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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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FROM THE EDITOR



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ON THE VERGE OF CHANGE

We live in times when the situation in the world, in Russia, and in specific territories is changing quite rapidly. Changes are also taking place in the journal "Problems of Territory's Development". Summing up the results of 2025, we note that this year saw the preparation of our first thematic issue. We have begun translating the journal into English and, aiming to enhance the quality of published articles, have strengthened our peer-review procedures, among other initiatives. A number of changes await us in 2026 as well. However, on the whole, we stay true to our traditions, and the journal's thematic focus remains linked to the search for solutions to the numerous problems of development at various territorial levels.

Thus, in the article by *E.V. Balatsky*, the most important institutional advantages of the Chinese governance model are systematized, demonstrating its substantial difference from Western and Russian models. The work outlines the fundamental principles and characteristic features of Chinese elites, which include an immunity to degradation and degeneration, historical continuity in strategic decision-making, the formation of a state instinct, a weakening of foreign policy aggressiveness during the transition of the old world order, timely balancing of all aspects of Chinese society's life, and the achievement of permanent managerial responsibility. The author suggests that certain elements of the Chinese governance system could be utilized in Russian practice.

For citation: Uskova T.V. (2025). On the verge of change. *Problems of Territory's Development*, 29(6), 7–9. DOI: 10.15838/ptd.2025.6.140.1

The problems and prospects of digitizing the budgetary process at the municipal level are examined in the work by *S.N. Rastvortseva* and *E.V. Panina*. The role of the internal public finance management system is defined, the specifics and emerging problems of budget process digitization in municipalities are identified, and a set of measures to improve the situation in this sphere is substantiated. The authors' conclusions are based on in-depth interviews with experts in the field of budget system development.

Addressing the numerous tasks of socio-economic development of territories is largely determined by the availability of investments. In this regard, *S.G. Pyankova* and *L.A.-N. Baizhanova* have undertaken an attempt to reveal the methodological possibilities for assessing the investment potential of Russian regions under conditions of economic uncertainty. The study concludes that to account for the multidirectional and multi-level nature of modern investment processes, a comprehensive methodological toolkit for assessing regional investment potential should be employed.

V.I. Belov and *G.V. Gioev* investigate the influence of the livestock industry on the sustainable development of rural areas. The work identifies current trends in livestock development, reveals a number of factors that have the greatest impact on the sustainable development of rural territories, and proposes the authors' own methodology for such assessment.

Issues of sustainable development of Russian territories are also reflected in the article by *A.G. Ataeva* and *A.G. Ulyaeva*. The researchers dedicated their work to elucidating methodological approaches for integrating sustainability principles into regional socio-economic development strategies. To improve the methodological toolkit of strategic planning for regional development, they propose an applied framework for integrating sustainability at all stages of the strategic cycle.

Issues of adaptation by Russian enterprises to changing geopolitical conditions and increasing sanction pressure are examined by *E.Yu. Shirokova* and *E.V. Lukin*. The work demonstrates the dynamics of key processes occurring at enterprises in Northwestern Russia, highlights key trends, identifies management responses to important external and internal factors, and proposes measures for adaptation to a situation of economic uncertainty.

The mutual influence between scientific-technological development and the economic structure of Russian regions is revealed in the article by *N.N. Volkova* and *E.I. Romanyuk*. The existence of a stable interdependence between these aspects of regional development is proven. It is revealed that regions with a diversified economic structure have a higher index of scientific-technological development.

An assessment of regional differences in Russia's natural population growth is given in the work of *V.N. Arkhangelskiy*, *E.P. Sigareva*, and *S.Yu. Sivoplyasova*. The authors propose a new approach to the statistical analysis of natural population growth components at the regional level, which allows for the adjustment of regional policy measures aimed at demographic stabilization, taking into account changes in individual elements of the population reproduction process.

In the study by *A.V. Korolenko*, theoretical and methodological approaches to studying the demographic potential of territories are systematized, and a methodology for its assessment at the regional level is developed and tested. The conducted research confirmed the close interconnection between the quantitative and qualitative components of a territory's demographic potential.

An assessment of the relationship between regional economic growth and environmental pollution is conducted in the work of *S.S. Patrakova* and *D.S. Palkina*. It is established that an increase in the gross regional product

is accompanied by growth in emissions of pollutants into the atmosphere from stationary sources and in the number of passenger cars, but the volume of polluted wastewater discharged into surface water bodies decreases.

Traditionally, the issue concludes with the "Monitoring of Changes" section. It reflects the results of monitoring the economy of

Northwestern Russia for September 2025, prepared by *M.A. Sidorov* and *E.V. Lukin*, as well as the main trends in the social well-being of the population in the Vologda Region in October 2025, presented by *M.V. Morev* and *E.E. Leonidova*.

We hope that the articles published in the journal will be of interest to our readers and that our readership will continue to expand.

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EFFICIENCY OF PUBLIC AND MUNICIPAL ADMINISTRATION

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INSTITUTIONS OF ELITE SELF-ORGANIZATION IN THE CHINESE MANAGEMENT MODEL



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The article attempts to systematize the most important institutional advantages of the Chinese management model, which differs significantly from the Western and Russian models. The research considers six fundamental elements of the self-organization model of the Chinese elites: maintaining the monopoly of the Chinese Communist Party in the system of power; the ability of the Communist Party to self-organize (scale, hierarchy, sequence of career growth, meritocracy, total lack of immunity from criminal prosecution, the presence of the death penalty); the system of checks and balances of power, consisting of formal (the practice of filing complaints against representatives government, etc.) and informal (mental and personnel traditions based on the historical factor) institutions; refusal to export its model and the implementation of the doctrine of soft hegemony; global coordination of all levels of the national economy through the modern State Planning Committee of the People's Republic of China (State Committee for Development and Reform); adherence to three basic principles (common sense, naturalness and managerial paranoia), which are subordinated to the effect of nesting. The article shows that these elements provide many advantages for the Chinese elites: the presence of immunity against degradation and degeneration, the historical continuity of strategic decisions and the formation of state instinct, the weakening of foreign policy aggressiveness during the change of the old world order, the timely balancing of all aspects of Chinese society, the achievement of permanent managerial responsibility.

