, $f_k^j(t)$;

– number of women who died per 1,000 people in the five-year age group $i$ in region $j$ in year $t$, $m_i^j(t)$.

Based on the available fertility rates, the age-related fertility rates of girls for the five-year-old age groups of the mother are calculated according to formula 1:

$$b_k^j(t) = \frac{f_k^j(t)}{200} \cdot 0.488, \qquad k = \overline{4,10}, \quad (1)$$

where 0.488 is the share of girls among newborns, $k$ corresponds to the mother's age group.

The mortality rates of the female population were used to obtain survival coefficients using formula 2:

$$p_i^j(t) = 1 - \frac{m_i^j(t)}{200}, \qquad i = \overline{1,10}, \quad (2)$$

where $i$ corresponds to the mother's age group.

The net reproduction coefficients for each region $j$ in year $t$ are determined according to formula 3 (Notestein, 1960):

$$HKB^j(t) = \sum_{k=4}^{10} \left[ b_k^j(t) \cdot \prod_{i=1}^{k-1} p_i \right], \; i = \overline{1,10}; \; k = \overline{4,10}. \quad (3)$$

Based on the presented methodology, net population reproduction coefficients were calculated for 79 regions of Russia, exception for the Nenets Autonomous Area, the Khanty-Mansi Autonomous Area – Yugra, and the Yamal-Nenets Autonomous Area, which are geographically part of the Arkhangelsk and Tyumen regions, respectively, as well as the republics of Crimea and Chechnya, and Sevastopol due to the lack of sufficient statistical data on the considered indicators.

The estimates obtained for the period from 1995 to 2023 are characterized by rather high dynamics and differentiation by regions of Russia (Kalabikhina et al., 2022). In general, during the period under review, the average value of the net reproduction coefficient of the Russian population increased from 0.662 to 0.680, i.e. by 2.7%. At the same time, the dynamics of the indicator increased from 1999 to 2015 to a peak value of 0.879, followed by a decrease of 22.7% to a level almost comparable to the level of 1995. In turn, the differentiation of regions by the level of the net reproduction coefficient varies from 14.0% in 2003–2004 to 18.9 and 20.9% in 2011 and 1995, respectively.

The above, as well as the fact that the value of the net reproduction coefficient of the population in the study period does not exceed one, testifies to the ongoing depopulation process in the country (Aivazian et al., 2019; Rybakovsky, Fadeeva, 2020), determine the need to identify the interdependencies between the indicator of demographic potential and the characteristics of the socio-economic situation of regions (Jagger et al., 2008) to identify the factors that have the greatest impact on the change in the value of the net reproduction coefficient, which will allow applying the results obtained to justify strategies to equalize regional differences and develop measures aimed at increasing the level of this indicator, and therefore, the transition from depopulation to extended reproduction (Ivanova et al., 2023).

The initial set of characteristics of the socio-economic situation of the regions included 21 indicators, which were divided into several blocks characterizing various spheres of life: economic, welfare of the population, social, the state of the health system and the environment. The economic block included the index of industrial production, the average per capita size of GDP, investments in fixed assets, etc. The financial well-being of the population was assessed on the basis of such indicators as average per capita monetary income, the amount of paid services, bank deposits, retail trade turnover, the total area of residential premises, museum attendance, and some others. The social sphere was characterized by the number of crimes, the ratio of the number of divorces to the number of marriages, the unemployment rate, the migration growth rate, etc. The state of the healthcare system is represented by the expenditures of consolidated healthcare budgets per capita, the average per capita expenditure of the population on medical services, the number of doctors and nursing staff, the number of beds in medical institutions, etc. The ecological situation of the region was assessed on the basis of the volume of pollutants released into the atmosphere from stationary sources.

After a preliminary analysis of an expanded set of different indicators of the level of socio-economic development of Russian regions for the presence of statistically significant correlations, as well as sufficient variability, the following indicators for the period from 1995 to 2023 were selected for further modeling:

– number of doctors per 10,000 people ($x_1$);

– ratio of divorces and marriages ($x_2$);

– crime per 10,000 people ($x_3$);

– total area of living quarters per person, $m^2$/person ($x_4$);

– number of unemployed people per 10,000 working-age population ($x_5$);

– migration growth rates per 10,000 people ($x_6$);

– capacity of outpatient clinics for 10,000 people ($x_7$);

– number of museum visits per 1,000 people ($x_8$);

– paid medical services, rubles per person ($x_9$);

– expenses of consolidated budgets for healthcare, rubles per person ($x_{10}$).

The absence of characteristics of the economic situation of the regions among the selected indicators is due to their strong direct correlation with the expenditures of consolidated budgets on healthcare. Thus, the inclusion of health expenditure indicators in the final set makes it possible to take into account not only the state of the health system in the regions, but also their level of economic well-being (Ivanov et al., 2014).

At the first stage, using correlation analysis methods, the relationships between the resulting variable (net reproduction coefficient, *y*) and the above characteristics were revealed. The Pearson pair correlation coefficients and all subsequent stages of data analysis and model construction were based on the values of the resulting and explanatory variables averaged over the time period under review, which made it possible to offset the effect of random fluctuations and noise on the result.

Based on the analysis of the values of the matrix of paired correlation coefficients, conclusions were drawn about a fairly strong relationship between the net reproduction coefficient (y) of the population and such indicators as the number of doctors per 10,000 people, the total area of residential premises per person, the number of unemployed, as well as between the number of doctors and the total area of residential premises, the capacity of outpatient clinics and health care costs.

The strongest negative correlation is observed between the net reproduction rate and the ratio of divorces and marriages (coefficient value -0.55). An even more pronounced negative relationship is observed between the area of residential premises (coefficient -0.71), due to the continuing decline in the population with increasing rates of residential commissioning.

Attention should also be paid to the positive relationship between the net reproduction rate and the number of unemployed per 10,000 working-age population, which is explained by the low involvement of women caring for children in the labor market (Arkhangel'skii et al., 2016; Ivanova, 2022).

Attention should also be paid to the positive relationship between the net-In order to identify hidden relationships due to the simultaneous influence of several indicators on the resulting variable, as well as possible relationships between explanatory variables, multiple correlation coefficients were calculated, which turned out to be significant at the level of 5%. This means that all indicators depend on others quite a lot. The most significant coefficients of multiple correlation were found in the net reproduction rate and the number of divorces. It can be concluded that the remaining indicators explain their variation very qualitatively by the reproduction rate and the number of unemployed per 10,000 people of the working-age population, which is explained by the weak involvement of women caring for children in the labor market (Arkhangel'skii et al., 2016; Ivanova, 2022).

The results obtained allow concluding that it is necessary to check the totality of explanatory variables for the effect of multicollinearity. The analysis used three approaches to assess multicollinearity: VIF variance inflation factors, Fisher statistics, and the criterion $\chi^2$ *(Tab. 2)*.

Despite the fact that Fischer's statistics confirmed the presence of multicollinearity – almost all values $F_{расч}$ turned out to be higher than the tabular value of 2.07, and the calculated value $\chi^2_{\text{расч}} = 86.93$ turned out to be higher than the critical tabular value of 50.99, which indicated the need to reject the null hypothesis of the absence of multicollinearity. Based on the results of calculating the VIF coefficients, each of which does not exceed the threshold value of 10, we can conclude that the effect of multicollinearity on the effectiveness of the parameters of the multiple regression model

**Table 2. Calculated values of VIF and Fisher statistics for each explanatory variable**

| Indicator | VIF | F-Fischer statistics | Value |
|---|---|---|---|
| $x_1$ | 1.626 | 4.798 | ** |
| $x_2$ | 5.332 | 33.210 | ** |
| $x_3$ | 2.593 | 12.214 | ** |
| $x_4$ | 3.422 | 18.572 | ** |
| $x_5$ | 3.040 | 15.643 | ** |
| $x_6$ | 2.352 | 10.364 | ** |
| $x_7$ | 2.486 | 11.395 | ** |
| $x_8$ | 1.662 | 5.075 | ** |
| $x_9$ | 2.424 | 10.915 | ** |
| $x_{10}$ | 4.276 | 25.117 | ** |

According to: Center for Demographic Research of the Russian School of Economics (2025). The Russian database on fertility and mortality (RosBRiS). Available at: https://www.nes.ru/demogr-fermort-data?lang=ru (accessed: 07.07.2025).

based on the available data is insignificant. This, in turn, allows concluding that it is possible to build a classical linear regression model of the dependence of demographic potential on the socio-economic indicators of the regions under consideration, taking into account the entire set of explanatory variables without the need to introduce additional procedures aimed at eliminating multicollinearity (Wang et al., 2025).

**Research result**

The parameters of a linear multiple regression equation with a complete list of factors can be written as follows (Tikhomirov, Tikhomirova, 2023):

$$\hat{y} = a_0 + \sum_{p=1}^{10} a_p x_p. \quad (4)$$

*Figure 1* shows a limited ("short") multiple regression model for simulating

```
Model 2: OLS, using observations 1-79
Dependent variable: y

              coefficient    std. error    t-ratio    p-value
  ---------------------------------------------------------------
  const        1.25278       0.0528024     23.73     4.80e-036 ***
  x2          -7.60332e-05   1.11299e-05   -6.831    2.14e-09  ***
  x3           0.000827997   0.000141787    5.840    1.35e-07  ***
  x4          -0.0104054     0.00319018    -3.262    0.0017    ***
  x9          -3.19364e-05   5.61257e-06   -5.690    2.48e-07  ***
  x10          1.24790e-05   1.57708e-06    7.913    2.05e-011 ***

Mean dependent var   0.714460   S.D. dependent var   0.107065
Sum squared resid    0.185162   S.E. of regression   0.050363
R-squared            0.792909   Adjusted R-squared   0.778724
F(5, 73)             55.90029   P-value(F)           1.36e-23
Log-likelihood       127.1148   Akaike criterion    -242.2296
Schwarz criterion   -228.0129   Hannan-Quinn        -236.5339
```

**Figure 1. Limited model of multiple regression of the dependence of the demographic potential of regions on the level of their socio-economic development**

According to: Demographic Yearbook of Russia (2025). Federal State Statistics Service. Available at: https://rosstat.gov.ru/folder/210/document/13207 (accessed: 07.07.2025).

the net coefficient of population reproduction from a reduced number of socio-economic characteristics in Russia's regions on average for the period from 1995 to 2023. The model includes only those explanatory variables that correspond to the statistically significant parameters of the model according to Student's test.

The selection of factors for regression dependence was done using the "a posteriori" method, which implies the step-by-step removal of factors from the regression model with the highest *p*-value of the corresponding parameter until only factors with significant regression coefficients remain. There are 5 significant indicators left in the model: the number of divorces $x_2$, the number of crimes $x_3$, the area of residential premises per person $x_4$, paid medical services per person $x_9$, and healthcare costs per person $x_{10}$. The coefficient of determination of the resulting model is 79.3%, and the model itself is significant according to the Fisher test at the significance level of 1%.

However, to increase the explanatory power of the model and improve the quality of the forecast, it is advisable to exclude from the sample regions that are characterized by abnormal values of indicators compared to other regions or, in other words, can be characterized as gross errors.

In the process of preparing data for building a regression model, special attention was paid to outlier analysis. For this, a step-by-step approach was used, including a combination of one-dimensional and multidimensional methods. At the first stage, the Smirnov – Grubbs criterion was applied, which makes it possible to detect gross errors in each of the indicators separately. As a result, 8 regions were identified characterized by abnormal values of certain signs: Moscow, Saint Petersburg, the Magadan Region, the republics of Dagestan, Ingushetia, and Tuva, the Sakhalin Region, and the Chukotka Autonomous Area.

The Grubbs criterion of variance was used for additional verification. It compares the sample variance with the truncated variance (that is, without the potential outlier). This approach allowed confirming that not all observed deviations are statistically significant, and some could be a consequence of the usual variability of the data. As a result, the presence of abnormal values in the data of three regions (Saint Petersburg, the Republic of Ingushetia, and the Chukotka Autonomous Area) was confirmed.

However, since a one-dimensional analysis does not allow identifying situations where a region differs significantly from the main array of subjects in terms of a combination of factors, multidimensional Hotelling statistics were calculated for each of the marked regions to more fully analyze the initial sample. Statistically significant emissions according to this criterion were Saint Petersburg ($T^2 = 56.35$), the Republic of Ingushetia ($T^2 = 60.32$), and the Chukotka Autonomous Area ($T^2 = 44.91$), whose values exceed the critical value of 24.38. Accordingly, these regions were excluded from the sample to obtain a model with better quality characteristics than the above model.

This modification made it possible to maintain the necessary level of representativeness of the data and ensure an optimal balance between the coefficient of determination and the standard error in the subsequent regression model *(Fig. 2)*.

The non-emission model demonstrates higher quality indicators: the value of the coefficient of determination ($R^2$) is 0.828 versus 0.793 for the second model, and the normalized coefficient of determination reaches 0.815, which is also higher than 0.779 for the model with emissions *(Tab. 3)*. Additionally, it is worth noting a decrease in the standard error from 0.050 to 0.046, which indicates a higher stable parameter estimates and lower variance of residuals. These differences are not numerically critical, but collectively speak in favor of higher accuracy and interpretability of the outlier-free model.

```
Model 2: OLS, using observations 1-79
Dependent variable: y

             coefficient    std. error    t-ratio    p-value
  ------------------------------------------------------------
  const       1.25278       0.0528024     23.73     4.80e-036 ***
  x2         -7.60332e-05   1.11299e-05   -6.831    2.14e-09  ***
  x3          0.000827997   0.000141787    5.840    1.35e-07  ***
  x4         -0.0104054     0.00319018    -3.262    0.0017    ***
  x9         -3.19364e-05   5.61257e-06   -5.690    2.48e-07  ***
  x10         1.24790e-05   1.57708e-06    7.913    2.05e-011 ***

Mean dependent var   0.714460   S.D. dependent var   0.107065
Sum squared resid    0.185162   S.E. of regression   0.050363
R-squared            0.792909   Adjusted R-squared   0.778724
F(5, 73)             55.90029   P-value(F)           1.36e-23
Log-likelihood       127.1148   Akaike criterion    -242.2296
Schwarz criterion   -228.0129   Hannan-Quinn        -236.5339
```

**Figure 2. Limited model of multiple regression of the dependence of the demographic potential of regions**

According to: Demographic Yearbook of Russia (2025). Federal State Statistics Service. Available at: https://rosstat.gov.ru/folder/210/document/13207 (accessed: 07.07.2025).

**Table 3. Comparison of regression models of the dependence of demographic potential on the level of development of the socio-economic situation of regions with significant parameters**

| Emission-free model | | Emissions-based model | |
|---|---|---|---|
| Regression statistics | | Regression statistics | |
| Multiple R | 0,910 | Multiple R | 0.890 |
| R-square | 0,828 | R-square | 0.793 |
| Normalized R-square | 0,815 | Normalized R-square | 0.779 |
| Standard error | 0,046 | Standard error | 0.050 |
| According to: Demographic Yearbook of Russia (2025). Federal State Statistics Service. Available at: https://rosstat.gov.ru/folder/210/document/13207 (accessed: 07.07.2025). | | | |

However, it is also advisable to check this model for autocorrelation of residues. For this purpose, the Durbin – Watson statistics were calculated. The resulting value was $DW = 1.91$, which was close to the threshold value of 2. This indicates that there is no pronounced positive or negative autocorrelation. However, since the Durbin – Watson test has an uncertainty zone, it is important to take into account the critical boundaries determined by the number of observations and the number of regressors. With 76 observations and five explanatory variables, the lower critical limit is approximately 1.50, and the upper limit is 1.71. Thus, our value of $DW = 1.91$ is above the upper bound. This allows concluding with confidence that there is no first-order autocorrelation in the model.

To confirm this result, the Breusch – Godfrey test was applied, which has no restrictions on the inclusion of lags of the dependent variable as factors and is more universal when checking autocorrelation of various orders. The results of the Breusch – Godfrey test for first-order autocorrelation are: statistics $LM = 2.12$ $p$-value ($\chi^2$): 0.145; Fischer statistics $F = 1.84$, $p$-value (F): 0.18.

Both *p*-values exceed the standard significance level of 5%, which makes it impossible to reject the null hypothesis of the absence of autocorrelation. Thus, both tests consistently showed that there is no autocorrelation in the model. This confirms the correctness of the model specification in terms of the premise of error independence. The absence of autocorrelation also has a positive effect on the accuracy of forecasts and the interpretability of results: there is no need to use alternative estimation methods (for example, generalized least squares) or introduce lags (Tikhomirov, Tikhomirova, 2024).

Based on the above, the emission-free model with selected significant factors seems to be more reliable and appropriate for further analysis and forecasting. Data purification has improved the statistical characteristics of the model without unnecessarily complicating its structure (Abdulrashid et al., 2023; Jindrov et al., 2013).

The model demonstrated the best balance between high explanatory power and low standard error, while maintaining the interpretability of the coefficients and the stability of the model structure. The constructed model adequately reflects the dynamics of the dependent variable and can be used to predict various scenarios, including deterioration and improvement of conditions. Its structure makes it possible to vary the values of factors and assess how possible changes in the social environment will affect the demographic situation in the country.