For citation: Balatsky E.V. (2025). Institutions of elite self-organization in the Chinese management model. *Problems of Territory's Development*, 29(6), 10–29. DOI: 10.15838/ptd.2025.6.140.2

We consider the possibility of Russia borrowing the institutions of the Chinese management system; the research notes that there are prerequisites for such borrowing in terms of creating a ruling party, a system of operational complaints and an institution of elite self-purification.

Management model, institutions of self-organization, elites, one-party system of government, China, Russia, the West.

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Introduction

In 2025, an epoch-making book by David D. Li was published in Russian translation (Li, 2025). Its author is a well-known Chinese economist with an impressive track record of achievements by international standards. The book in question has already attracted the attention of the scholarly community, which was quick to voice its opinion. However, the responses vary greatly. Alongside a brief summary of the book by Derek Sivers¹, there exists a highly critical review by Noah Smith², which systematically argues that Li’s book will not reassure but rather further alarm the American reader. For instance, Smith quite reasonably contrasts the relationship between the Chinese Communist Party (CCP) and the Chinese people, based on a “parent/child” model, with the established American tradition, in which many Americans feel deep aversion to such an idea. Consequently, Li’s book is likely to achieve the opposite effect.

One cannot overlook the substantive dialogue that took place between David D. Li and leading contemporary intellectual Jeffrey Sachs³, in which many of the book’s propositions are further clarified. In the Russian-language

information space, the video presentation of the aforementioned book by VCIOM Director V. Fedorov draws attention⁴. Nevertheless, a thorough academic analysis of Li’s monograph is still lacking, which provides the rationale for filling this gap. As for the validity and relevance of discussing Li’s ideas, they are linked to understanding the deep foundations of self-organization among Chinese elites that have predetermined their success in recent decades. This is of immense importance for the restructuring of the old world order in favor of “young” states that have demonstrated the effectiveness of their governance systems and become new centers of power. In this case, China is but one example of alternative institutional systems among countries that are regional leaders.

In this regard, the aim of this work is to systematize the key elements of the Chinese governance model, understand their advantages, and explore the possibility of their adoption. The novelty of the author’s approach lies in integrating the empirical data from Li’s work into a broader context of social, philosophical, and cybernetic knowledge. The research method involves correlating

¹ See: Sivers D. (2025). China’s World View – by David Daokui Li. Available at: <https://sive.rs/book/ChinaWorldView>

² See: Smith N. (2024). China’s plaining will backfire. Available at: <https://www.noahpinion.blog/p/chinasplaining-will-backfire>

³ Conversation with David Daokui Li, China’s World View. SDG Academy. Available at: <https://sdgacademylibrary.mediaspace.kaltura.com/>

⁴ See: <https://rutube.ru/video/362e2b37b8625fd53362486c3036f666/>

specific institutional mechanisms of the Chinese governance system with universally significant patterns from related sciences.

Academic diplomacy, Chinese style

Let us pose a reasonable question: what has Daokui Li accomplished in his book that makes it worth dissecting in detail?

The answer can be broken down into three distinct points.

1. The author “provides a window into the soul” of China and, by doing so, attempts to make the Celestial Empire *more comprehensible* to the West and, consequently, *less threatening*. Of course, this task is largely utopian, as no amount of knowledge about a geopolitical rival eliminates the geopolitical confrontation itself, which has unfolded between the USA and the PRC. In this sense, the United States and the West will not renounce their hegemony, but the rivalry with China could become less hysterical and aggressive – and that is a significant achievement in the context of a crumbling world order. Understanding the adversary’s mentality alleviates excessive fears and emotions, which, under favorable circumstances, can contribute to the normalization and rationalization of international relations.

2. With his book, D. Li has launched a new phenomenon that can be termed *academic diplomacy*. In this case, the economist-scholar has taken on the mission of providing a systematic exposition of the Chinese mentality, worldview, and the ideology of the Chinese elite. Understanding these aspects serves as the foundation for any diplomatic negotiations and the search for mutually acceptable solutions in international relations. Despite its seeming simplicity, the task of elucidating the Chinese worldview is, in fact, anything but trivial. For example, there is still no equivalent to Li’s book for Russia, even though, given the current spread of Russophobia, it would be logical to present the country’s position on key issues. Moreover,

while a high-ranking Chinese scholar can be heard on matters of worldview and ideology, in Russia, there simply are no such representatives of science whose opinions would be considered by the domestic authorities, let alone by external actors in the geopolitical system. Furthermore, irrespective of this circumstance, we do not even see attempts by Russia’s academic community to take the initiative in systematizing the Russian worldview. In this sense, Daokui Li demonstrates *the proactivity* of Chinese scholarship in providing valuable material for politics and diplomacy. This is a truly significant initiative, and it is likely to be further developed in the future, including in other countries.

3. D. Li reveals the mechanisms that sustain the *high effectiveness of non-Western institutions*. This direction allows for once and for all refuting the notion held by the economic mainstream about the superiority of liberal-democratic Western institutions compared to administrative-command management systems. Here, the veil is lifted from such paradoxes as the sustained high efficiency of a one-party system over many decades; the sustained economic viability of state-owned enterprises; the stability of the country’s high-quality managerial elite, and so on. Gaining an understanding of these issues significantly expands the field of institutional research, allowing for the examination of competition between different types of power institutions. It is precisely this direction that opens up substantial scientific prospects.

In light of the above, Li’s book merits the closest attention; hereafter, we will focus precisely on the deep-seated factors ensuring the effectiveness of the state governance system in China. To this end, we will sequentially examine the most important and interesting aspects of political power in the Celestial Empire. In doing so, we will supplement D. Li’s analytical passages with our own arguments and interpretations, which will allow us to see the Chinese governance system in sharper relief.

The paradoxes of a one-party system of power

Modern literature already contains examples of successful “decoding” of the model behind the Chinese governance system’s success. In particular, there is a fairly detailed list of political principles that ensure the long-term success of China’s economy (Popov, 2025). Subsequently, this list was formalized into six fundamental elements of Chinese politics (Balatsky, 2025). However, such a success model is normative in nature and does not reveal how the Chinese leadership manages to adhere to these principles and correctly project them onto the current situation. For understanding this very aspect, D. Li’s book provides rich material.

The starting point for the effectiveness of the entire system of power in the Celestial Empire lies in the presence of the Chinese Communist Party (CCP) within the country. It is precisely the presence of a people’s party that safeguards the interests of the masses that allows for preserving the nation’s integrity and correctly determining the country’s development vector. Moreover, it is the CCP that ensures the strength and stability of the Chinese state itself. However, several acute and interconnected questions arise here. First question: How, despite the party hegemony that began in 1949 with the founding of the PRC, has the CCP managed not to degenerate or degrade for over 75 years? Second question: Why did the Communist Party of the Soviet Union (CPSU) completely decay from within and self-liquidate over a similar period?

Let us attempt to answer these questions step by step, drawing on Li’s work.

We begin with the circumstance that a one-party system has a tremendous advantage over multi-party systems – it bears no costs from the lack of need to fight for power. Consequently, all the attention of the party leadership can be focused on the overarching task of governing the country (*Tab. 1*). This, among other things, allows the CCP to rely on an indefinitely long planning horizon and undertake large-scale strategic projects that are simply inaccessible to democratic governance systems. For example, in the United States, the Republican and Democratic parties spend enormous financial and human resources on election campaigns, and afterward, many decisions and projects are limited by the four-year presidential term; ideally, this period extends to eight years in case of a candidate’s re-election. For comparison: building an aircraft carrier in Russia takes eight years, and considering all the preparatory documentation – ten years⁵; the planned construction duration for an aircraft carrier in the US is nine years plus preparation time⁶. Consequently, electoral systems do not facilitate balanced decision-making even on issues related to the creation of complex military weaponry. Thus, from the standpoint of strategic decision-making and the consistency of their implementation, a one-party system has clear advantages over democratic forms of governance. This is in addition to the savings on transactional costs due to the absence of an election procedure.

Table 1. Differences between one-party and multi-party systems of governance

Type of political system	Functions of the ruling political party	
	Struggle for power	State governance
Multi-party	*	*
One-party	–	**

Source: own elaboration.

⁵ See: <https://ria.ru/20210924/avianosets-1751572546.html?ysclid=mg9keq0yd0491111115>

⁶ See: <https://telegra.ph/SSHA-zatyagivayut-programmu-stroitelstva-avianoscev-04-05?ysclid=mg9khas3r2561491130>

It is noteworthy that modern Western economic science typically sidesteps this circumstance, thereby deliberately obscuring the advantages of an administrative-command management system.

However, Table 1 reveals only the macroeconomic advantages of the Chinese governance system, while its microeconomic benefits are no less significant. To account for the latter, it is sufficient to understand the constraints that the CCP imposes on its citizens. It turns out that these are not as significant as commonly thought. In China, only Communist Party members can hold government positions, but they are not prohibited from running their own businesses. Non-party citizens can also engage in any activity except holding government offices (Tab. 2). Thus, CCP members are the most mobile members of society, with minimal infringement on the freedoms of other citizens.

As we can see, China's command system, so often criticized by the West, turns out to be not so wretched and terrifying. However, this still does not explain the resilience and effectiveness of the CCP itself. For that, it is sufficient to refer to Table 3, which schematically reflects the principles and logic of the CCP's operation. Here, the macro- and microeconomic aspects of the CCP's activities (see Tab. 1 and 2) are complemented by its internal structure. Let us examine individual elements of the CCP model in more detail.

The *scale* of the CCP's presence in all layers of the economy and society is manifested in the fact that its representatives are literally everywhere – in large and small companies, including private ones, at state-owned enterprises, in all government bodies, in public organizations, etc. The omnipresence of CCP agents might alarm an outside observer, but behind it lies an extremely simple phenomenon, which, following D. Li,

Table 2. Career differences for party and non-party citizens in China

Type of citizen	Career	
	In business	In state governance
Non-party	*	–
CCP member	*	*

Source: own elaboration.

Table 3. The logic of CCP functioning

Principle of CCP functioning	Mission	Result
System of diagnostics		
1. Scale	Totality of feedback control	Timeliness and completeness of identified problems
Personnel policy		
2. Hierarchy	Organizational order within the party	System of incentives for managerial personnel
3. Sequential career progression	Elimination of qualification gaps	Ensuring sufficient managerial experience among top executives
4. Meritocracy	Positive selection of managerial personnel	Availability of qualified and wise leaders
Personal accountability		
5. Total absence of immunity from criminal prosecution	Totality of personal accountability of managers	Purification of government bodies from unfit elements
6. Death penalty	Extremely severe punishment for serious violations	Negative example for current managers

Source: own elaboration.

we will call “*managerial paranoia*” (Li, 2025, p. 199). This term implies an almost panicky fear among Chinese managers of large-scale societal problems. That is precisely why the CCP does everything to saturate the country with its “personnel sensors”, which promptly signal emerging problems for their timely resolution. The source of managerial paranoia lies in China’s own history, which has shown the ruling elites that ignoring real societal problems is fraught with their “ripening” with the most terrible consequences. The conclusion is simple – the elites do everything to avoid repeating past mistakes in this regard.