To demonstrate the applied value of the model, a scenario analysis was carried out, reflecting potential changes in the demographic situation when adjusting socio-economic indicators. The situation was modeled, characterized by an improvement in all socio-economic conditions, taking into account their actual variability. A scenario was considered in which the number of divorces per 10,000 marriages $x_2$ decreases by 15%, crime per 10,000 people $x_3$ decreases by 1%, housing conditions $x_4$ improve by 3%, the capacity of outpatient clinics $x_7$ increases by 10%, and healthcare $x_{10}$ costs increase by 5%. A detailed analysis showed that varying socio-economic indicators by a smaller amount than indicated individually does not lead to a statistically significant change in the level of the net reproduction coefficient.

This optimistic scenario demonstrated an increase in the projected value of the net reproduction rate in most regions, with a total increase of 8.7%. The increase was most noticeable in the Magadan, Leningrad, and Murmansk regions. However, in some regions, the improvement of social factors had a negative impact on the level of the net reproduction rate. This applies to the republics of Ingushetia, Dagestan, and the Kabardino-Balkarian Republic, which may be due to both the specifics of the regional socio-economic structure and the high sensitivity of these constituent entities to changes in individual factors. This highlights the need for an individual approach when developing social measures and shows that universal improvements are not always effective across the country.

A pessimistic scenario was also considered, in which the number of divorces per 10,000 marriages $x_2$ increases by 12%, crime per 10,000 people $x_3$ increases by 4%, housing conditions $x_4$ worsen by 7%, the capacity of outpatient clinics $x_7$ decreases by 7%, and healthcare costs $x_{10}$ decrease by 8%. Attempts to alternately vary the considered characteristics by a smaller amount individually did not lead to statistically significant changes in the net reproduction coefficient.

As expected, this scenario had a negative impact on the demographic potential of most regions, with a total decline of 10.4 percentage points. The decline was most affected in the Magadan, Leningrad, and Murmansk regions. In turn, the republics of Ingushetia, Dagestan, and the Kabardino-Balkarian Republic showed an increase, which confirms the specifics of these regions and the need to implement targeted measures aimed at leveling the demographic situation in the country's regions.

**Conclusions**

In the course of the study, a regression model was built to identify the impact of socio-economic factors on the level of demographic potential in the country's regions, in particular on the value of the net reproduction coefficient. The main attention was paid to the preliminary analysis of the data array for the presence of gross errors (outliers), as well as the effect of the multicollinearity effect on the effectiveness of estimates of the parameters and quality characteristics of the constructed model.

Scenario analysis showed that with an improvement in the values of socially significant factors, most regions demonstrate a positive trend in the model values of the indicator. However, not all regions are experiencing an increase: in some republics of the North Caucasus, a decrease in the projected value has been noted. This is due to the specifics of regional conditions, traditionally high baseline fertility rates, and cultural characteristics that are poorly correlated with the socio-economic variables under consideration.

The practical significance of the work performed lies in the possibility of applying the obtained model to assess the potential effect of changes in social policy. With the correct interpretation of the coefficients, recommendations can be made for managing the demographic situation at the regional level, as well as approaches to standardizing variables in similar studies.

Thus, according to the results of the conducted research, the goal of analyzing the impact of socio-economic factors on demographic processes in Russia was successfully achieved. Modeling and analysis suggest that, despite some deviations, the model reflects general patterns and can serve as a basis for developing effective solutions in the field of demographic policy.

As questions and prospects for further research, the author suggests setting up and attempting to solve problems related to building a model while preserving gross errors in the sample, but correcting them using stable estimation methods (for example, censoring, the Huber model), as well as evaluating the model on panel data to take into account the specifics of regional differences in more detail. Although panel data models are also a useful tool for considering the dynamics of demographic processes, since they allow finding and analyzing changes simultaneously in time and space, the constructed multiple regression model at the stage of identifying common patterns has a number of advantages, primarily related to the simple implementation and interpretation of the results. Also, unlike multiple regression, the panel data model takes into account fixed or random effects, which requires additional computing power.

It is important to emphasize that the Russian Federation is a large multinational country with pronounced regional differences in socio-economic development, population structure and migration trends, which was confirmed by the conducted research. With this in mind, building a single model that reflects

the reality of all regions equally well is a very difficult task, so another approach to improving the quality of forecasting demographic potential and justifying the impact of changes in socio-economic conditions on its level may be to solve the problem of building a cluster model that generalizes into clusters similar in their socio-economic and demographic characteristics of the regions. Nevertheless, the results obtained make it possible to use the model as a tool for evaluating the effectiveness of measures aimed at equalizing and ensuring the progressive development of the demographic process.

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## МОДЕЛИРОВАНИЕ ДЕМОГРАФИЧЕСКОГО ПОТЕНЦИАЛА РЕГИОНОВ РОССИИ С УЧЕТОМ ДИФФЕРЕНЦИАЦИИ ИХ СОЦИАЛЬНО-ЭКОНОМИЧЕСКОГО ПОЛОЖЕНИЯ

*Одной из наиболее актуальных проблем в России и ее регионах остается проблема демографического спада, выражающаяся в сохраняющемся на протяжении нескольких десятилетий низком уровне рождаемости и усугубляющаяся высоким уровнем преждевременной смертности среди молодежи и населения трудоспособного возраста. Однако в долгосрочном периоде реализуемые меры демографической политики не привели к существенным изменениям в тенденции происходящего в стране демографического процесса. Это обусловливает цель настоя-*

*щего исследования, которая заключается в выявлении социально-экономических факторов, в наибольшей степени оказывающих влияние на изменение уровня демографического потенциала регионов России, с использованием современного статистического и математического аппарата. При этом особую значимость имеет определение понятия «демографический потенциал», что вызвано различиями в интерпретации его содержания. В статье представлен обзор наиболее распространенных подходов к определению и оценке демографического потенциала территорий. В качестве индикатора демографического потенциала выбран нетто-коэффициент воспроизводства населения, поскольку он характеризует специфику как рождаемости, так и преждевременной смертности населения регионов России. Для выявления закономерностей развития данного показателя построена эконометрическая модель, описывающая зависимость демографического потенциала от различающихся условий социально-экономического развития регионов. Основная проблема на данном этапе заключалась в определении набора социально-экономических характеристик, оказывающих наибольшее влияние на демографический потенциал. Решить ее предложено с применением методов корреляционного анализа, а также апостериорного отбора факторов. На основе полученной модели проведен сценарный анализ, подтверждающий высокую чувствительность демографического потенциала к изменениям социально-экономических условий в регионах страны. Практическая значимость исследования заключается в возможности использования результатов моделирования органами государственного и муниципального управления для оценки эффективности мер, направленных на развитие демографического процесса, а также для выработки стратегии демографической политики.*

*Региональное развитие, демографический потенциал, нетто-коэффициент воспроизводства, регрессия, мультиколлинеарность, сценарный анализ.*

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## ИНФОРМАЦИЯ ОБ АВТОРЕ

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# MONITORING OF CHANGES: MAIN TRENDS

## THE ECONOMY OF NORTHWEST RUSSIA IN 2025: SLOWING GROWTH AND REORIENTATION TOWARD DOMESTIC DEMAND

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Vologda Research Center of the Russian Academy of Sciences (VolRC RAS) continues to acquaint its readers with materials on the state and development trends of the economy of the Northwestern Federal District (NWFD) against the backdrop of all-Russian dynamics.

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The Russian economy operated throughout 2025 amid an acute phase of adaptation to unprecedented sanctions pressure and the transition toward deep structural transformation. External conditions remained challenging and volatile: the global economy continued to decelerate, grappling with market fragmentation, rising protectionism across many countries, and the repercussions of tighter monetary policy pursued by major central banks *(Tab. 1)*. According to World Bank forecasts, global GDP growth in 2026–2027 is projected at 2.6–2.7%—well below the 3.2% average recorded over the 2010–2019 period[1]).

This global slowdown is, moreover, unevenly distributed. In the euro area—which has lost access to affordable Russian energy supplies—growth stood at 1.4% in 2025 and is projected to drop to 0.9% in 2026. The U.S. economy slowed to 2.1% growth in 2025 amid persistently high interest rates and the waning of fiscal stimulus. China, confronting a property market crisis and mounting trade restrictions, is shifting toward a managed slowdown, with growth expected to ease from 4.9% to 4.2% over the 2025–2027 period. This poses structural risks for Russia's exports of intermediate goods. India, by contrast, continues to post high growth rates (6.5–7.2% annually) and remains the world's fastest-growing major market. Strong investment appeal, a demographic dividend, and active economic policy make it a priority destination for Russian exports.

The key takeaway from this brief overview of the external environment is that operating

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[1] World Economic Situation and Prospects 2026. United Nations. 216 p. DOI: 10.18356/9789211577761.

**Table 1. Global economic trends, % change from previous year**

| Indicator | 2023 | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|---|
| Gross domestic product | | | | | |
| World | 2.8 | 2.8 | 2.7 | 2.6 | 2.7 |
| Advanced economies | 1.6 | 1.7 | 1.7 | 1.6 | 1.6 |
| • United States | 2.9 | 2.8 | 2.1 | 2.2 | 1.9 |
| • Euro area | 0.5 | 0.9 | 1.4 | 0.9 | 1.2 |
| • Japan | 0.7 | -0.2 | 1.3 | 0.8 | 0.8 |
| Emerging market and developing economies | 4.4 | 4.3 | 4.2 | 4.0 | 4.1 |
| East Asia and Pacific | 5.2 | 5.0 | 4.8 | 4.4 | 4.3 |
| • China | 5.4 | 5.0 | 4.9 | 4.4 | 4.2 |
| Europe and Central Asia | 3.6 | 3.6 | 2.4 | 2.4 | 2.7 |
| • Russia | 4.1* | 4.9* | 1.0* | 0.8 | 1.0 |
| Latin America and the Caribbean | 2.4 | 2.4 | 2.2 | 2.3 | 2.6 |
| Middle East and North Africa | 2.1 | 2.6 | 3.1 | 3.6 | 3.9 |
| South Asia | 8.0 | 6.3 | 7.1 | 6.2 | 6.5 |
| • India | 9.2 | 6.5 | 7.2 | 6.5 | 6.6 |
| Sub-Saharan Africa | 3.0 | 3.7 | 4.0 | 4.3 | 4.5 |
| Global trade | | | | | |
| Global trade volume | 0.6 | 3.4 | 3.4 | 2.2 | 2.7 |
| Commodity price index (2010 = 100) | 108 | 105 | 98 | 91 | 94 |
| Energy price index (2010 = 100) | 107 | 102 | 90 | 80 | 85 |
| Oil price (USD per barrel) | 83 | 81 | 69 | 60 | 65 |
| Non-energy commodity price index (2010 = 100) | 110 | 113 | 115 | 113 | 113 |

*Rosstat data.
Source: Global Economic Prospects, January 2026. Washington: World Bank. 180 p. DOI: 10.1596/978-1-4648-2267-4

conditions for Russia's export-oriented, resource-based economic model have become markedly more challenging. On the one hand, this underscores the importance of export diversification–developing non-resource exports, above all to India, Southeast Asian nations, and Africa. On the other hand, it necessitates a greater prioritization of domestic sources of growth. Indeed, domestic demand dynamics and the restructuring of the economy were the decisive factors shaping gross value added in 2025[2]. According to preliminary Rosstat data, Russia's GDP expanded by 1% in 2025 (compared to 4.9% a year earlier). Estimated growth in the fourth quarter of 2025 also came in at 1% *(Fig. 1)*.

Changes in the Business Confidence Index point to deteriorating expectations among Russian enterprises. In February 2026, the index for manufacturing and mining fell to 0.4 and -7, respectively—down significantly from the 3.3 and -0.9 recorded a year earlier *(Fig. 2)*. The Business Confidence Index in construction dropped by 3 percentage points in the first quarter of 2026, hitting the lowest level among the sectors listed at -11.

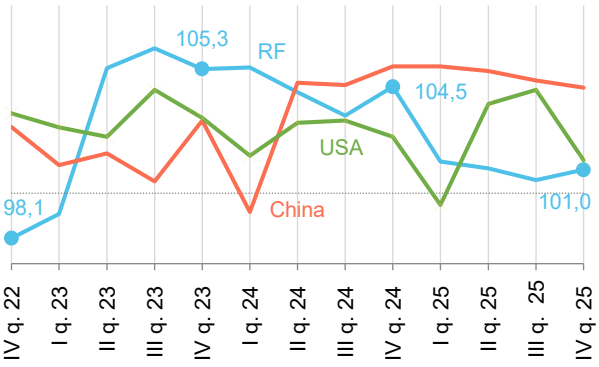



**Figure 1. Gross domestic product growth, % change from corresponding quarter of previous year**

[2] Here and further in the text (unless otherwise specified) January – December 2025 is compared with January–December 2024.

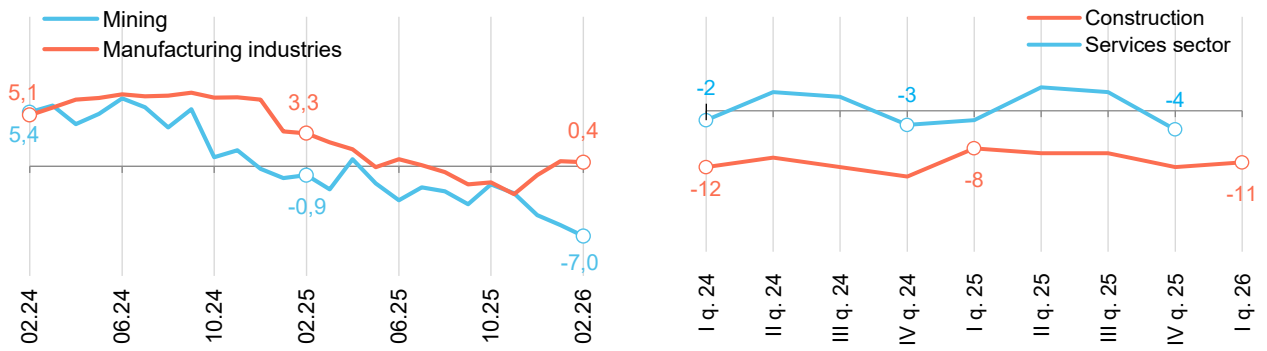



**Figure 2. Business Confidence Index, %**

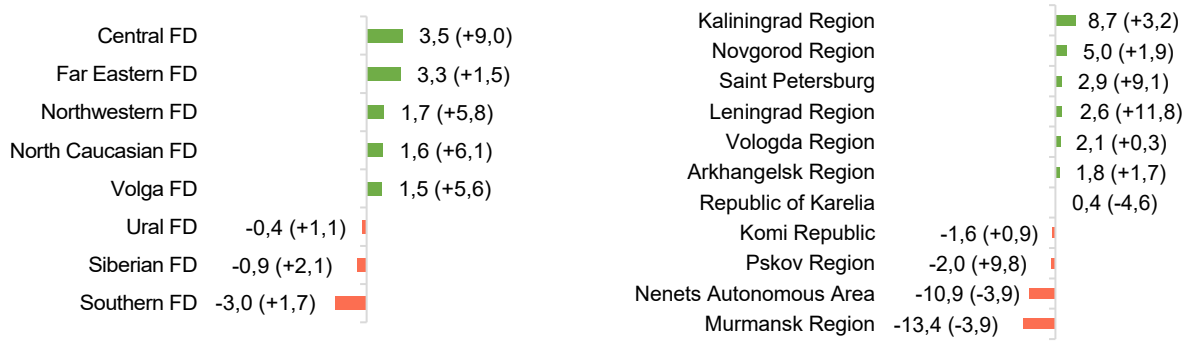



**Figure 3. Growth in output of goods and services in basic economic activities*, January–December 2025 vs January–December 2024, by federal district and NWFD regions, %**

*Basic economic activities include: crop production, animal husbandry, hunting, and related service activities; mining and quarrying; manufacturing; electricity, gas, steam, and air conditioning supply; water supply; sewerage, waste management, and remediation activities; construction; wholesale trade (except of motor vehicles and motorcycles); retail trade (except of motor vehicles and motorcycles); transportation.

Note: Figures in parentheses indicate the change in the indicator for January–December 2024 relative to January–December 2023, in %.

*Entrepreneurs' short-term expectations have hit record lows: 52% anticipate that their businesses will face worsening conditions in the first quarter of 2026, while only 12% expect improvement. The share of companies pursuing a growth strategy in Q4 stood at just 8%. Thirty-nine percent of business owners reported that their Q4 2025 revenues were lower than in the previous quarter, and 29% stated that their income was insufficient to cover direct operating expenses. The proportion of those entering Q1 2026 with feelings of worry and anxiety rose to 62%. Some entrepreneurs have been forced to shift their businesses rather abruptly into "survival mode"*[3].