The *hierarchical personnel structure* of the CCP is based on a system of ranks awarded based on performance and serving as the basis for further career advancement. Government positions correspond to qualification ranks, which introduces necessary order into personnel appointments. A consequence of this hierarchical structure is a *sequential career progression*, according to which personnel appointments move both vertically (according to ranks) and horizontally (within ranks); additionally, there are upper age limits – for example, candidates over 68 are not considered for positions like federal minister or provincial governor (Li, 2025, p. 73). Furthermore, a promotion of more than one rank at a time is not permitted (Li, 2025, p. 61); an additional criterion for filtering out unsuitable personnel is an impeccable reputation (Li, 2025, p. 73). This system is quite conservative (for example, a 40-year-old federal minister or head of state is impossible in China), yet it safeguards against the emergence of insufficiently experienced and qualified leaders. Let us immediately note that, unlike in China, any appointments are possible in Russia – regardless of a candidate’s age, experience, qualifications, or reputation; something similar exists in the USA and Europe. Finally, complementing these two principles is

the principle of *meritocracy*, according to which any promotion in position and rank must be earned through success in the previous role. And again, in Russian management practice, there are many examples of appointments to high positions of people with no positive achievements to their name. Thus, strict regulation of careers in government bodies and the CCP serves as a guarantee against personnel chaos and future management errors.

In addition to all of the above, the Celestial Empire operates a *system of self-control* within the CCP, with the National Supervisory Commission serving as its institutional element (Li, 2025, p. 214). This system of self-control is based on two interrelated principles – *total absence of immunity from criminal prosecution and the existence of the death penalty*. The Chinese governance system categorically rejects the principle of impunity. Daokui Li provides striking examples of the CCP’s self-control system in action: Zhou Yongkang, head of police in the 2000s and initiator of an effective anti-corruption campaign in law enforcement agencies, was himself sentenced to life imprisonment 15 years later as a high-ranking corrupt official (Li, 2025, p. 90); Zheng Xiaoyu, in 2003, became the first director of the National Food and Drug Administration and received the title of “model worker” (analogous to a knighthood in the UK), only to be executed in 2007 by decision of the Supreme Court of China (Li, 2025, p. 92); military commander Guo Boxiong, who held an army position second only to the country’s president, engaged in trading general’s ranks and maintained numerous mistresses, resulting in a life sentence in 2015 (Li, 2025, p. 95). Thus, in China, no manager can count on impunity for their crimes, and the punishment can be extremely severe – death penalty or life imprisonment; sometimes the punishment also extends to the wives of corrupt officials.

It is noteworthy that the Chinese accountability system strictly corresponds to modern economic theory, particularly the economics of crime. For example, economic analysis emphasizes that in combating crime, one should simultaneously increase both the severity of punishment and the probability of its occurrence (Becker, 2003). In this context, principles 5 and 6 in Table 3 represent precisely such an ambivalent system for maintaining order: the first removes limitations on the severity of punishment, while the second prevents the probability of crime disclosure from being nullified. Consequently, the self-organization of Chinese elites is carried out according to the most advanced and stringent scientific norms. From this perspective, the very fact of the abolition of the death penalty appears as an outright degradation of the Western legal system, pressure from which China has so far successfully resisted.

What has been said is quite sufficient to explain why the CCP has not degenerated over its 75 years of existence. Moreover, a direct comparison with the USSR also easily explains the degradation of the Soviet elites – in that country, communists were virtually immune to prosecution, and high-ranking party leaders had immunity even from investigation by the KGB. It is enough to recall that the limits of the KGB's jurisdiction in the USSR extended not only to high-ranking party and Soviet officials but also to many state institutions and socio-political organizations; violating these established boundaries was suppressed and severely punished (Zhitnukhin, 2014, p. 151). Regarding members of the Politburo of the CPSU Central Committee, the country's KGB did not even have the right to double-check suspicious information it possessed (Zhitnukhin, 2014, p. 150). It was precisely thanks to such criminal immunity that A.N. Yakovlev and E.A. Shevardnadze avoided exposure of their subversive activities (Zhitnukhin, 2014, p. 154). In other words, the USSR had a *system of exceptions* to the law on

criminal prosecution; contemporary China has learned from this negative experience.

Attention should be paid to the circumstance that all six principles in Table 3 in China are a kind of sacred foundation of society and the CCP, whereas the Western world has increasingly retreated from them over time. Using the philosophical terminology of V.A. Shmakov, these principles can be called an element of the *noumenal world*, while the actual state of affairs in the party elite is an element of the *phenomenal world* (Shmakov, 2016). The law of synarchy presupposes correspondence between the monads and multiplicities of the two worlds at all hierarchical levels. If a social system accumulates strong deviations from the predetermined noumena (laws), this leads to an unacceptably large noumenal-phenomenal discrepancy, followed by the collapse of the entire social system, for example, the disintegration of the state itself (Balatsky, 2024). Thus, the current model of self-organization of the Chinese elite corresponds to the profound philosophical foundations of existence, which underlies the effectiveness of the Celestial Empire's governance system.

The system of checks and balances of power, Chinese style

The previous section sheds light on the personnel structure and dynamics of China's power elites. However, the system for forming managerial decisions in the country, which is significantly regulated by the factor of history, remains unexamined. This circumstance allows us to clarify the current institutional system of China regarding the work of specific representatives of the managerial class. To do this, let us recall D. North's formula, according to which a country's institutions (norms of life and behavior) are divided into formal (laws, regulations, directives, etc.) and informal (traditions, customs, etc.):

$$\underbrace{\left(\text{System of checks and balances}\right)}_{\text{Institutions}} = \underbrace{\left(\text{Formal norms}\right)}_{\text{Legal system}} + \underbrace{\left(\text{Informal norms}\right)}_{\text{Traditions}}. \quad (1)$$

However, the second term of formula (1) for China can be expanded as follows:

$$\left(\frac{\text{Informal norms}}{\text{Traditions}}\right) = \left(\frac{\text{Factor of history}}{\text{Mental traditions}}\right) + \left(\frac{\text{Factor of retired elite}}{\text{Personnel traditions}}\right). \quad (2)$$

The legal system for curbing voluntarism in the actions of various officials and party figures in China is regulated by *mixed institutions*, i.e., a blend of purely legal and administrative elements. For example, Daokui Li explains that in the Celestial Empire, as in other countries, courts exist and function, but their significance is limited; in addition to them, there is a system of complaints to local party and state bodies, which is a much more effective tool for providing feedback to the authorities. This resembles the practice of complaints to party bodies in the USSR, but in China, it has been preserved and harmoniously integrated into the overall legal system.

Interestingly, this seemingly crude and irrational system at first glance has deep institutional roots. For instance, the transition from the Roman Republic to the Roman Empire was marked by increased efficiency in governing provinces. In the Republic, a proconsul dispatched to a province was practically accountable to no one: he was not obliged to report his actions either to the provincials or to the central authority (Sobolevsky, 2001). In this regard, one might recall that the career of Marcus Tullius Cicero began at the final stage of the Roman Republic with the case of Verres, whose name became synonymous with a dishonest governor (Bobrovnikova, 2006, p. 175); the futility of fighting the irresponsibility of the former propraetor of Sicily, multimillionaire Gaius Verres, was precisely the cause of Cicero's oratorical triumph. During Imperial times, the rules changed – the emperor had the right of supreme supervision, including over provincial governors. When conflicts arose locally,

provincials complained to the emperors, who, even if generally extremely unjust, severely punished such governors. Thus, command systems of governance demonstrated their advantages even in ancient times – advantages that mainstream economic science has diligently obscured in recent decades. For imperial China, such an order of affairs was traditional, so it does not cause rejection among the current population. Moreover, in today's China, courts and the practice of submitting complaints and petitions complement each other, making the institutional system more flexible, diverse, and effective.

As for informal checks and balances on power in China, the primary factor here is the factor of history (the first term on the right side of formula (2)). Its essence lies in a dual mental influence: firstly, Chinese political leaders, when making critically important decisions, take *historical retrospection* into account as fully as possible; secondly, they consider the *historical perspective* and their place in the memory of descendants (Li, 2025, p. 30). Li explains very clearly that George W. Bush, were he a Chinese leader, would not be able to peacefully enjoy retirement: he would be endlessly pursued by accusations related to two catastrophic events – the US invasion of Iraq in 2003 and the financial crisis of 2008. Perhaps the most vivid example of the significance a leader's future place in national history holds is the return of Mao Zedong to power after witnessing, in 1953, Nikita S. Khrushchev's vilification of Joseph Stalin's personality – a figure who, in an instant, transformed from hero and god into villain and devil. The horror at the prospect of a similar fate awaiting Mao provoked him to return to politics and fight for power, from which he had already stepped away by that time.

It must be said that such a sensitive attitude toward history among Chinese leaders has stark antitheses in the USSR and Russia. For example, Mikhail Gorbachev became one of the

most despised leaders in the eyes of the people throughout the country's history, yet this entirely predictable outcome did not deter the last leader of the USSR from taking destructive actions to dismantle the state. Moreover, he later felt no pangs of conscience and lived a long life peacefully outside his own homeland. Such an outcome seems simply impossible for a Chinese leader. A peculiar "competitor" Gorbachev is the first president of the Russian Federation, Boris Yeltsin, who remained, in the eyes of the people, the epitome of uncultured behavior, alcoholism, and capriciousness. However, fear of such labels did not contribute to his personal reform nor prevent him from systematically dismantling the nascent state.

These examples reveal the moral constraints that operate within Chinese elites and have already been forgotten in many other countries. At the same time, one should not think that considering the factor of history is something completely unique, inherent only to the Chinese nation. For instance, the proponent of a good knowledge of Greco-Roman history was Arnold Toynbee, who believed that it equips a person with knowledge of practically all possible social archetypes and allows for much better navigation of current events (Toynbee, 2011). Characteristically, Toynbee himself worked in the intelligence department of the British Foreign Office from 1915 to 1919, which influenced the general cultural level of the country's diplomats and intelligence officers. However, today, as Britain has ceased to be a colonial empire, the cultural level of its establishment has catastrophically declined, apparently due to the disappearance of the very need for a global understanding of ongoing processes.

The phenomenon of Chinese elites' dependence on history is generated – however much it may sound like a pun – by the sheer length of the history of Chinese statehood itself. Existing empirical data indicate that the

centuries-long existence of a stable state, in and of itself, creates stable and self-reproducing state institutions, laying the foundation for the so-called *state instinct*; furthermore, the longer a stable state exists, the stronger this notorious instinct becomes (Bockstette et al., 2022). This fact largely explains China's virtuoso maneuvering on the international stage after 1949, which stands in sharp contrast to the naive actions of late Soviet elites and current Russian politicians. Some analysts believe that Chinese chronicles, say, from the Three Kingdoms period (3rd century AD), provide a wealth of information on how warring states and leaders form coalitions with each other, then commit betrayals, with the most cunning ultimately winning; these plots are known to all Chinese, as they form the basis of still popular novels and plays (Ponarin, 2025). It is possible that such knowledge makes Chinese politicians more mature and experienced compared to many Western colleagues.

The factor of history establishes a unique mental tradition among Chinese elites, yet it is complemented by a very distinctive personnel policy (the second term on the right side of formula (2)). Its essence lies in maintaining two processes: the top leadership of China regularly consults with former leaders on key issues, thereby ensuring the continuity of the state decision-making process (Li, 2025, p. 71). When appointing the top party and state leader, the opinions of retired leaders, such as former members of the Standing Committee, are taken into account (Li, 2025, p. 74). The tradition persists to this day where current and retired leaders meet annually in the resort city of Beidaihe to exchange views on upcoming personnel appointments. This tradition is difficult to overestimate for stabilizing the entire system of state decisions and for avoiding sharp and ill-considered turns in domestic and foreign policy.