### 1. Gross output

Output of goods and services in basic economic activities across the Northwestern Federal District (NWFD) as a whole increased by 1.7% – the third-highest growth rate among all federal districts *(Fig. 3)*. Most regions within the NWFD posted gains in this indicator, with the Kaliningrad and Novgorod regions leading the way (up 8.7% and 5.0%, respectively). At the same time, the Murmansk Region and the Nenets Autonomous Area saw substantial declines in output (down 13.4 and 10.9%, respectively).

[3] Pessimism, anxiety and survival: entrepreneurs – about the past and current quarters. Available at: https://smbiz.fom.ru/post/pessimizm-trevozhnost-i-vyzhivanie-predprinimateli-o-proshedshem-i-tekushem-kvartalah (accessed: 15.03.2026).

**Table 2. Industrial production trends, % change from corresponding period of previous year**

| Territory | 2023 | 2024 | 2025 | R* |
|---|---|---|---|---|
| Industry overall | | | | |
| Russian Federation | 104.3 | 105.1 | 101.3 | - |
| Northwestern Federal District | 105.3 | 107.7 | 100.6 | 4 |
| Novgorod Region | 102.7 | 102.7 | 109.0 | 7 |
| Kaliningrad Region | 96.7 | 103.2 | 108.8 | 8 |
| Saint Petersburg | 113.1 | 116.9 | 105.4 | 16 |
| Vologda Region | 106.2 | 101.2 | 101.8 | 30 |
| Arkhangelsk Region | 98.8 | 107.5 | 100.0 | 42 |
| Pskov Region | 112.6 | 108.5 | 98.3 | 56 |
| Komi Republic | 100.3 | 99.9 | 97.2 | 64 |
| Leningrad Region | 107.7 | 110.4 | 96.6 | 66 |
| Nenets Autonomous Area | 93.7 | 97.6 | 95.5 | 73 |
| Republic of Karelia | 100.2 | 98.8 | 94.5 | 77 |
| Murmansk Region | 97.5 | 99.7 | 88.6 | 83 |
| Mining | | | | |
| Russian Federation | 99.0 | 99.5 | 98.4 | - |
| Northwestern Federal District | 97.2 | 99.2 | 95.3 | 7 |
| Republic of Karelia | 100.8 | 98.8 | 99.3 | 30 |
| Murmansk Region | 103.6 | 95.8 | 99.3 | 30 |
| Kaliningrad Region | 95.9 | 97.1 | 96.7 | 48 |
| Komi Republic | 99.4 | 100.4 | 96.2 | 52 |
| Nenets Autonomous Area | 93.5 | 97.4 | 95.5 | 59 |
| Vologda Region | 97.1 | 93.6 | 94.7 | 61 |
| Novgorod Region | 90.7 | 84.1 | 89.4 | 70 |
| Pskov Region | 95.4 | 106.3 | 89.4 | 70 |
| Leningrad Region | 108.5 | 99.1 | 81.7 | 81 |
| Arkhangelsk Region | 92.0 | 101.1 | 78.6 | 83 |
| Saint Petersburg | 85.6 | 146.1 | 72.7 | 84 |
| Manufacturing | | | | |
| Russian Federation | 108.7 | 109.1 | 103.6 | - |
| Northwestern Federal District | 108.6 | 110.8 | 102.4 | 3 |
| Kaliningrad Region | 97.1 | 103.2 | 111.2 | 8 |
| Novgorod Region | 103.4 | 102.5 | 110.0 | 9 |
| Saint Petersburg | 115.1 | 118.9 | 107.0 | 13 |
| Arkhangelsk Region | 99.6 | 109.8 | 104.2 | 22 |
| Nenets Autonomous Area | 108.4 | 120.3 | 102.7 | 29 |
| Vologda Region | 106.1 | 101.3 | 102.5 | 30 |
| Komi Republic | 104.3 | 98.1 | 101.9 | 32 |
| Pskov Region | 110.0 | 108.5 | 101.6 | 35 |
| Leningrad Region | 110.6 | 110.4 | 95.2 | 71 |
| Republic of Karelia | 98.2 | 98.9 | 90.5 | 80 |
| Murmansk Region | 94.2 | 100.7 | 81.8 | 83 |

*Here and throughout, R denotes the rank of the respective region among all federal subjects (and for the NWFD, among federal districts) based on the indicator's performance in January–December 2025, unless otherwise specified. Rankings exclude statistical data for the Donetsk People's Republic (DPR), Lugansk People's Republic (LPR), Zaporozhye Region, and Kherson Region.

***Industrial output*** in the NWFD continued to expand, posting a 0.6% increase for the year as a whole – somewhat below the nationwide growth rate of 1.3% *(Tab. 2)*. Several NWFD regions recorded substantial gains in industrial production, most notably the Novgorod Region, the Kaliningrad Region, and the city of Saint Petersburg (up 9.0, 8.8, and 5.4%, respectively). In the Arkhangelsk Region, however, industrial output remained flat, while half of the regions in the NWFD saw declines – most sharply in the Murmansk Region and the Republic of Karelia (down 11.4 and 5.5%, respectively).

***Manufacturing output*** in the Northwestern Federal District (NWFD) continued to expand, though the growth rate slowed markedly compared to the previous year (2.4% vs 10.8%). A similar trend was observed nationwide, where overall manufacturing growth decelerated to 3.6% from 9.1% a year earlier, yet the sector remained the primary driver of industrial expansion[4]. Manufacturing posted positive dynamics across most regions of the district, with the Kaliningrad Region and the Novgorod Region each recording growth in excess of 10%. At the same time, output in this sector contracted in the Murmansk Region, the Republic of Karelia, and the Leningrad Region, by 18.2, 9.5, and 4.9%, respectively.

***Mining and quarrying output*** in the NWFD declined more steeply than the national average (down 4.7% vs 1.6% for Russia as a whole). The downturn affected enterprises in every region of the district, with three regions – Saint Petersburg, the Arkhangelsk Region, and the Leningrad Region – posting some of the sharpest declines nationwide (down 27.3%, 21.4%, and 18.3%, respectively).

[4] Ministry of Economic Development of the Russian Federation. About the current situation in the Russian economy. Results of 2025 Available at: https://www.economy.gov.ru/material/file/download/021bb908e9cb3b7fd5d6481b0cef1cfb/o_tekushchey_situacii_v_rossiyskoy_ekonomike_itogi_2025 (accessed: 16.03.2026).

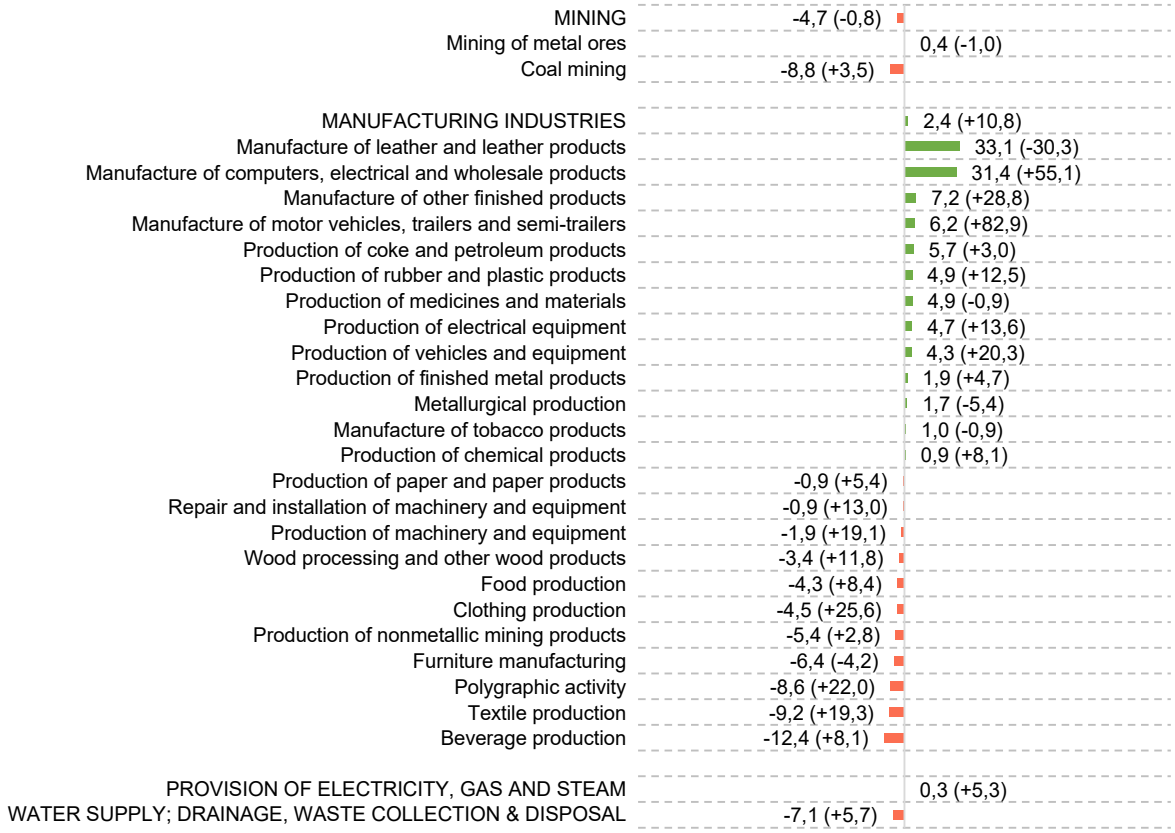



**Figure 4. Growth in Industrial Output in the NWFD, January–December 2025, % Change from January–December 2024**

Note: Figures in parentheses indicate the change in the indicator for January–December 2024 relative to January–December 2023, in %.

The lack of publicly available data on crude oil and natural gas production[5] complicates a full assessment of the sector's performance. However, given that oil and gas account for roughly 60% of total NWFD extraction, the composite mining index suggests that output has contracted substantially. Some insight can be gleaned from Deputy Prime Minister Alexander Novak's statement that nationwide crude oil production edged down by just 0.77% over the year to 512 million metric tons – its lowest level in 16 years[6]. Coal production fell by 8.8%, reversing a 3.5% gain a year earlier *(Fig. 4)*. By contrast, the extraction of metal ores increased by 0.4%.

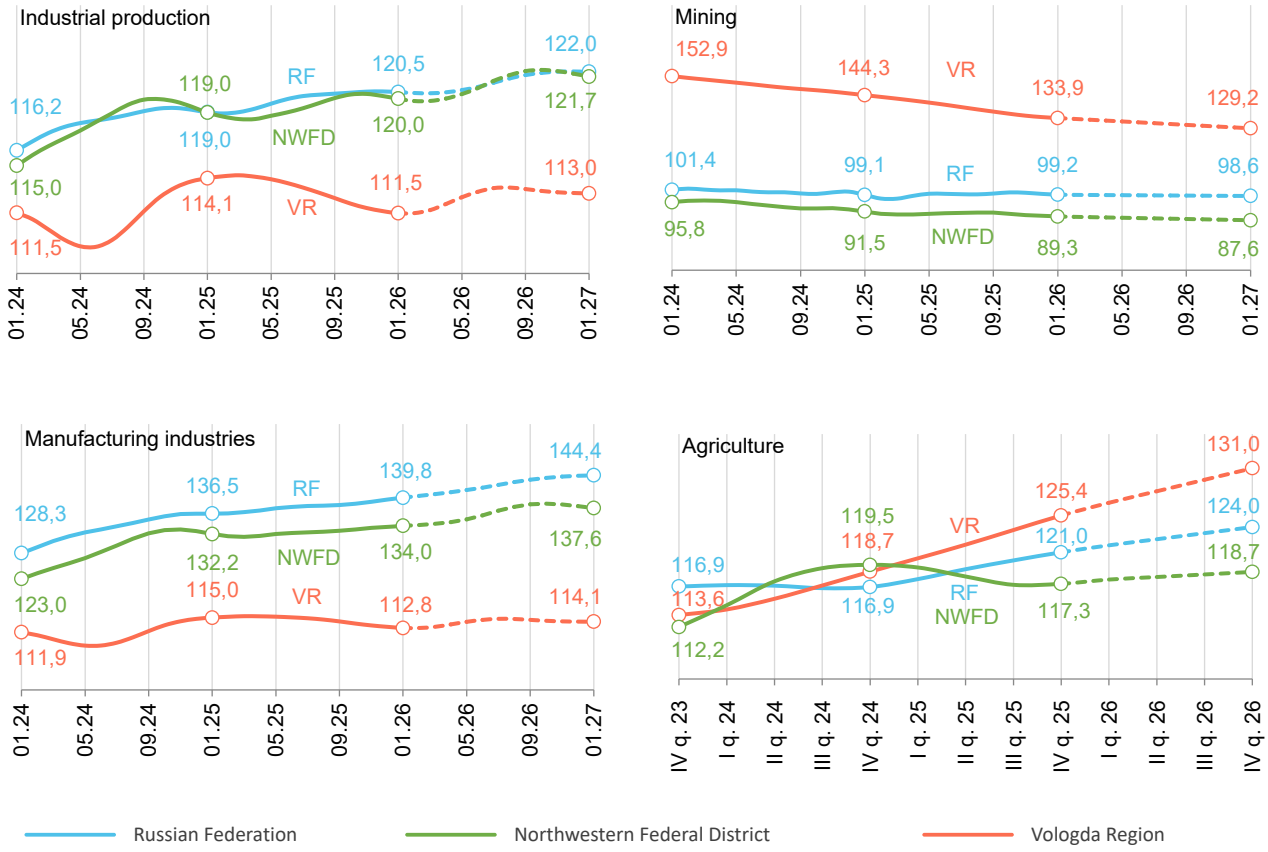
Sectoral trends in NWFD manufacturing point to a deceleration of positive momentum. ***Manufacturing industries producing intermediate goods*** in the NWFD expanded their output. Production of coke and refined petroleum products rose by 5.7%; pharmaceuticals and medicinal materials, by 4.9%; fabricated metal products and chemicals, by 1.7% and 0.9%, respectively. Meanwhile, output in the wood-processing industry fell by 3.4%.

Several ***manufacturing industries geared toward final consumer demand*** in the NWFD recorded declines. Notably, production of beverages and food products contracted by 12.4% and 4.3%, respectively; textiles, by 9.2%;

[5] Rosstat has stopped publishing data on oil production. Available at: https://www.rbc.ru/economics/26/04/2023/64492a769a794789b8b0feec (accessed: 17.03.2026).

[6] Novak announced a decrease in oil production in Russia. Available at: https://www.interfax.ru/business/1069004 (accessed: 16.03.2026).

**Trends in the development of industrial and agricultural production, 2024–2027, % of 2018 level**




furniture, by 6.4%; and wearing apparel, by 4.5%. At the same time, the manufacture of leather and leather products surged by 33.1% (following a 30.3% drop the previous year), while output of other finished goods rose by 7.2%, and rubber and plastic products grew by 4.9%.

***Manufacturing industries serving investment demand*** in the NWFD presented a mixed picture. Strong growth in the production of computers, electronic and optical products (up 31.4%), as well as motor vehicles, trailers, and semi-trailers (up 6.2%), contrasted with declines in the manufacture of other non-metallic mineral products (down 5.4%) and machinery and equipment (down 1.9%). This divergence may reflect corporate efforts to draw down inventories of raw materials and components[7], coupled with a broader slowdown in investment activity.

*Rosatom's fuel division (managed by TVEL JSC) has launched pilot operations at Russia's first "gigafactory" for energy storage systems, located in the Nemansky District of Kaliningrad Region. The facility boasts an annual production capacity of 4 GWh – equivalent to roughly 1.5 million charging modules or 50,000 traction batteries for electric vehicles. It is the country's sole large-scale, full-cycle industrial producer of lithium-ion batteries, spanning everything from primary battery chemistry to finished modules and complete battery packs. At the pilot operation stage, the plant employs 334 specialists; once full design capacity is reached, headcount is expected to increase by a factor of 3.5. Procurement from local suppliers has already exceeded*

[7] Quarterly GDP forecast 01.2026. Available at: https://ecfor.ru/publication/kvartalnyj-prognoz-vvp-vypusk-69/ (accessed: 16.03.2026).

*4 billion rubles, encompassing reinforced concrete products, steel structures, ready-mix concrete, specialized equipment rental, and other items*[8].

Agricultural output in the NWFD declined by 1.6%, even as nationwide production rose by 4.9% *(Tab. 3)*. Most regions within the district recorded a drop in agricultural production, with the Murmansk Region and the Kaliningrad Region posting declines of 19.8 and 6.3%, respectively. At the same time, several NWFD regions increased their agricultural output, with the Vologda Region leading the way (up 5.2%).

**Table 3. Agricultural production dynamics, % change from corresponding period of previous year**

| Territory | 2023 | 2024. | 2025 | R |
|---|---|---|---|---|
| Russian Federation | 100.2 | 96.7 | 104.9 | - |
| Northwestern Federal District | 100.8 | 107.5 | 98.4 | 7 |
| Vologda Region | 101.7 | 102.2 | 105.2 | 32 |
| Arkhangelsk Region | 101.5 | 99.3 | 102.3 | 51 |
| Novgorod Region | 99.6 | 100.5 | 102.0 | 52 |
| Republic of Karelia | 99.9 | 97.9 | 100.5 | 59 |
| Komi Republic | 94.6 | 104.1 | 99.8 | 63 |
| Leningrad Region | 101.1 | 101.7 | 98.2 | 65 |
| Pskov Region | 98.7 | 132.4 | 95.8 | 67 |
| Nenets Autonomous Area | 102.8 | 92.3 | 95.4 | 69 |
| Kaliningrad Region | 103.2 | 107.6 | 93.7 | 74 |
| Murmansk Region | 106.1 | 102.3 | 80.2 | 84 |

Positive momentum in the ***labor market*** showed signs of slowing.