The above is sufficient to understand that the diversity and effectiveness of the system of checks and balances on power elites in China is not lower, but higher, than in Western countries. Hence the effectiveness of the decisions made.

Hegemony, Chinese style: The evolutionary aspect

China's growing might has brought the question of its future global hegemony to the fore. However, Daokui Li denies such aspirations on the part of the Celestial Empire. This is manifested in two overarching principles of the country's foreign policy. First: refusal to export the Chinese model. Second: rejection of aggressive diplomacy, i.e., diplomacy is merely an extension of domestic business. Let us examine these principles in slightly more detail and show that the true state of affairs is somewhat more complex than Daokui Li presents to us.

The refusal to export the Chinese model is generated primarily by its impossibility. Expanding the logographic writing system and the spoken language with its modulations beyond China's borders is practically impossible; it is equally problematic to impose one's religious and philosophical canons on the Muslim world and Western countries; an attempt to transfer communist and socialist principles would be no less dubious. Chinese elites understand that any attempts to move in these directions would provoke enormous local resistance and only increase fear of the Celestial Empire. In this regard, the refusal to export the Chinese model is not a voluntary renunciation of global hegemony but a consequence of the impossibility of its realization in traditional forms. It appears that the expansion of Chinese influence will continue, including through the search for new forms to ensure this influence.

The rejection of aggressive diplomacy imposing its interests on the world is also not related to China's goodwill. The CCP leadership understands that the country's enormous population generates high complexity in

maintaining internal order. In such a situation, foreign policy serves as a complement to domestic policy, not vice versa; any overextension of forces on the foreign policy arena is fraught with the country's disintegration. Therefore, external markets are used as a space for the expansion of domestic production and the strengthening of the state's economic might. At the same time, experience shows that China very consistently and firmly defends its foreign economic interests.

Thus, the external absence of overt claims to global geopolitical dominance by China is associated with the cultural limitations of its civilization, and by no means with the peacefulness or pliability of its leadership. At the same time, the Celestial Empire's aspiration for dominance is not absent but hidden behind the veil of a "calm" foreign policy. However, beneath this lies a deep philosophical foundation that strongly distinguishes China from the West. To understand these differences, it is sufficient to refer to the theory of natural selection in its two interpretations. The first interpretation belongs to Charles Darwin: *the strongest survives (wins)*. The second interpretation is associated with the names of Alfred Russel Wallace and Thomas Malthus: *the weakest perishes (loses)* (Lipton, Bhaerman, 2010, p. 198). The Malthus – Wallace interpretation predisposes people and state elites to *self-improvement* so as not to be worse than others, while Darwin's interpretation predisposes them to *fight* for their primacy. The West has traditionally followed the Darwinian paradigm, while China has chosen the Malthus – Wallace paradigm for itself. However, the difference between the two paradigms signifies a difference in the tactics for securing a privileged position, not in the ultimate goal.

The above allows for a better understanding of China's foreign policy stance – it will not allow itself to become weak and will fight for its privileges in the geopolitical system, but it will do so not recklessly, by overextending all its forces and resources, but step by step, gradually, and systematically. For the Celestial Empire, it

is completely unimportant whether it will be officially proclaimed the global hegemon or not; the main thing is to be strong enough to guarantee the inviolability of its vital interests from external threats. Considering that the main threat to its interests is the United States, it needs to be not weaker than them, and that precisely signifies global hegemony. Thus, China's impending hegemony is hidden and wrapped in a more rational philosophy, but it does not disappear. In this regard, by analogy with the concepts of hard and soft power introduced by Joseph Nye (Nye, 2023), one can speak of *hard* and *soft hegemony*. If the United States adhered to the doctrine of hard hegemony with its characteristic forceful diktat, China adheres to the doctrine of soft hegemony in the form of peaceful (economic and diplomatic) pressure. This constitutes the uniqueness of the emerging new world order with the Celestial Empire at its head.

Today, there are numerous practical manifestations of the “Chinese approach” in foreign policy. For example, on the one hand, in response to the West's intimidation of the “Global South” countries with the threat of Chinese dominance, the CCP leadership proclaimed the Celestial Empire not an external player but an integral part of the so-called “Global South,” thereby trying to soften the confrontation with representatives of such a large regional bloc (Lomanov, 2024). On the other hand, the CCP's foreign policy stance on the unity of three ideological constructs – “Community with a Shared Future for Mankind,” “profound global changes,” and “Chinese-style modernization” – can only be realized based on the leading role of the third element, whereby a strong China unites the destinies of other peoples and steers all global changes in the right direction. Therefore, the CCP's main task is building a strong, modernized state, which constitutes the “highest form of politics” (Lomanov, 2024).

Chinese ideologues have masterfully distinguished between such fundamental

concepts as “shared values” and “universal values”: the former genuinely exist and include the human right to a prosperous life, freedom, justice, democracy, etc., but all these shared values are realized in diverse institutional forms depending on the cultural traditions and preferences of peoples. Under the guise of “universal values”, the West has attempted to impose its own institutional model for realizing “shared values” on other countries, under the banner of its non-alternative nature (Lomanov, 2025). This interpretation allows China, on the one hand, to align with the West in sharing these common values (content), and on the other hand, to preserve its historical and cultural distinctiveness (form). However, this can only be achieved by strengthening the country's material might—a point on which Soviet ideologists erred when they attempted to embark on a path of reforms hoping for equal rights with Western civilization without the Soviet Union having achieved the necessary level of economic power.

Economic coordination, Chinese style

The Celestial Empire's gigantic economy itself presents a huge management challenge. The main complexity lies in coordinating all links of a vast and extremely heterogeneous economy to impart a unified vector of movement and development. For this purpose, a special economic coordinating body was created in China – the National Development and Reform Commission (NDRC), which is part of the structure of the PRC Government and was originally called the State Planning Commission of the PRC. The significance of the NDRC is difficult to overestimate, primarily due to its extremely broad mandate. The head of the NDRC holds a status above that of ordinary ministers; the commission includes various departments and a complex of research organizations (Li, 2025, p. 107). However, in

addition to everything else, the peculiarity of the NDRC's work lies in the heterogeneity of the functions it performs, which allows it to reach a new level of coordination in the economic life of a vast country. Let us examine this feature in more detail.

The macroeconomic function of the NDRC involves constant monitoring of all significant prices, inflation and unemployment levels, the scale and growth rates of all economic sectors, formulating sectoral plans, etc. Depending on the prevailing situation, decisions are made to regulate it. These decisions may fall under the purview of various ministries and agencies, but their final approval and coordination are carried out by the superior body – the NDRC. Thus, the managerial capabilities of economic agencies are limited by the NDRC's final verdict.

The price regulation function concerns socially significant goods and services. The NDRC controls prices for electricity, gasoline, education, and medical procedures. These are zones of the government's strategic responsibility. For example, gasoline prices cannot be left to float freely because China has the largest domestic automobile market (annual sales of 27 million vs 18 million in the USA, with a total of 270 million vehicles in the country vs 260 million in the USA) (Li, 2025, p. 110). Stock market prices are also subject to regulation. For instance, when stock prices are too high, the government stimulates IPOs to cool the market, and when they are too low, it temporarily bans IPOs (Li, 2025, p. 114). The NDRC has also intervened in pricing for MBA programs at Western universities in China: complaints about excessive prices of \$100,000 for two years of study were heard by the government, resulting in corrective measures (Li, 2025, p. 111). Although the NDRC faces criticism from all sides for excessive price control, the agency continues its work in this direction.

Controlling the launch/ban of large investment projects aims to prevent economic overheating or excessive cooling. Since the ultimate losses from bankruptcies fall on workers, local authorities, and banks, the NDRC prohibits new projects in sectors with excessively low prices and overcapacity. Ignoring prohibitions entails strict penalties. For example, in 2003, an entrepreneur who violated the ban on building new steel plants received an actual prison sentence (Li, 2025, p. 111). The NDRC also issues permits to city authorities for subway construction; such control is related to fears that such projects may improperly increase the debt burden on regional authorities. To prevent overheating in the housing market, the NDRC introduced an original restriction: each family in Beijing is allowed to purchase only two real estate properties; foreigners can purchase only one property after five years of residence in the city (Li, 2025, p. 113).

Product quality control is also linked to the patronage of the population by Chinese authorities. For example, in China, when an unsafe product is found on the market, consumers lodge complaints not with the manufacturer, as in the West, but with the government through the complaint submission system. Being the guarantor of product quality, the government particularly rigorously controls market products. For instance, in China, only 30% of motorcycles meet environmental standards, which provokes enhanced control by the NDRC (Li, 2025, p. 113). However, this is not all. For example, since the 1990s, motorcycles have been either completely banned in all major cities of the PRC or the issuance of registration documents for them has been severely restricted; entry onto most highways is also prohibited for motorcycles. The authorities' motivation is as follows: motorcycles are dangerous for the riders themselves, they interfere with pedestrians and other vehicles, and are often used by criminals (Li, 2025, p. 106).

Globally, the NDRC’s activities are governed by two informal principles – *the primacy of social stability and economic development, and the principle of delicacy and prudence (Figure)*. The first principle is a direct consequence of the principle of comprehensive responsibility of the Chinese government, which compels NDRC staff to intervene in economic life when threats to social stability or disruptions in economic development arise. To indifferently observe unfolding problems would violate the entire Chinese mentality and the meaning of the CCP’s proactive role. The second principle is also a consequence of the very essence of the NDRC’s activities – it must reconcile the positions of different departments, find reasonable compromises, weigh all arguments, and fend off lobbying attacks from influential groups. To avoid being in constant conflict with everyone, NDRC staff have developed not just prudence but also a special sensitivity in their work and a kind of exceptional delicacy. Otherwise, there would be no end to grievances, and the agency’s effectiveness would be lost.

The above demonstrates how finely balanced the Celestial Empire’s economic management system is. Moreover, the leading role of the CCP gives rise to an extremely high business culture

and art of communication among officials, which is almost impossible for other countries to adopt, as it presupposes special national traditions that are insufficiently prevalent in the Western mentality. Let us recall that in Russia, the creation of a government body similar to the NDRC has been proposed systematically and for a long time (Polterovich, 2016; Polterovich, 2023a; Polterovich, 2023b), but this idea has not gained support.

Universal principles of the Chinese governance system

The model of Chinese power self-organization examined above reveals many important aspects of the Celestial Empire’s national governance system. However, in addition to all this, this model is permeated with certain universal principles that are projected onto different spheres of life and help harmonize social relations. Below, we will examine three such principles with some practical applications.

1. *Common sense*. This principle may seem trivial, but experience shows that consistently cultivating it is not so simple. The essence of the principle is to adhere to the simplest possible solutions, paying no attention to any theoretical templates or dogmas.