The unemployment rate in the NWFD during October – December 2025 remained unchanged from the same period a year earlier, at 2.0%. Nationwide, the rate edged down by 0.1 percentage points to 2.2% (Tab. 4). Half of the regions in the district recorded a decline in unemployment, with Novgorod Region posting a drop to 0.8% – the lowest level in the entire country. Meanwhile, unemployment remained flat in the Leningrad Region and Saint Petersburg, and several regions – including the Nenets Autonomous Area, the Komi Republic, and the Arkhangelsk Region – saw unemployment begin to rise again.

**Table 4. Labor market trends, % change from corresponding period of previous year**

| Territory | Oct.–Dec. 2023 | Oct.–Dec. 2024 | Oct.–Dec. 2025 | R* |
|---|---|---|---|---|
| Unemployment rate, % of labor force | | | | |
| Russian Federation | 2.9 | 2.3 | 2.2 | - |
| Northwestern Federal District | 2.5 | 2.0 | 2.0 | 4 |
| Novgorod Region | 1.7 | 1.2 | 0.8 | 1 |
| Saint Petersburg | 1.5 | 1.5 | 1.5 | 21 |
| Vologda Region | 2.9 | 2.0 | 1.7 | 33 |
| Kaliningrad Region | 2.9 | 2.2 | 1.9 | 48 |
| Pskov Region | 2.6 | 2.3 | 2.1 | 57 |
| Murmansk Region | 2.6 | 2.5 | 2.4 | 62 |
| Republic of Karelia | 5.2 | 3.8 | 2.8 | 69 |
| Arkhangelsk Region | 5.1 | 2.0 | 2.8 | 68 |
| Leningrad Region | 2.8 | 2.8 | 2.8 | 65 |
| Komi Republic | 4.0 | 3.1 | 3.3 | 73 |
| Nenets Autonomous Area | 5.8 | 3.3 | 3.6 | 77 |
| Territory | 2023 | 2024 | 2025 | R |
| Employer demand for workers | | | | |
| Russian Federation | 117.2 | 117.3 | 100.9 | - |
| Northwestern Federal District | 117.7 | 114.4 | 102.0 | 4 |
| Pskov Region | 111.6 | 117.7 | 107.9 | 17 |
| Leningrad Region | 123.2 | 126.4 | 105.1 | 24 |
| Saint Petersburg | 120.7 | 112.8 | 103.9 | 28 |
| Kaliningrad Region | 111.7 | 114.9 | 103.8 | 29 |
| Nenets Autonomous Area | 116.4 | 106.8 | 103.3 | 33 |
| Vologda Region | 118.2 | 126.3 | 102.8 | 38 |
| Republic of Karelia | 114.5 | 109.6 | 98.6 | 58 |
| Komi Republic | 112.3 | 109.5 | 96.1 | 70 |
| Novgorod Region | 124.4 | 126.9 | 95.2 | 73 |
| Arkhangelsk Region | 116.0 | 111.3 | 93.4 | 79 |
| Murmansk Region | 104.0 | 99.9 | 91.7 | 80 |

* For the "Unemployment rate" indicator, R denotes the rank of the respective region among all federal subjects (and for the NWFD, among federal districts) based on the indicator's performance in October–December 2025. Rankings exclude statistical data for the Donetsk People's Republic (DPR), Lugansk People's Republic (LPR), Zaporozhye Region, and Kherson Region.

[8] Rosatom has launched Russia's first "gigafactory" of lithium-ion energy storage devices. Available at: https://atommedia.online/press-releases/rosatom-zapustil-pervuyu-v-rossii-gigafabriku-litiyionnykh-nakopiteley-energii/ (accessed: 15.03.2026).

The volume of job vacancies reported by employers to public employment services in the NWFD, as in Russia as a whole, posted an increase (up 2.0% and 0.9%, respectively). Although the positive trend in this indicator was substantially weaker than in previous years, the share of enterprises reporting labor shortages declined[9]. Half of the regions in the district recorded an uptick in advertised vacancies, most notably the Pskov Region and the Leningrad Region (up 7.9 and 5.1%, respectively). By contrast, the remaining regions of the NWFD saw a reduction in registered vacancies – down 8.3% in the Murmansk Region and 6.6% in the Arkhangelsk Region.

**2. Income generation**

Trends in the income generation phase were characterized by rising household and budget revenues, set against a backdrop of deteriorating financial conditions for entrepreneurs.

***Real disposable personal income*** in the NWFD and across the Russian Federation increased by similar margins (8.0% and 7.7%, respectively). Growth in this indicator was recorded in all regions of the district, with Leningrad Region and Saint Petersburg serving as the primary locomotives for the macro-region, each posting an increase of 9.9% *(Tab. 5)*.

***Real accrued wages*** in the NWFD rose by 3.1% (compared to a 4.4% increase nationwide). At the same time, the observed deceleration in wage growth signals the beginning of a shift from a labor market favoring employees to one favoring employers[10]. According to a Central Bank survey, companies are planning more moderate wage indexation in 2026 relative to the 2023–2025 period, as wage growth continues to outpace gains in labor productivity[11]. The slowdown in positive wage dynamics is evident across all regions of the district, with four regions ranking at the very bottom nationally in terms of this indicator: the Murmansk Region, the Komi Republic, the Republic of Karelia, and the Nenets Autonomous Area recorded wage increases ranging from just 0.2 to 0.5%

**Table 5. Trends in household income generation, % change from corresponding period of previous year**

| Territory | 2023 | 2024 | 2025 | R |
|---|---|---|---|---|
| Real disposable personal income | | | | |
| Russian Federation | 106.5 | 109.9 | 107.7 | - |
| Northwestern Federal District | 105.4 | 111.1 | 108.0 | 2 |
| Leningrad Region | 107.3 | 112.1 | 109.9 | 3 |
| Saint Petersburg | 104.2 | 113.8 | 109.9 | 3 |
| Republic of Karelia | 107.9 | 108.4 | 108.7 | 12 |
| Pskov Region | 106.8 | 107.9 | 108.5 | 14 |
| Novgorod Region | 106.5 | 109.3 | 107.6 | 26 |
| Nenets Autonomous Area | 105.0 | 106.3 | 106.1 | 42 |
| Kaliningrad Region | 106.9 | 112.3 | 106.0 | 44 |
| Vologda Region | 107.4 | 111.1 | 104.6 | 72 |
| Komi Republic | 103.4 | 103.7 | 104.0 | 77 |
| Arkhangelsk Region | 105.9 | 104.8 | 103.8 | 79 |
| Murmansk Region | 107.3 | 104.3 | 101.4 | 85 |
| Real accrued wages | | | | |
| Russian Federation | 108.2 | 109.7 | 104.4 | - |
| Northwestern Federal District | 106.1 | 107.8 | 103.1 | 5 |
| Leningrad Region | 107.2 | 112.3 | 106.3 | 15 |
| Pskov Region | 109.3 | 114.0 | 105.9 | 19 |
| Kaliningrad Region | 108.6 | 111.0 | 104.9 | 29 |
| Novgorod Region | 111.0 | 110.0 | 104.5 | 34 |
| Arkhangelsk Region | 106.2 | 104.5 | 104.0 | 41 |
| Saint Petersburg | 105.2 | 106.5 | 102.8 | 63 |
| Vologda Region | 103.7 | 111.7 | 102.0 | 66 |
| Nenets Autonomous Area | 104.4 | 107.0 | 100.5 | 80 |
| Republic of Karelia | 108.2 | 106.3 | 100.4 | 81 |
| Komi Republic | 106.6 | 106.0 | 100.4 | 81 |
| Murmansk Region | 106.0 | 106.0 | 100.2 | 84 |

[9] Press release of the Central Bank dated December 19, 2025. Available at: https://www.cbr.ru/press/pr/?file=19122025_133000key.htm (accessed: 16.03.2026).

[10] The labor market is going to face the optimization of personnel costs and a slowdown in salary growth. Available at: https://www.vedomosti.ru/economics/articles/2026/01/19/1170051-rinok-truda-zhdet-optimizatsiya-trat-na-personal?ysclid=mkkr7mqkoo508284379 (accessed: 16.03.2026).

[11] Press release of the Central Bank dated December 19, 2025. Available at: https://www.cbr.ru/press/pr/?file=19122025_133000key.htm (accessed: 16.03.2026).

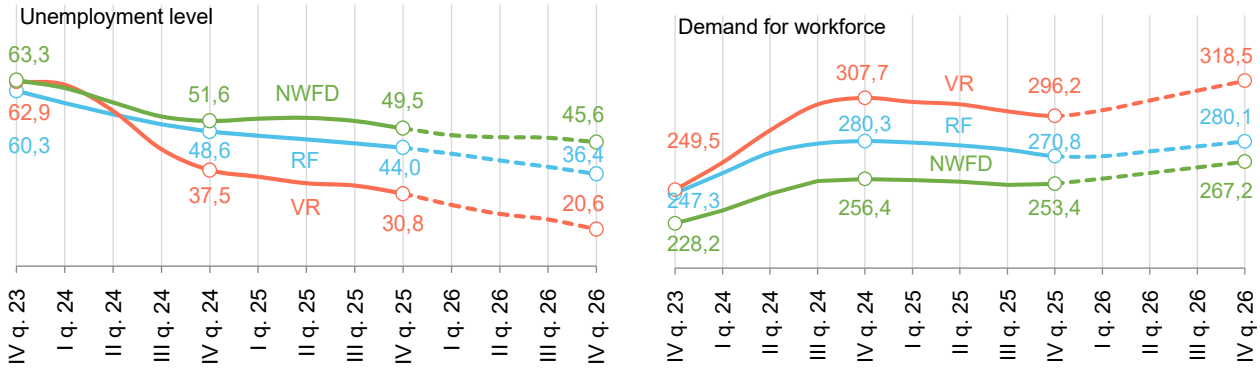
***Real consolidated budget revenues (including territorial state extra-budgetary funds)*** in the NWFD declined by 1.7%, a contraction that affected all regions of the district except Kaliningrad Region and Saint Petersburg, which recorded increases of 2.5% and 0.8%, respectively *(Tab. 6)*. The steepest drops in budget revenues were observed in the Nenets Autonomous Area, the Komi Republic, and the Vologda Region (down 15.1, 11.3, and 10.7%, respectively). Receipts from taxes on entrepreneurial income in the NWFD fell by 14.9% (compared to a 13.4% decline nationwide). Trends in excise tax collections across the NWFD worsened by 1.6% overall. Personal income tax (PIT) receipts in the macro-region grew by 3.5%, with increases recorded in the majority of the district's regions – most notably in the Novgorod Region, where the indicator surged by 14.9%. However, several NWFD regions saw PIT revenues decline, with the sharpest drop occurring in the Vologda Region (down 10.6%). Nationwide, real consolidated budget revenues rose by 0.6%, buoyed importantly by a 5.7% increase in PIT collections. The national trend in excise tax receipts also improved marginally, by 0.8%.

***Taxes, duties, and other mandatory payments collected for the consolidated budget of the Russian Federation*** from NWFD regions increased by 2.7%, compared to a nationwide rise of 0.9%. A significant factor behind this development was growth in half of the district's regions, including jumps of 33.6% in the Novgorod Region and 27.4% in the Kaliningrad Region. In the remaining NWFD regions, however, tax collections contracted – most acutely in the Vologda Region (down 29.4%), one of whose core specializations is the production of metal goods.

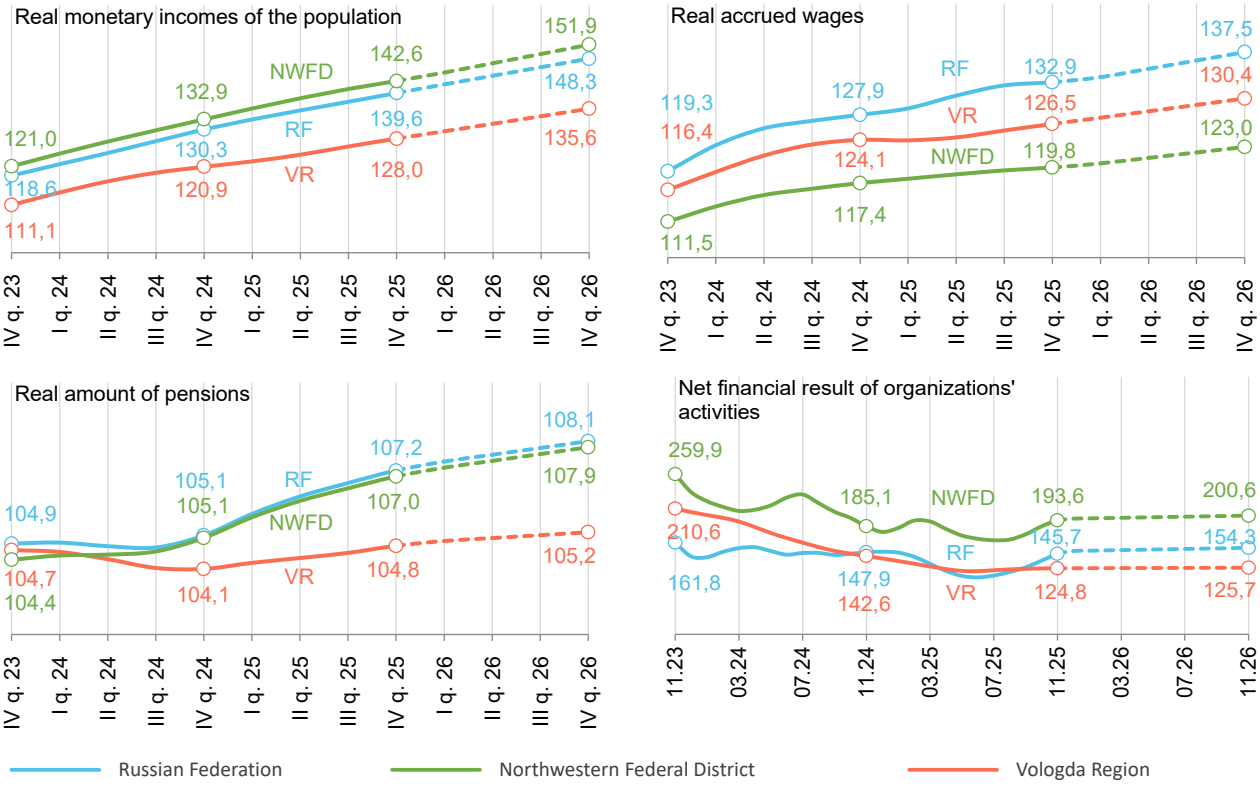
**Table 6. Trends in business and government revenue generation, % change from corresponding period of previous year**

| Territory | 2023 | 2024 | 2025 |
|---|---|---|---|
| Consolidated budget revenues (including territorial state extra-budgetary funds) | | | |
| Russian Federation | 105.2 | 101.2 | 100.6 |
| Northwestern Federal District | 97.0 | 102.5 | 98.3 |
| Kaliningrad Region | 90.7 | 109.6 | 102.5 |
| Saint Petersburg | 93.4 | 106.9 | 100.8 |
| Leningrad Region | 118.8 | 101.7 | 99.0 |
| Republic of Karelia | 97.5 | 96.6 | 98.7 |
| Arkhangelsk Region | 89.9 | 98.7 | 98.7 |
| Novgorod Region | 102.0 | 88.2 | 97.6 |
| Murmansk Region | 108.0 | 93.9 | 96.5 |
| Pskov Region | 107.2 | 95.2 | 91.8 |
| Vologda Region | 100.8 | 94.5 | 89.3 |
| Komi Republic | 86.3 | 98.6 | 88.7 |
| Nenets Autonomous Area | 79.6 | 117.0 | 84.9 |
| Taxes, duties, and other mandatory payments to the consolidated budget of the Russian Federation | | | |
| Russian Federation | 100.3 | 109.7 | 100.9 |
| Northwestern Federal District | 114.0 | 98.0 | 102.7 |
| Novgorod Region | 93.6 | 84.2 | 133.6 |
| Kaliningrad Region | 71.2 | 131.7 | 127.4 |
| Pskov Region | 119.5 | 106.3 | 110.3 |
| Arkhangelsk Region | 84.9 | 105.8 | 106.6 |
| Saint Petersburg | 132.4 | 110.8 | 106.4 |
| Leningrad Region | 127.2 | 96.4 | 105.9 |
| Murmansk Region | 216.7 | 54.3 | 99.2 |
| Republic of Karelia | 106.0 | 114.0 | 93.7 |
| Komi Republic | 90.1 | 53.6 | 82.2 |
| Nenets Autonomous Area | 46.2 | 116.5 | 77.2 |
| Vologda Region | 145.4 | 77.6 | 70.6 |
| Territory | 11 months of 2023 | 11 months of 2024 | 11 months of 2025 |
| Balanced financial result of organizations | | | |
| Russian Federation | 127.2 | 78.5 | 85.5 |
| Northwestern Federal District | 107.4 | 73.0 | 83.2 |
| Novgorod Region | 81.5 | 1.1 | 64 p. |
| Murmansk Region | 86.2 | 10.2 | 197.1 |
| Saint Petersburg | 119.4 | 54.4 | 103.8 |
| Pskov Region | 152.6 | 112.0 | 88.1 |
| Arkhangelsk Region | 72.5 | 93.3 | 84.0 |
| Leningrad Region | 112.0 | 123.5 | 75.8 |
| Kaliningrad Region | 125.5 | 214.8 | 71.9 |
| Komi Republic | 101.5 | 77.8 | 61.9 |
| Vologda Region | 90.3 | 60.0 | 35.0 |
| Nenets Autonomous Area | 32.4 | 54.0 | 20.7 |
| Republic of Karelia | 51.0 | 150.8 | 14.7 |

**Labor market development trends, 2023–2026, % of 2018 level**




**Income generation trends in the economy, 2023–2026, % of 2018 level**




***The balanced financial result*** of organizations in the NWFD continued to contract in January–November 2025, falling by 17.8% relative to the same period a year earlier – when a decline of 27% had already been recorded. The nationwide picture was somewhat better, with a drop of 14.5% following a 21.5% decrease the previous year. The deterioration in financial performance was evident across enterprises in nearly all regions of the district. At first glance, the Novgorod Region, the Murmansk Region, and Saint Petersburg appear to be exceptions, having posted increases of 64-fold, nearly twofold, and 3.8%, respectively. In each of these cases, however, the upturn was preceded by a deep slump.

### 3. Final use

***Consumer demand*** is serving as a key stabilizing factor, underpinning economic growth even as business incomes contract.

***Retail trade turnover*** in the NWFD expanded by 2.0% *(Tab. 7)*. Nationwide, retail trade turnover rose by 2.6%, with food retail growing by 2.2%

and non-food retail by 3.1%. In the NWFD, non-food retail turnover increased by 0.8%, despite a 2.9% decline in Saint Petersburg. The Vologda Region led the macro-region in non-food retail growth, posting a 16.1% increase. Food retail turnover in the NWFD grew by 4.0%, with the strongest gains recorded in Saint Petersburg and the Leningrad Region (up 6.8 and 6.4%, respectively). This indicator was weighed down, however, by declines in the Vologda Region and the Murmansk Region (down 3.4 and 1.4%, respectively).

**Table 7. Consumer market trends, % change from corresponding period of previous year**

| Territory | 2023 | 2024 | 2025 | R |
|---|---|---|---|---|
| Retail trade turnover | | | | |
| Russian Federation | 108.0 | 107.7 | 102.6 | - |
| Northwestern Federal District | 113.1 | 106.5 | 102.0 | 7 |
| Republic of Karelia | 112.2 | 101.3 | 106.4 | 11 |
| Komi Republic | 105.8 | 107.3 | 105.5 | 13 |
| Vologda Region | 102.6 | 106.0 | 105.2 | 16 |
| Leningrad Region | 114.4 | 106.7 | 104.8 | 20 |
| Kaliningrad Region | 107.5 | 112.2 | 103.5 | 34 |
| Novgorod Region | 102.9 | 106.2 | 103.0 | 43 |
| Pskov Region | 102.3 | 108.1 | 101.3 | 67 |
| Saint Petersburg | 119.2 | 107.2 | 100.5 | 73 |
| Nenets Autonomous Area | 103.7 | 102.9 | 100.4 | 75 |
| Arkhangelsk Region | 102.8 | 100.0 | 100.4 | 75 |
| Murmansk Region | 101.1 | 102.7 | 98.9 | 82 |
| Volume of paid services to households | | | | |
| Russian Federation | 106.9 | 104.3 | 102.8 | - |
| Northwestern Federal District | 110.2 | 102.4 | 104.2 | 2 |
| Saint Petersburg | 115.3 | 100.7 | 106.0 | 13 |
| Leningrad Region | 110.2 | 109.9 | 105.7 | 15 |
| Kaliningrad Region | 107.8 | 108.5 | 103.9 | 24 |
| Republic of Karelia | 104.8 | 102.7 | 101.6 | 54 |
| Pskov Region | 101.7 | 101.9 | 101.6 | 54 |
| Nenets Autonomous Area | 92.9 | 103.3 | 100.9 | 64 |
| Vologda Region | 100.5 | 102.3 | 100.7 | 68 |
| Novgorod Region | 100.3 | 100.5 | 100.7 | 68 |
| Murmansk Region | 101.1 | 100.8 | 100.1 | 74 |
| Arkhangelsk Region | 105.1 | 104.9 | 100.0 | 75 |
| Komi Republic | 98.3 | 101.2 | 99.1 | 80 |
| Consumer price index (to December of the previous year) | | | | |
| Russian Federation | 107.4 | 109.5 | 105.6 | - |
| Northwestern Federal District | 107.1 | 109.3 | 105.8 | 5 |
| Arkhangelsk Region | 109.0 | 108.1 | 104.7 | 6 |
| Saint Petersburg | 106.8 | 109.5 | 104.8 | 7 |
| Komi Republic | 107.3 | 109.3 | 105.9 | 34 |
| Vologda Region | 107.8 | 110.0 | 106.3 | 53 |
| Republic of Karelia | 107.7 | 108.6 | 106.4 | 55 |
| Novgorod Region | 106.9 | 109.2 | 106.7 | 63 |
| Pskov Region | 106.0 | 108.5 | 106.9 | 67 |
| Nenets Autonomous Area | 104.6 | 106.3 | 107.1 | 72 |
| Leningrad Region | 106.0 | 109.3 | 107.2 | 74 |
| Kaliningrad Region | 108.2 | 110.3 | 108.0 | 83 |
| Murmansk Region | 107.9 | 108.2 | 108.2 | 84 |
| Producer price index for industrial goods (to December of the previous year) | | | | |
| Russian Federation | 119.2 | 107.9 | 96.7 | - |
| Northwestern Federal District | 111.0 | 108.0 | 99.3 | 5 |
| Nenets Autonomous Area | 173.9 | 98.0 | 61.3 | 1 |
| Komi Republic | 124.3 | 108.0 | 88.5 | 8 |
| Vologda Region | 119.8 | 102.8 | 92.1 | 10 |
| Republic of Karelia | 130.6 | 109.1 | 95.6 | 18 |
| Kaliningrad Region | 108.8 | 108.4 | 101.3 | 37 |
| Leningrad Region | 108.2 | 112.6 | 101.9 | 38 |
| Arkhangelsk Region | 108.3 | 109.5 | 102.7 | 47 |
| Novgorod Region | 108.5 | 105.4 | 105.9 | 60 |
| Murmansk Region | 97.7 | 112.8 | 106.6 | 63 |
| Pskov Region | 114.5 | 109.7 | 106.9 | 65 |
| Saint Petersburg | 105.9 | 105.4 | 111.5 | 78 |

The volume of ***paid services*** provided to households in the NWFD increased by 4.2% (compared to 2.8% nationwide). Most regions of the district recorded growth, with Saint Petersburg and the Leningrad Region leading the way (up 6.0% and 5.7%, respectively). The only exceptions were the Arkhangelsk Region, where the volume of services remained flat, and the Komi Republic, which posted a decline of 0.9%.

***Consumer inflation*** in the NWFD was broadly in line with the national average (5.8 vs 5.6%, respectively). Food prices rose by 5.2% both in the federal district and across Russia as a whole. Non-food price increases were more moderate, at 4.2% in the macro-region and 3.0% nationally. Housing and utilities tariffs climbed by 11.9% in both the NWFD and the country overall. Consumer prices for services increased by 8.6% in the macro-region and 9.3% nationwide.

***Producer prices for industrial goods*** in the NWFD decreased by 0.7% overall, while the nationwide decline stood at 3.3%. A sharp drop in industrial product prices was recorded in the Nenets Autonomous Area (down 38.7%), ranking the region first in the country in terms of the magnitude of this decline. Prices also fell for industrial output in the Komi Republic, the Vologda Region, and the Republic of Karelia (down 11.5, 7.9, and 4.4%, respectively). In the remaining NWFD regions, producer prices for industrial goods rose, with the most pronounced increase observed in Saint Petersburg (up 11.5%).

The volume of *construction work* completed in the NWFD and the Russian Federation expanded by 4.3 and 2.5%, respectively *(Tab. 8)*. Among the regions of the district, the Leningrad Region, the Republic of Karelia, and Saint Petersburg recorded increases (up 40.3, 13.8, and 1.0%, respectively). The remaining regions saw declines in construction activity, most notably in the Nenets Autonomous Area, the Murmansk Region, and the Pskov Region (down 56.8, 49.4, and 26.7%, respectively). It should be noted that the observed trends in the volume of construction work may reflect the completion of existing projects rather than the current intensity of ongoing construction activity[12].

***Housing completions*** in the NWFD posted a strong growth rate relative to the national average (3.4% vs 0.4%), driven by positive dynamics in the majority of regions. The Pskov Region, however, saw a sharp decline of 11.7%.

***The volume of mortgage loans issued*** contracted substantially in both the NWFD and the country as a whole, by 10.2 and 13.7%, respectively. This downturn affected nearly all regions of the district, with mortgage lending shrinking by between 8.7 and 19.0%. The only exceptions were the Nenets Autonomous Area and the Leningrad Region, which recorded increases of 4.3 and 0.4%,

**Table 8. Construction sector trends, % change from corresponding period of previous year**

| Territory | 2023 | 2024 | 2025 | R |
|---|---|---|---|---|
| Volume of work in TEA "Construction" | | | | |
| Russian Federation | 109.0 | 103.8 | 102.5 | - |
| Northwestern Federal District | 106.1 | 109.6 | 104.3 | 3 |
| Leningrad Region | 112.5 | 150.9 | 140.3 | 4 |
| Republic of Karelia | 114.0 | 76.0 | 113.8 | 18 |
| Saint Petersburg | 107.7 | 105.0 | 101.0 | 39 |
| Arkhangelsk Region | 132.6 | 76.6 | 99.1 | 45 |
| Vologda Region | 102.4 | 110.2 | 98.8 | 46 |
| Komi Republic | 89.4 | 130.8 | 96.2 | 50 |
| Novgorod Region | 109.1 | 98.6 | 85.6 | 64 |
| Kaliningrad Region | 126.5 | 100.7 | 82.7 | 68 |
| Pskov Region | 95.7 | 102.8 | 73.3 | 76 |
| Murmansk Region | 77.0 | 83.2 | 50.6 | 83 |
| Nenets Autonomous Area | 71.6 | 122.6 | 43.2 | 85 |
| Housing completions | | | | |
| Russian Federation | 107.5 | 97.6 | 100.4 | - |
| Northwestern Federal District | 101.7 | 91.3 | 103.4 | 3 |
| Murmansk Region | 33.7 | 118.9 | 134.8 | 6 |
| Novgorod Region | 109.6 | 89.6 | 118.8 | 11 |
| Nenets Autonomous Area | 60.8 | 116.2 | 118.5 | 13 |
| Vologda Region | 115.1 | 91.5 | 118.0 | 14 |
| Leningrad Region | 105.5 | 97.1 | 103.8 | 37 |
| Republic of Karelia | 100.8 | 106.9 | 101.9 | 39 |
| Saint Petersburg | 100.2 | 76.6 | 100.8 | 46 |
| Arkhangelsk Region | 103.3 | 102.9 | 100.6 | 49 |
| Komi Republic | 107.1 | 104.6 | 100.2 | 52 |
| Kaliningrad Region | 92.3 | 100.3 | 100.0 | 54 |
| Pskov Region | 111.6 | 95.4 | 88.3 | 75 |
| Volume of mortgage loans issued | | | | |
| Russian Federation | 151.9 | 58.3 | 86.3 | - |
| Northwestern Federal District | 136.9 | 61.1 | 89.8 | 1 |
| Nenets Autonomous Area | 124.3 | 59.5 | 104.3 | 5 |
| Leningrad Region | 136.7 | 56.3 | 100.4 | 7 |
| Kaliningrad Region | 181.3 | 65.6 | 91.3 | 21 |
| Saint Petersburg | 130,1 | 62,2 | 90,4 | 25 |
| Pskov Region | 154,9 | 60,0 | 89,1 | 36 |
| Republic of Karelia | 154,8 | 52,1 | 85,9 | 53 |
| Novgorod Region | 146,2 | 57,0 | 85,2 | 46 |
| Murmansk Region | 136,6 | 58,6 | 84,9 | 48 |
| Arkhangelsk Region | 133,3 | 77,7 | 83,4 | 52 |
| Komi Republic | 137,5 | 52,1 | 83,2 | 43 |
| Vologda Region | 152,5 | 56,4 | 81,0 | 65 |

[12] On the dynamics of industrial production. Available at: https://disk.360.yandex.ru/i/vH-A_0xwv8zCtg (accessed: 19.01.2026).

respectively. According to Bank of Russia data, state support programs accounted for 81% of mortgage lending in December 2025. Year-on-year, the number of mortgage loans granted fell by more than a quarter, while the total value of lending declined by only 8.9%[13].

***Real expenditures of the consolidated budget (including territorial state extra-budgetary funds)*** increased by 1.8% in the NWFD and by 4.7% nationwide *(Tab. 9)*. More than half of the regions in the district recorded growth in budget spending, including the Leningrad Region (up 10.2%), the Kaliningrad Region, and the Nenets Autonomous Area (up 6.1 and 4.3%, respectively). At the same time, several regions of the macro-region saw their budget expenditures contract – most sharply in the Murmansk Region (down 7.0%), with three other regions (Pskov, Novgorod, and Vologda) posting declines of 4.4–4.7%. Meanwhile, budget spending on social policy and healthcare resumed growth in both the NWFD and Russia overall: rising by 8.6 and 11.7%, and by 1.1 and 4.6%, respectively.

**Table 9. Consolidated budget expenditure trends (including territorial state extra-budgetary funds), % change from corresponding period of previous year**

| Territory | 2023 | 2024 | 2025 |
|---|---|---|---|
| Russian Federation | 106.4 | 101.5 | 104.7 |
| Northwestern Federal Dis-trict | 102.2 | 104.8 | 101.8 |
| Leningrad Region | 103.5 | 109.4 | 110.2 |
| Kaliningrad Region | 99.0 | 91.9 | 109.3 |
| Nenets Autonomous Area | 95.4 | 96.8 | 106.1 |
| Arkhangelsk Region | 97.9 | 97.2 | 104.3 |
| Komi Republic | 97.6 | 97.3 | 102.5 |
| Republic of Karelia | 94.6 | 91.3 | 102.4 |
| Saint Petersburg | 105.1 | 108.4 | 101.3 |
| Vologda Region | 102.9 | 111.8 | 95.6 |
| Novgorod Region | 110.9 | 93.5 | 95.5 |
| Pskov Region | 104.8 | 92.7 | 95.3 |
| Murmansk Region | 92.1 | 111.7 | 93.0 |

The ***fixed capital investment*** index for the NWFD stood at 104.3, contrasting with a nationwide decline to 97.7 *(Tab. 10)*. The positive overall trend in the macro-region was driven by investment growth in the Leningrad Region, the Vologda Region, and Saint Petersburg (up 29.8, 4.8, and 1.0%, respectively). The remaining NWFD regions recorded declines in investment activity, with the sharpest drops observed in the Komi Republic and the Murmansk Region (down 25.5 and 24.2%, respectively).

**Table 10. Fixed capital investment trends, % change from corresponding period of previous year**

| Territory | 2023. | 2024. | 2025. | R* |
|---|---|---|---|---|
| Russian Federation | 109.8 | 108.4 | 97.7 | - |
| Northwestern Federal District | 108.7 | 118.2 | 104.3 | 2 |
| Leningrad Region | 122.0 | 138.9 | 129.8 | 2 |
| Vologda Region | 87.3 | 136.9 | 104.8 | 16 |
| Saint Petersburg | 110.7 | 112.2 | 101.0 | 31 |
| Nenets Autonomous Area | 94.6 | 117.5 | 99.4 | 38 |
| Republic of Karelia | 92.5 | 92.7 | 95.8 | 42 |
| Kaliningrad Region | 135.1 | 106.5 | 94.7 | 44 |
| Arkhangelsk Region | 100.8 | 89.8 | 85.0 | 67 |
| Novgorod Region | 117.6 | 103.6 | 82.3 | 68 |
| Pskov Region | 101.1 | 136.6 | 80.4 | 73 |
| Murmansk Region | 92.4 | 110.4 | 75.8 | 80 |
| Komi Republic | 98.4 | 115.3 | 74.5 | 82 |

*According to data from the analytical agency AUTOSTAT, a total of 46,905 new heavy-duty trucks were sold in Russia in 2025 (down 54% compared to 2024)[14], alongside 12,345 new medium-duty trucks (down 44% year-on-year)[15] and 87,587 new light commercial vehicles (down 21.9% year-on-year)[16].*

[13] Housing mortgage lending market overview. Available at: https://cbr.ru/statistics/bank_sector/mortgage/Indicator_mortgage/1225/ (accessed: 19.01.2026).

[14] Sales of new high-capacity vehicles (HCVs) in Russia in 2025 and in December. Available at: https://www.autostat.ru/press-releases/61614/ (accessed: 16.03.2026).

[15] Sales of new medium-capacity vehicles (MCVs) in Russia in 2025 and in December. Available at: https://www.autostat.ru/press-releases/61594/ (accessed: 16.03.2026).

[16] Sales of new LCVs in Russia in 2025 and in December. Available at: https://www.autostat.ru/press-releases/61585/ (accessed: 16.03.2026).

According to data from the Federal Customs Service, the total value of Russia's ***exports*** declined by 3.7% in 2025, while ***imports*** fell by 1.4%. Exports to Europe contracted by 16.5%, to Asia by 1.0%, and to Africa by 6.5%. Imports from Europe and Asia decreased by 1.1% and 2.7%, respectively, while imports from Africa surged by 26.1%. Exports of food products decreased by 4.1%, whereas imports of this category rose by 15.0%. The value of mineral product exports fell by 14.8% (yet still accounted for 53.9% of total exports), while imports of mineral products declined by 7.2%. Foreign trade turnover in chemical products and rubber posted gains: the value of exports in this category rose by 21.6%, and imports by 3.8%. Exports of machinery and equipment increased by 26.6%, whereas imports of these goods fell by 7.7%, though they still accounted for slightly less than half of total import value.

***Global market prices*** for crude oil fell by 15.8%, while prices for rolled metal products declined by 9.2% *(Tab. 11)*.

By contrast, phosphate fertilizers rose in price by 21.2%, and natural gas by 9.9%.

**Table 11. Global commodity price trends, % change from corresponding period of previous year**

| Commodity | 2023 | 2024 | 2025 |
|---|---|---|---|
| Phosphate fertilizers (PF) | 71.2 | 102.5 | 121.2 |
| Gas | 32.5 | 83.6 | 109.9 |
| Rolled metal (Metal) | 118.6 | 92.7 | 90.8 |
| Oil | 83.2 | 97.5 | 84.2 |

Global prices for steel products show an upward trend: increases were recorded for both flat products (up 17.7–19.1%) and long products (up 13.9–37.1%; *Tab. 12*). On the domestic market, however, prices declined: flat rolled products fell by 9.1–12.3%, and long products by 16.4–19.2% *(Tab. 13)*.

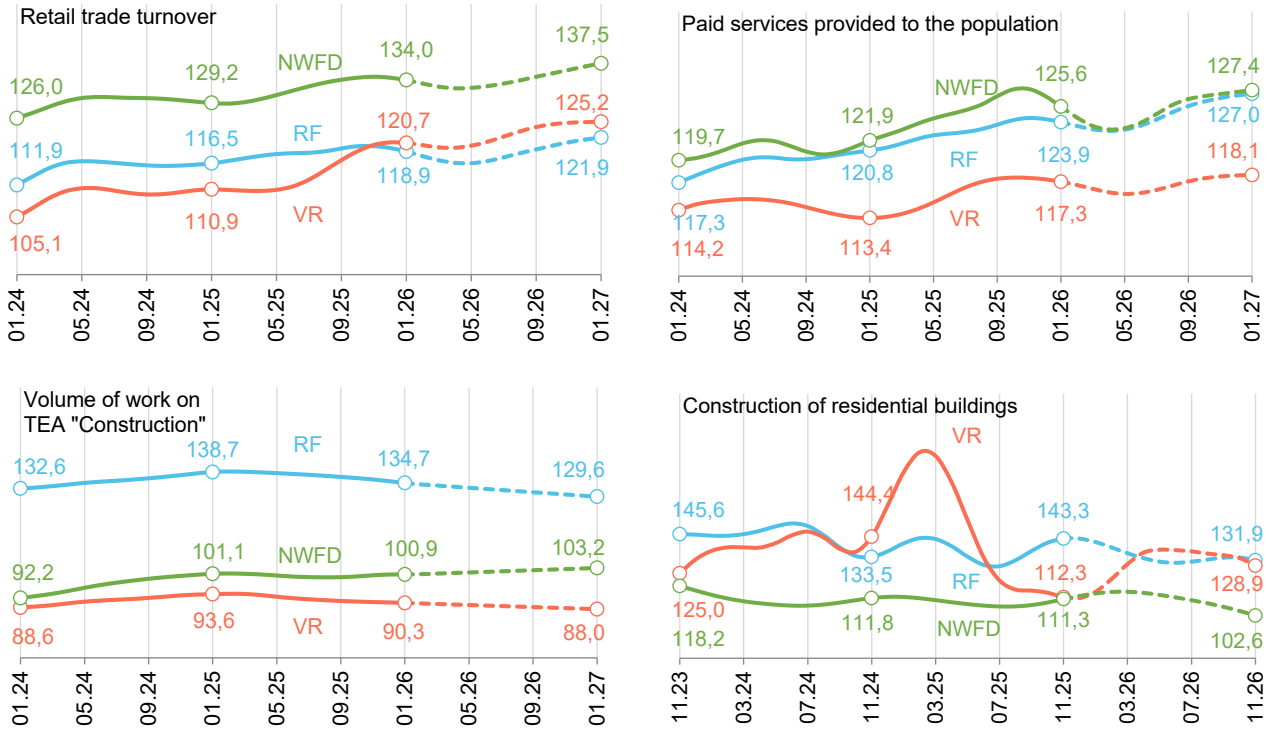
**Table 12. World market prices for steel products (EU countries) per metric ton (as of early February of the respective year)**

| Type of steel product | Unit | 2024 | 2025 | 2026 | 2026, % of | |
|---|---|---|---|---|---|---|
| | | | | | 2025 | 2024 |
| Flat products | | | | | | |
| Cold-rolled sheet | USD | 800 | 690 | 815 | 118.1 | 101.9 |
| Galvanized sheet | USD | 840 | 763 | 898 | 117.7 | 106.8 |
| Hot-rolled sheet | USD | 698 | 588 | 700 | 119.1 | 100.4 |
| Long products | | | | | | |
| Reinforcing steel (rebar) | USD | 763 | 613 | 698 | 113.9 | 91.5 |
| Structural sections | USD | 915 | 700 | 960 | 137.1 | 104.9 |
| Merchant bars | USD | 865 | 700 | 888 | 126.9 | 102.7 |

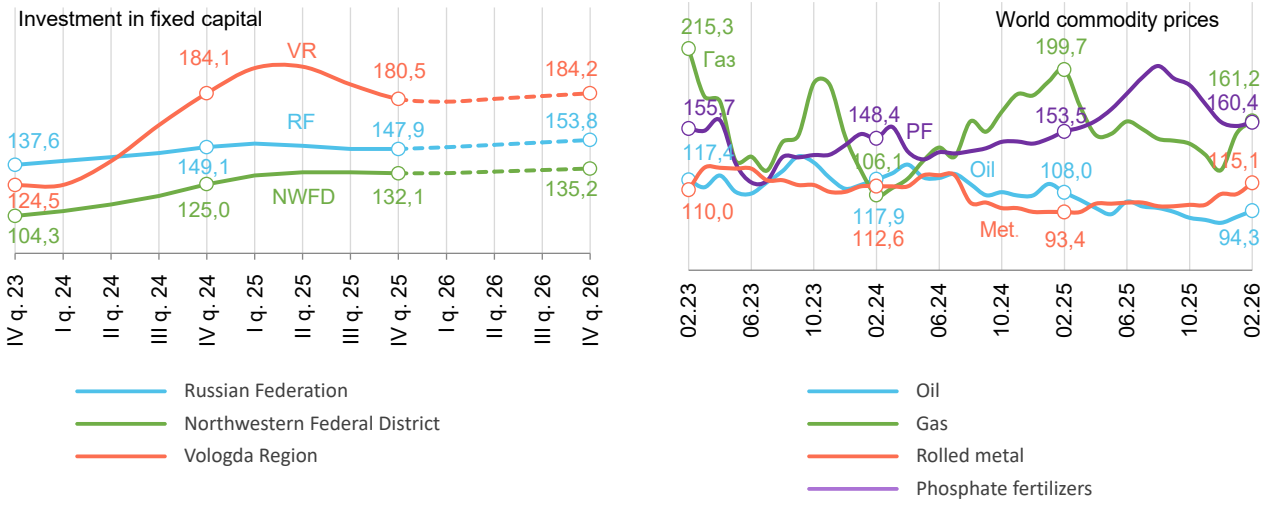
**Table 13. Russian domestic market prices for steel products per metric ton (as of early March of the respective year)**

| Type of steel product | Unit | 2024 | 2025 | 2026 | 2026 % of | |
|---|---|---|---|---|---|---|
| | | | | | 2025 | 2024 |
| Flat products | | | | | | |
| Cold-rolled sheet | RUB | 86500 | 83900 | 75050 | 89.5 | 86.8 |
| Galvanized sheet | RUB | 112350 | 107375 | 94200 | 87.7 | 83.8 |
| Hot-rolled sheet | RUB | 67840 | 61975 | 56350 | 90.9 | 83.1 |
| Long products | | | | | | |
| Rebar | RUB | 65917 | 58075 | 48567 | 83.6 | 73.7 |
| Beams and channels | RUB | 83533 | 81650 | 66813 | 81.8 | 80.0 |
| Round bars | RUB | 63500 | 57500 | 47833 | 83.2 | 75.3 |
| Angles | RUB | 66000 | 60800 | 49100 | 80.8 | 74.4 |

## Consumer market and construction development trends, 2023–2027, % of 2018 level




## Investment activity and foreign trade trends, 2022–2026, % of 2018 level



Summing up, it is worth emphasizing that the economy of the Northwestern Federal District operated throughout 2025 against a backdrop of entrenched economic challenges, while nonetheless exhibiting isolated pockets of positive momentum.

1. The decisive role of domestic demand: continued growth in consumer spending by both households and the state served as the primary locomotive of economic expansion, even as business incomes contracted. It should be noted, however, that several indicators of final consumption were somewhat inflated due to the partial pull-forward of demand from early 2026.

2. Continued growth in fixed capital investment: investment activity remained robust, concentrated in a subset of the district's regions, and occurred despite a nationwide decline in capital formation.

3. Output growth in some industrial sectors: amid declines in traditional activities (mining, food production, apparel, textiles), there was a noticeable revival in certain high-tech and import-substituting industries (electronics, automotive manufacturing, lithium-ion battery production).

Thus, both the NWFD and the country as a whole face a mounting imperative to transition swiftly toward a phase of sustainable growth. This transition will be facilitated by a systematic boost in demand – for durable goods, machinery and equipment, as well as for intermediate products (from wood processing, metallurgy, and non-metallic mineral construction materials) that will be needed to replenish inventories as a new investment cycle gets underway. Key steps in this direction will include the easing of monetary and fiscal policy, alongside a fundamental rethinking of housing policy. Examples of measures already implemented include expanded support for industrial projects[17], assistance to agricultural producers[18], backing for the domestic market[19], and support for infrastructure initiatives[20]. Also noteworthy is the proposal to redirect spending away from inefficient outlays or expenditures lacking near-term stimulative effects, and toward budget items capable of providing a short-term developmental impulse – above all, measures that bolster final demand for domestically produced goods, whether for end consumption or for building up stocks of raw materials and supplies[21].

*Sources: Rosstat, Ministry of Economic Development of Russia, Bank of Russia, Federal Customs Service, Government of Russia, metalinfo.ru, metaltorg.ru, divercitytimes.com, tradingeconomics.com, data.stats.gov.cn, bea.gov, and others.*

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[17] RF Government Resolution 210 dated March 2, 2026 on expanding the possibilities of applying the federal investment tax deduction for groups of companies.

[18] RF Government Resolution 192-r dated February 6, 2026 on the allocation of an additional 2 billion rubles for the implementation of the preferential agroleasing program; RF Government Resolution 50-r dated January 21, 2026 on the allocation of 26.5 billion rubles for the continuation of the program of preferential lending to agricultural producers and processors of agricultural products; RF Government Resolution 2110 dated December 23, 2025 on the approval of new support measures for agricultural producers.

[19] RF Government Resolution 78 dated January 31, 2026 on a new temporary ban on the export of gasoline, diesel and other fuels.

[20] RF Government Resolution 2229 dated December 30, 2025 on the launch of a program of preferential loans for projects to create fast charging hubs for electric vehicles.

[21] Quarterly GDP forecast 01.2026. Available at: https://ecfor.ru/publication/kvartalnyj-prognoz-vvp-vypusk-69/ (accessed: 16.03.2026).

# MONITORING OF THE SOCIAL WELL-BEING OF THE VOLOGDA REGION POPULATION IN FEBRUARY 2026

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In January–February 2026, the Vologda Research Center of the Russian Academy of Sciences (VolRC RAS) conducted the latest round of its ongoing public opinion monitoring survey on the socio-economic and political situation in the country and the region. The findings are presented below.

VolRC RAS has carried out this public opinion monitoring survey since 1996, with fieldwork conducted once every two months. Each wave comprises 1,500 respondents aged 18 and older residing in the cities of Vologda and Cherepovets, as well as in Babaevsky, Velikoustyugsky, Vozhegodsky, Gryazovetsky, Tarnogsky, Kirillovsky, Nikolsky, and Sheksninsky municipal okrugs. The sample is designed to be representative of the regional population by maintaining appropriate proportions in three key dimensions: the urban–rural divide; the distribution across settlement types (rural localities, small and medium-sized towns); and the adult population's gender and age structure. The survey employs a face-to-face questionnaire method administered at respondents' places of residence. The sampling error does not exceed 3%.

The analysis examines the dynamics of assessments across 14 socio-demographic categories, broken down by:

– gender (men, women);
– age (under 30, 30–55, over 55);
– education level (secondary/incomplete secondary, specialized secondary, higher);
– self-assessed income bracket (bottom 20%, middle 60%, top 20%);
– area of residence (City of Vologda, City of Cherepovets, districts of the region).

Sociological data processing and analysis rely on an index-based method. Index values are calculated by subtracting the percentage of negative responses from the percentage of positive responses, and then adding 100 to the result to eliminate negative figures. Consequently, uniformly negative responses would yield an index of 0, uniformly positive responses an index of 200, and an equal split between positive and negative would produce a neutral midpoint of 100.

Compared to the previous monitoring wave (spanning December 2025 to February 2026), the key indicators of social well-being in Vologda Region remained broadly stable. Positive assessments of social mood stood at 70–73%, while the "reserve of patience" indicator ranged between 81% and 83% – levels consistent with those observed a year earlier (February 2025; *Tab. 1*).

It is also worth noting that the reserve of patience Index recorded in February 2026 matches the annual average for 2025 (169 points) and represents the highest level observed over the past ten years.

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**Table 1. Trends in selected indicators of social well-being in the Vologda Region*, % of respondents**

| Indicator | Response option | 2012 | 2015 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | Feb. 2025 | Apr. 2025 | June 2025 | Aug. 2025 | Oct. 2025 | Dec. 2025 | Feb. 2026 | Dynamics (+/-), Feb. 2026 to | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | Dec. 25 | Feb. 25 |
| Mood | Excellent mood; normal state | 67.3 | 68.7 | 71.2 | 69.9 | 61.0 | 66.7 | 67.3 | 65.6 | 69.0 | 71.6 | 69.4 | 71.2 | 71.9 | 72.9 | 70.9 | 73.2 | 69.7 | -4 | 0 |
| | Feelings of tension, irritation; fear, anxiety | 27.0 | 25.9 | 23.1 | 24.5 | 30.4 | 27.3 | 28.1 | 29.2 | 27.2 | 24.3 | 26.6 | 23.8 | 25.3 | 24.1 | 23.5 | 22.2 | 24.9 | +3 | -2 |
| | Social Mood Index | 140.3 | 142.8 | 148.2 | 145.5 | 130.6 | 139.4 | 139.3 | 136.4 | 141.8 | 147.3 | 142.8 | 147.4 | 146.6 | 148.8 | 147.4 | 151.0 | 144.8 | -6 | +2 |
| Reserve of patience | Things aren't so bad, life goes on; life is hard, but bearable | 76.6 | 78.4 | 77.1 | 77.0 | 72.3 | 75.8 | 76.9 | 76.5 | 77.9 | 81.1 | 79.6 | 79.6 | 80.4 | 79.9 | 83.5 | 83.4 | 81.1 | -2 | +2 |
| | Our desperate situation is impossible to endure any longer | 15.8 | 14.5 | 16.3 | 17.2 | 19.9 | 17.7 | 16.1 | 14.6 | 13.9 | 12.6 | 14.5 | 14.0 | 11.9 | 12.9 | 12.1 | 10.1 | 11.9 | +2 | -3 |
| | Reserve of Patience Index | 160.8 | 163.9 | 160.8 | 158.8 | 152.5 | 158.1 | 160.8 | 162.0 | 164.0 | 168.5 | 165.1 | 165.6 | 168.5 | 167.0 | 171.4 | 173.3 | 169.2 | -4 | +4 |

* According to the survey methodology, the sampling error does not exceed 3%. Therefore, here and throughout this report, changes of less than 3 percentage points are considered statistically insignificant and are highlighted in blue in the tables.

Self-assessed household income dynamics showed positive changes over the past two months. Among the bottom 20% income group, per capita monthly income (based on self-assessments) rose by 2,000 rubles (from 16,000 to 18,000 rubles), while among the middle 60% it increased by 1,500 rubles (from 30,000 to 31,500 rubles; *Tab. 2*).

Over the twelve months preceding the survey, self-assessed income levels rose across all income groups, with the most notable increase observed among the middle 60% of the region's residents (by 6,000 rubles, from 25,000 to 31,000 rubles). The regional average rose by 5,000 rubles (from 28,000 to 33,000 rubles).

In February 2026, assessments of the economic situation in the country, the region, and respondents' own household living standards remained essentially unchanged from December 2025 levels:

– positive assessments accounted for 12–15% of responses;

– 40–44% of the region's residents offered neutral assessments;

– negative assessments comprised 26–33% of responses *(Tab. 3)*.

A slight decline was observed in the index of the country's economic situation over the past two months (by 4 points, from 90 to 86), and in the index of the region's economic situation over the year from February 2025 to February 2026 (also by 4 points, from 86 to 82).

Assessments of the political situation in the country and the region showed no significant changes over the past two months, nor over the past year. The share of respondents who view the political situation in the country as "calm and favorable" stands at 20–22%, while for the region this figure is 50–52% (see *Tab. 4*).

**Table 2. Per capita household income and the ratio of per capita income to the subsistence minimum (by income group)**

| Income group | 2012 | 2015 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | Feb. 2025 | Apr. 2025 | June 2025 | Aug. 2025 | Oct. 2025 | Dec. 2025 | Feb. 2026 | Dynamics (+/-), Feb. 2026 to | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | Dec. 25 | Feb. 25 |
| Per capita household income, RUB | | | | | | | | | | | | | | | | | | | |
| Bottom 20% | 4330 | 5430 | 6602 | 7792 | 7546 | 8529 | 10008 | 11746 | 13211 | 14731 | 13609 | 14382 | 13726 | 14118 | 16549 | 16002 | 18216 | +2214 | +4607 |
| Middle 60% | 9293 | 11708 | 13251 | 14113 | 14031 | 15741 | 17503 | 20310 | 22885 | 27620 | 25473 | 27120 | 26831 | 27079 | 29274 | 29941 | 31594 | +1653 | +6121 |
| Top 20% | 19907 | 23624 | 27433 | 28267 | 28207 | 30338 | 37250 | 40186 | 43286 | 51186 | 48009 | 50076 | 53688 | 52992 | 49932 | 52421 | 51864 | -557 | +3855 |
| Average for the region | 10425 | 12837 | 14757 | 15686 | 15570 | 17220 | 19953 | 22578 | 25038 | 29757 | 27607 | 29161 | 29579 | 29669 | 30863 | 31665 | 32986 | +1321 | +5379 |
| Subsistence minimum, RUB* | 6563 | 9639 | 10658 | 11042 | 11509 | 11767 | 13633 | 14519 | 15608 | 17910 | 17910 | 17910 | 17910 | 17910 | 17910 | 17910 | 19128 | +1218 | +1218 |
| Ratio of per capita income to subsistence minimum by income group, times | | | | | | | | | | | | | | | | | | | |
| Bottom 20% | 0.7 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 1.0 | +0,1 | +0,2 |
| Middle 60% | 1.4 | 1.2 | 1.2 | 1.3 | 1.2 | 1.4 | 1.3 | 1.4 | 1.5 | 1.5 | 1.4 | 1.5 | 1.5 | 1.5 | 1.6 | 1.7 | 1.7 | 0 | +0,3 |
| Top 20% | 3.0 | 2.5 | 2.6 | 2.6 | 2.5 | 2.6 | 2.7 | 2.8 | 2.8 | 2.9 | 2.7 | 2.8 | 3.0 | 3.0 | 2.8 | 2.9 | 2.7 | -0,2 | 0 |
| Average for the region | 1.6 | 1.3 | 1.4 | 1.4 | 1.4 | 1.5 | 1.5 | 1.6 | 1.6 | 1.7 | 1.5 | 1.6 | 1.7 | 1.7 | 1.7 | 1.8 | 1.7 | -0,1 | +0,2 |
| Source: Decrees of the Government of the Vologda Region "On Establishing the Subsistence Minimum per Capita and for Major Socio-Demographic Groups in the Vologda Region". Official Portal of the Government of the Vologda Region. Available at: https://vologda-oblast.ru | | | | | | | | | | | | | | | | | | | |

**Table 3. Trends in assessments of the economic and financial situation, % of respondents**

| Indicator | 2012 | 2015 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | Feb. 2025 | Apr. 2025 | June 2025 | Aug. 2025 | Oct. 2025 | Dec. 2025 | Feb. 2026 | Dynamics (+/-), Feb. 2026 to | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | февр. 25 |
| Russia's economic situation | | | | | | | | | | | | | | | | | | | |
| Good | 10.7 | 6.2 | 14.4 | 14.6 | 11.7 | 11.5 | 11.7 | 12.1 | 13.9 | 14.5 | 13.0 | 14.3 | 14.2 | 15.1 | 16.1 | 14.3 | 12.0 | -2 | -1 |
| Average | 51.2 | 46.6 | 43.9 | 44.6 | 42.9 | 42.7 | 42.3 | 43.2 | 45.7 | 44.2 | 46.7 | 44.9 | 44.3 | 43.3 | 41.5 | 44.3 | 44.3 | 0 | -2 |
| Poor | 25.5 | 35.5 | 27.2 | 26.1 | 31.1 | 30.8 | 32.9 | 30.2 | 26.2 | 27.6 | 29.0 | 29.4 | 28.5 | 27.5 | 26.4 | 24.7 | 26.1 | +1 | -3 |
| Index | 85.2 | 70.7 | 87.2 | 88.6 | 80.6 | 80.8 | 78.7 | 81.9 | 87.7 | 86.9 | 84.0 | 84.9 | 85.7 | 87.6 | 89.7 | 89.6 | 85.9 | -4 | +2 |
| Region's economic situation | | | | | | | | | | | | | | | | | | | |
| Good | 9.9 | 5.2 | 11.8 | 11.5 | 10.8 | 10.9 | 11.1 | 13.8 | 15.0 | 16.1 | 15.2 | 16.2 | 15.9 | 16.5 | 17.7 | 15.1 | 14.6 | -1 | -1 |
| Average | 49.4 | 39.9 | 39.2 | 41.3 | 38.3 | 40.4 | 40.1 | 42.7 | 43.8 | 42.0 | 45.3 | 41.5 | 40.8 | 43.5 | 40.1 | 40.6 | 39.5 | -1 | -6 |
| Poor | 29.4 | 43.0 | 36.9 | 34.9 | 36.9 | 35.9 | 36.5 | 32.6 | 30.3 | 31.4 | 29.5 | 33.2 | 31.7 | 30.9 | 32.0 | 31.3 | 32.6 | +1 | +3 |
| Index | 80.5 | 62.2 | 74.9 | 76.6 | 73.9 | 75.0 | 74.6 | 81.2 | 84.7 | 84.7 | 85.7 | 83.0 | 84.2 | 85.6 | 85.7 | 83.8 | 82.0 | -2 | -4 |
| Household financial situation | | | | | | | | | | | | | | | | | | | |
| Good | 10.1 | 7.9 | 11.8 | 10.2 | 9.2 | 8.4 | 8.8 | 10.1 | 12.4 | 14.3 | 13.8 | 14.0 | 14.7 | 13.8 | 15.3 | 13.9 | 13.9 | 0 | 0 |
| Average | 54.2 | 49.5 | 48.7 | 50.1 | 46.2 | 48.6 | 47.9 | 51.0 | 51.6 | 48.0 | 47.0 | 46.5 | 47.7 | 50.7 | 48.9 | 47.1 | 44.4 | -3 | -3 |
| Poor | 27.4 | 31.2 | 30.2 | 29.7 | 33.0 | 32.4 | 32.2 | 27.9 | 26.4 | 26.9 | 29.1 | 26.4 | 27.5 | 25.2 | 25.3 | 27.6 | 29.1 | +2 | 0 |
| Index | 82.7 | 76.7 | 81.6 | 80.4 | 76.2 | 76.0 | 76.4 | 82.2 | 86.0 | 87.4 | 84.7 | 87.6 | 87.2 | 88.6 | 90.0 | 86.3 | 84.8 | -2 | 0 |

**Table 4. Dynamics of assessments of the political situation, % of respondents**

| Indicator | 2012 | 2015 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | Feb. 2025 | Apr. 2025 | June 2025 | Aug. 2025 | Oct. 2025 | Dec. 2025 | Feb. 2026 | Dynamics (+/-), Feb. 2026 to | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | Dec. 25 | Feb. 25 |
| In Russia | | | | | | | | | | | | | | | | | | | |
| Favorable, calm | 39.8 | 25.5 | 40.4 | 45.0 | 41.0 | 37.2 | 27.5 | 23.3 | 24.7 | 23.8 | 22.3 | 24.7 | 24.3 | 25.6 | 24.0 | 22.1 | 20.3 | -2 | -2 |
| Tense, critical, explosive | 43.2 | 58.7 | 45.6 | 41.6 | 43.2 | 47.2 | 56.9 | 62.3 | 59.7 | 61.6 | 63.0 | 61.1 | 62.1 | 61.3 | 60.2 | 61.9 | 62.4 | +1 | -1 |
| Index | 96.6 | 66.8 | 94.8 | 103.5 | 97.8 | 89.9 | 70.6 | 61.0 | 65.0 | 62.2 | 59.3 | 63.6 | 62.2 | 64.3 | 63.8 | 60.2 | 57.9 | -2 | -1 |
| In the region | | | | | | | | | | | | | | | | | | | |
| Favorable, calm | 51.8 | 46.0 | 54.9 | 58.0 | 53.9 | 53.7 | 47.9 | 49.8 | 52.5 | 52.3 | 51.3 | 52.9 | 54.3 | 51.1 | 52.3 | 51.9 | 49.4 | -3 | -2 |
| Tense, critical, explosive | 31.8 | 39.1 | 33.3 | 31.5 | 32.9 | 34.3 | 40.4 | 41.0 | 39.1 | 39.0 | 40.4 | 38.3 | 37.1 | 38.9 | 39.2 | 39.9 | 39.2 | -1 | -1 |
| Index | 120.0 | 106.9 | 121.6 | 126.4 | 121.0 | 119.8 | 107.5 | 108.8 | 113.4 | 113.3 | 110.9 | 114.6 | 117.2 | 112.2 | 113.1 | 112.0 | 110.2 | -2 | -1 |

**Summary**

The findings from the February 2026 monitoring wave indicate that the current public assessments of social well-being and the economic and political situation in the country and the region remain broadly stable.

A slight deterioration in public assessments of Russia's economic situation is observed in year-on-year terms, which is most likely attributable to a growing societal demand for improved living standards and quality of life. As experts note, "for the first time in many years, a clear public demand for a constructive agenda has crystallized in the collective consciousness"[2]; "the country enters 2026 weary of geopolitics and with a colossal demand for a return to normality in everyday life"[3]. According to VCIOM Director V. Fedorov: "The army is fighting; the people watch on television and via Telegram channels... as our troops overcome enemy resistance, yet their worries lie elsewhere: the economy, wages, jobs, prices, their children's education, healthcare..."[4].

[2] Garmonenko D. The Communist Party of the Russian Federation has revealed the grounds for the victory of United Russia. Available at: https://www.ng.ru/politics/2026-01-19/1_9418_kprf.html

[3] Obukhov S.P., Mikhalchuk A.M., Bogachev A.M., Strelkov D.A., Khamadieva T.V., Chervontsev A.V. Results of 2025 from V.V. Putin. Express analysis of the message to the Russian society and foreign opponents. Available at: https://kprf.ru/politindx/239901.html?ysclid=mlhmrkgapk916136109

[4] Alfimov V. From paycheck to victory: How Russian society has changed in a year (interview with V. Fedorov, head of VCIOM). Available at: https://www.kp.ru/daily/27763.3/5191948/?ysclid=mkgituc55z530676123

This particular feature is essential for understanding trends in public sentiment: the gradual "normalization" of life under the conditions of the special military operation (SMO) and the "return" of the socio-economic agenda – along with issues of social justice and improving the effectiveness of public administration, primarily within the country – impose special demands on the authorities in terms of meeting public expectations.

The direction in which public opinion on key aspects of citizens' daily lives will develop further will be revealed by the results of subsequent waves of VolRC RAS monitoring.

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*Vologda Research Center RAS*

**Appendix**

## MONITORING OF SOCIAL SENTIMENT

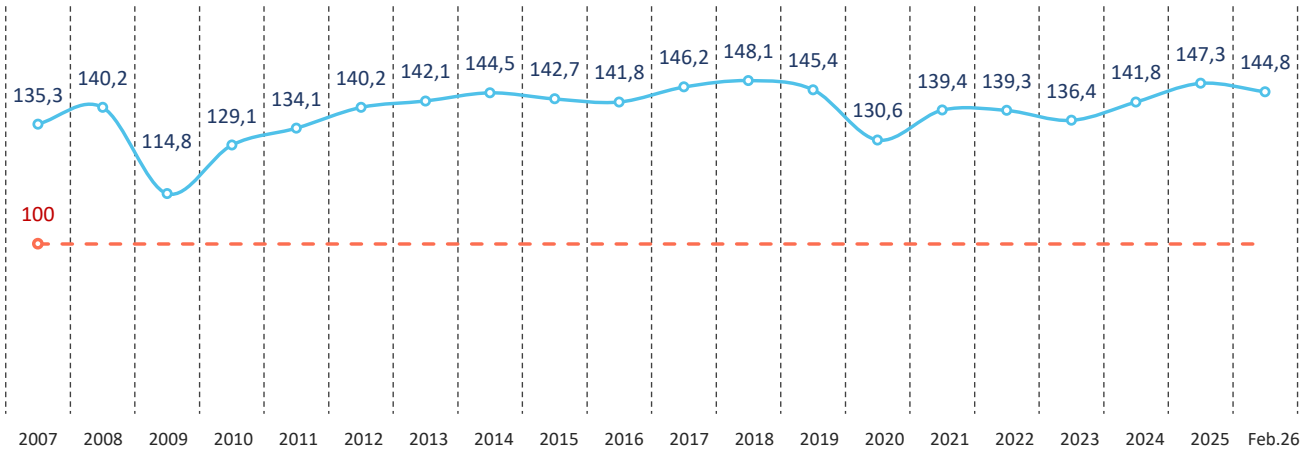


**Figure 1. Index of Social Sentiment, points**

In the first months of 2026, the Index of Social Sentiment among residents of the Vologda Region remained largely unchanged, holding steady at 2025 levels (145–147 points).

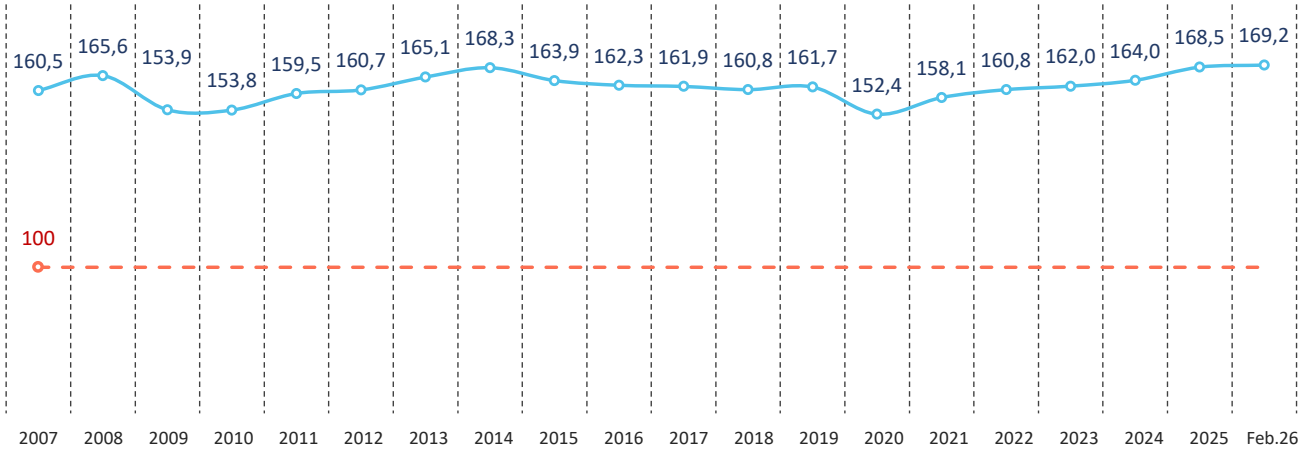


**Figure 2. Reserve of Patience Index, points**

The start of 2026 brought no significant shifts in how residents of Vologda Region assess their own reserve of patience. The corresponding index stood at 169 points, unchanged from its 2025 level.

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Here and throughout: Index values are calculated by subtracting the percentage of negative responses from the percentage of positive responses, and then adding 100 to the resulting figure in order to avoid negative values. Thus, uniformly negative responses would yield an index of 0, uniformly positive responses an index of 200, and an equal split between positive and negative would produce a value of 100 – essentially a neutral midpoint (- - -).

Data are presented starting from 2007—the final year of Vladimir Putin's second presidential term.

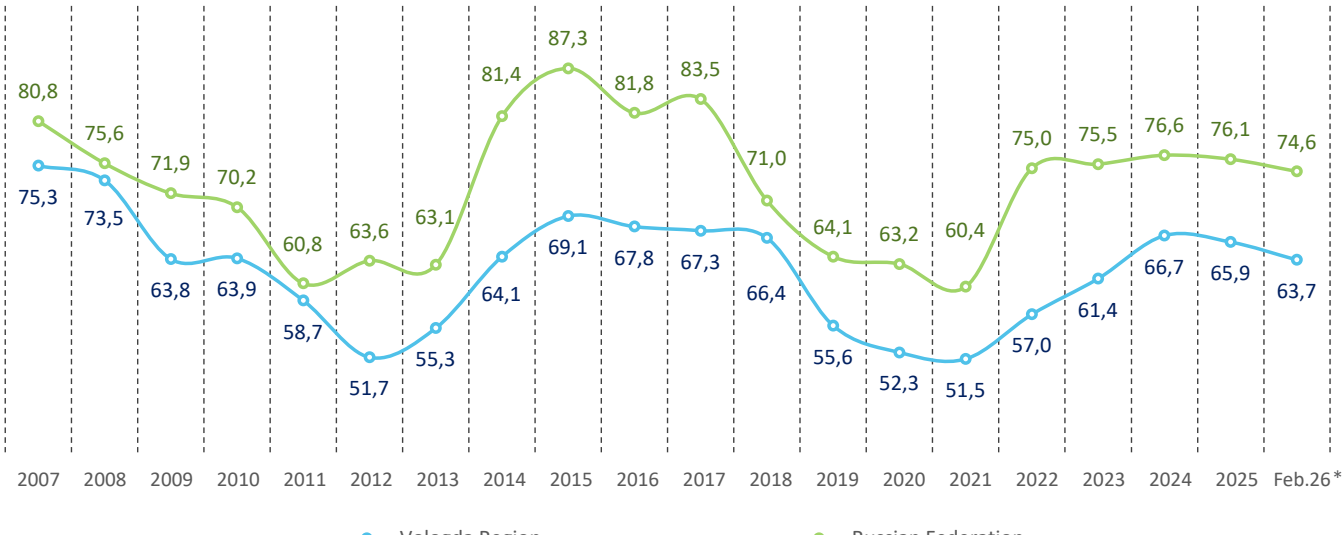


**Figure 3. Approval of the activities of the President of the Russian Federation, % of respondents**

In February 2026, compared to 2025, the share of positive assessments of the Russian President's performance among residents of the Vologda Region and Russia as a whole remained largely unchanged (64–66% and 75–76%, respectively).

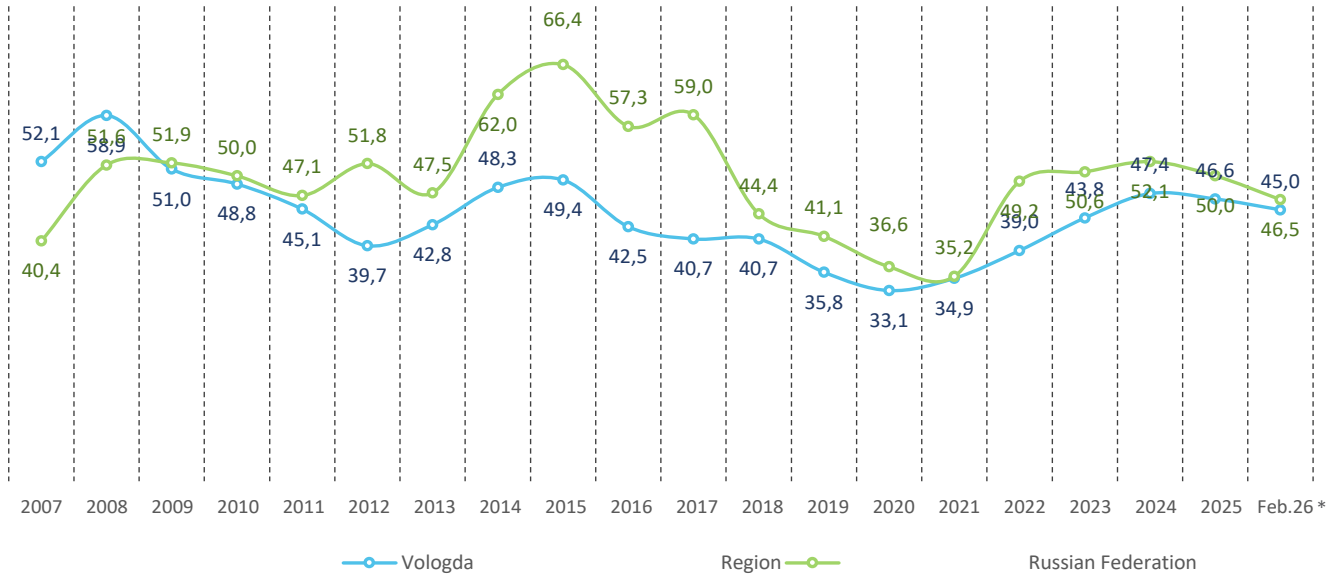


**Figure 4. Approval of the activities of the Government of the Russian Federation, % of respondents**

In February 2026, the approval rating of the Russian Government's performance within the Vologda Region showed no significant change compared to 2025 (45–47%), while the nationwide figure declined by 3 percentage points (from 50% to 47%).

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Here and throughout: Vologda Region data are from VolRC RAS surveys; Russian Federation data are from VCIOM (https://wciom.ru).

* VCIOM data on approval of the Russian President and Government are averaged across three survey waves: February 1, 2026; February 8, 2026; and February 15, 2026.

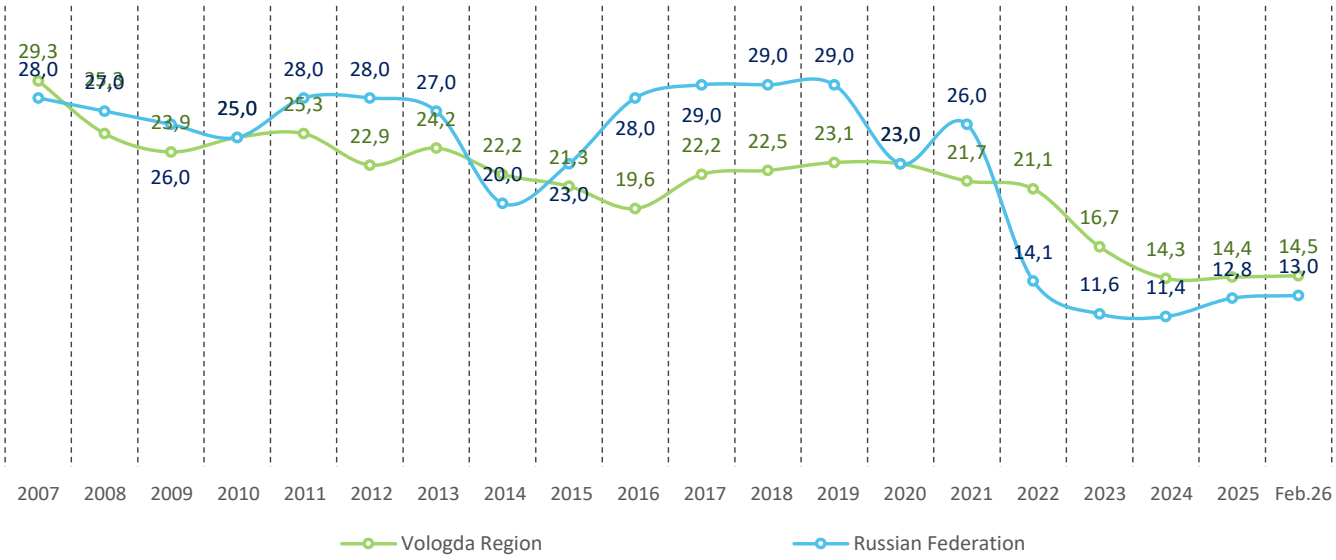


**Figure 5. Likelihood of protest actions (share of respondents who noted the possibility of mass protest rallies), % of respondents**

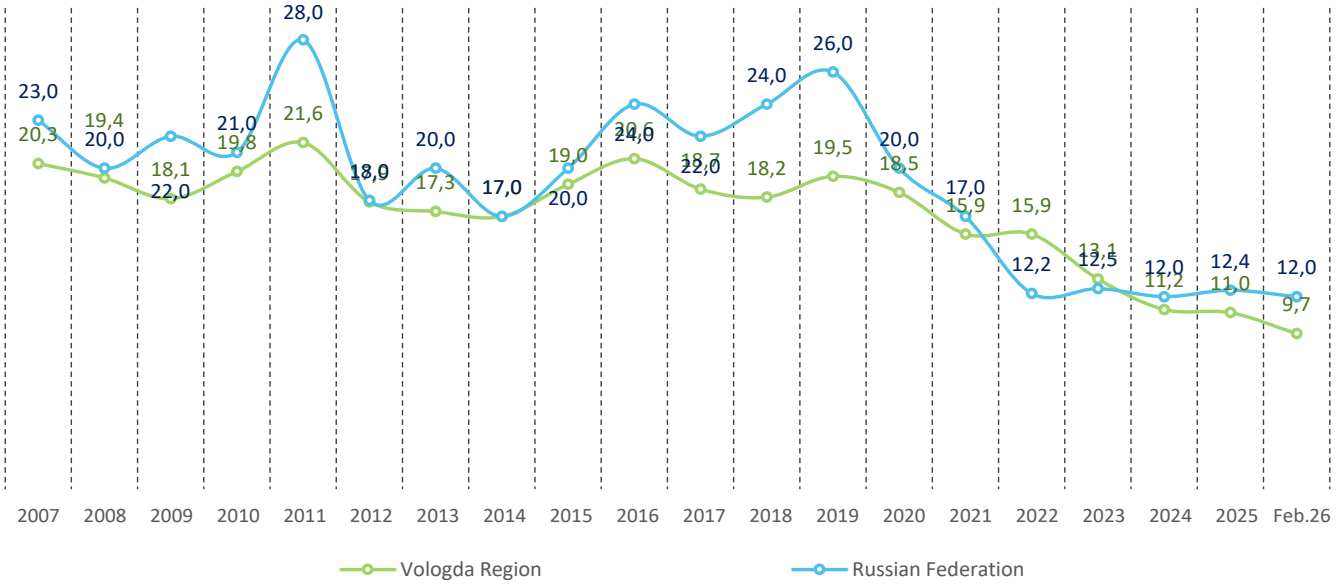


**Figure 6. Willingness to participate in protests (share of respondents who would be ready to take part in mass protest actions), % of respondents**

In February 2026, both regional and nationwide indicators of the perceived likelihood of protests, as well as respondents' own willingness to participate in them, remained at the average annual levels observed in 2025. Among residents of the region, 14–15% consider protest actions possible, compared to 13% among Russians overall. Ten to eleven percent of Vologda Region residents and 12% of Russians express readiness to take part in protest actions.

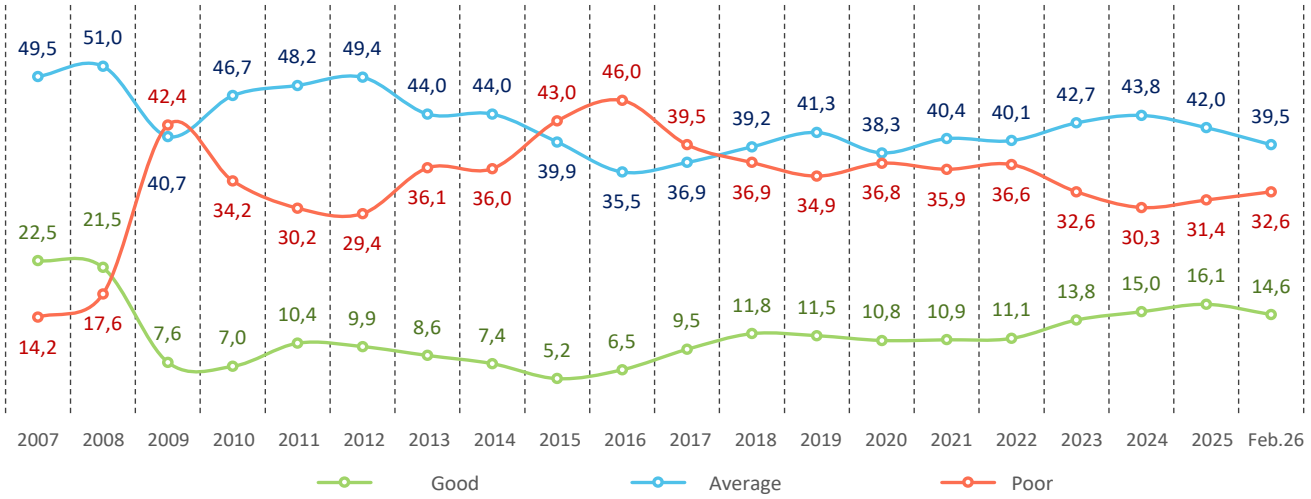


**Figure 7. Assessment of the economic situation in the region, % of respondents**

In February 2026, residents' assessments of the regional economy in the Vologda Region remained essentially unchanged from 2025 levels. Positive assessments accounted for 15–16% of responses, neutral ones for 40–42%, and negative ones for 31–33%.

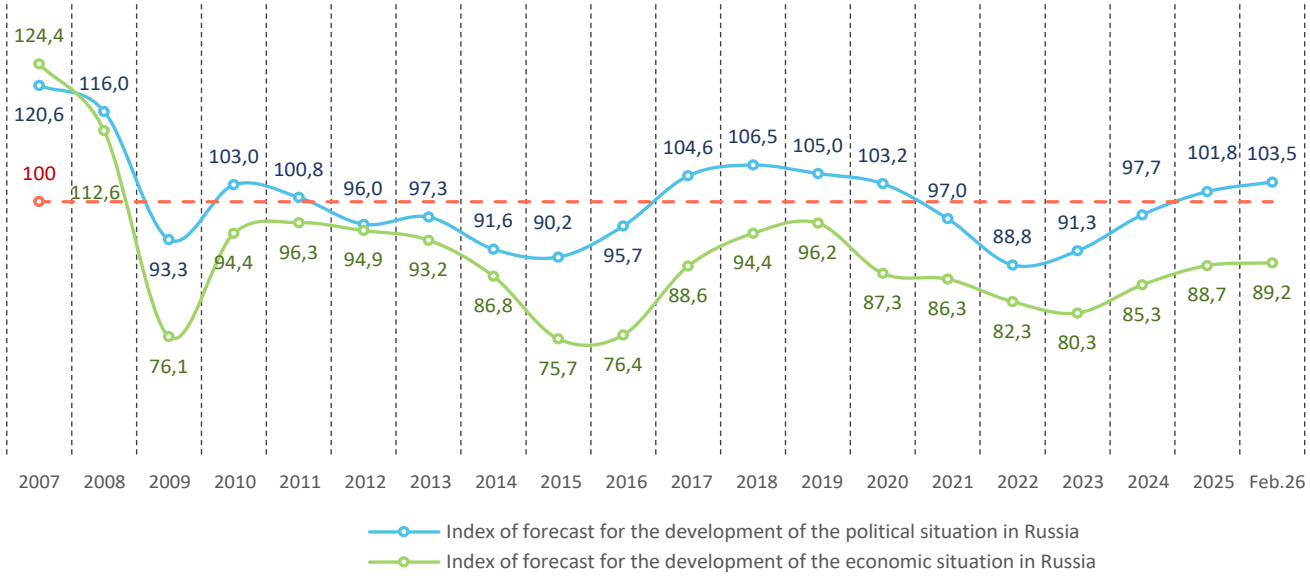


**Figure 8. Indices of forecasts for the development of the political and economic situation in Russia*, points**

At the start of 2026, the forecast indices for the development of the political and economic situation in Russia are in line with the 2025 annual averages (102–104 and 89 points, respectively).

* The index of forecast for the development of the political situation in Russia is calculated based on an analysis of respondents' positive and negative forecast assessments of the political situation in answer to the question: "What do you think awaits Russia's political life in the coming months?"

The index of forecast for the development of the economic situation in Russia is calculated based on an analysis of respondents' positive and negative forecast assessments of the economic situation in answer to the question: "Do you think the next 12 months will be a good time, a bad time, or something else for the Russian economy?"

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