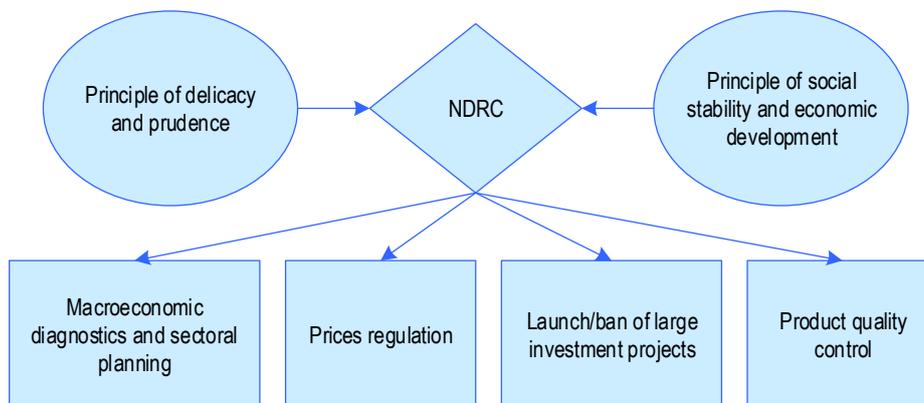


Figure. Functions of the National Development and Reform Commission

One manifestation of this principle lies in the mission of the country's top leader. The issue harks back to the long-standing debate about the role of the individual in history (Plekhanov, 2013). However, the Chinese establishment has simplified and concretized this problem with the thesis that each supreme leader must initially fulfill a specific mission for which he is well-suited by his personal qualities. Xi Jinping was chosen to build a modern China with an orderly governance system led by an ethical and effective CCP (Li, 2025, p. 54), and to ensure economic growth without harming culture and the environment (Li, 2025, p. 88). The realization of the first task is aided by Xi's personal qualities – he has a personal aversion to corrupt officials and calls them scum of society (Li, 2025, p. 55). This attitude guarantees that no abuses will be covered up by the country's supreme ruler. To achieve the second task, Xi acted as the ideologist of the new course, putting forward the vivid slogan that “green mountains and clear waters are more valuable than gold mountains and silver rivers” (Li, 2025, p. 88). If Xi Jinping did not possess these personal qualities and attitude, he would not have been chosen for such a high post. This is essentially the triumph of common sense on the question of the role of the individual in history – no a priori assumptions about democratic elections, popular votes, etc., are taken into account.

An example of the triumph of common sense in governance is the principle of the CCP's monopoly on power, based on the system of relations between business and government according to a simple rule: “Be close to the government, but stay away from politics” (Li, 2025, p. 142). In other words, business can enter politics and participate in politics, but it cannot determine policy itself. To control the process of people transitioning from business to power, China has the All-China Federation of Industry and Commerce, which closely interacts with

the CCP and serves as a channel for supplying people from business to government (Li, 2025, p. 140). Thanks to such a system, business in China, on the one hand, is not discriminated against, and on the other – does not interfere with the authorities in implementing national policy. Again, no liberal assumptions about the need to ensure equal access to power for all contenders are taken into account.

2. *Naturalness (conformity with nature)*. This principle serves as an additional test for common sense and implies following the natural logic of the managed system. Sometimes it is easier to perceive a situation through the antithesis of naturalness, i.e., by checking for its unnaturalness.

A vivid manifestation of the principle of naturalness is the elite's approach to eliminating popular protests not by restricting freedoms (mass demonstrations, rallies, etc.) but by addressing their root causes. The elites reasonably believe that many protests are caused by specific problems (water pollution, loss of savings due to fraudulent schemes, etc.), and therefore, these primary problems should be solved, not blame shifted onto the protesters. This is indeed quite reasonable and natural, and thus yields positive results.

Another example of the principle of naturalness is the periodic use of administrative interventions in various areas of the economy. For instance, restrictions on IPOs are introduced when the stock market overheats. This contradicts existing market regulation practices; however, Chinese authorities consider it reasonable to manually adjust the market if the standard mechanism is clearly leading in the wrong direction.

Even more impressive is the principle of limiting historical retrospection when resolving foreign policy issues. Chinese authorities believe that all the country's major foreign policy disputes were resolved by the time of the PRC's founding – by 1949. Accordingly, all of China's territorial

claims against other countries disregard the situation before 1949. At first glance, this seems entirely natural and simple, but many countries do not adhere to this approach. For example, Armenia and Azerbaijan endlessly delve into history in their claims over Karabakh (Artsakh). Israel and Palestine do something similar, and most recently, Venezuela and Guyana.

Finally, the aforementioned paradigm of soft hegemony takes the principle of natural selection into account to the greatest extent, but in the interpretation of Wallace – Malthus. This allows securing the country's privileged position without excessive strain on its forces and resources. The antithesis is the United States, which is willing to risk the very existence of the planet to preserve its leadership. The USA serves as an example of a positive test for the unnaturalness of its policy.

3. *Managerial paranoia*. This principle was mentioned earlier and signifies for any manager “worrying about tranquility”: power must vigilantly guard social stability. It is curious that this quality of the Chinese elites is completely natural and normal, as it fully corresponds to all systemic laws known today. This thesis may seem controversial, which is why we will demonstrate its alignment with fundamental economic and cybernetic principles.

The first is the cybernetic law of W. Ross Ashby, sometimes called the Law of Requisite Variety: the complexity (variety) of the managing subsystem must be no less than the complexity (variety) of the managed subsystem (Balatsky, 2013). This means that the range of actions and mobility of the power elites must exceed the corresponding parameters of the economic system. It is easy to see that such a requirement inevitably gives rise to managerial paranoia.

The second cybernetic principle is the law of E. A. Sedov, also known as the Law of Hierarchical Compensation: in a complex, hierarchically organized system, *an increase in variety at the upper level of the system is ensured by limiting variety at the previous levels*, and conversely, an increase in variety at the lower level destroys the upper level of organization, i.e., the system as such perishes (Nazaretyan, 2007; Gurina, Bedash, 2014). It follows that if the power elite is insufficiently active and effective, it is forced to restrict the freedoms of the population – which is extremely undesirable and dangerous – thus further stimulating the elites to be active.

Currently, the so-called Goodhart's law is gaining increasing significance: when a certain indicator (metric) becomes a target, it ceases to be a good indicator (Balatsky, 2013). Consequently, no formal metrics can serve as a control tool for long, as the living participants of a social system will eventually learn to circumvent and exploit them for their own purposes. This means that no formal system for evaluating the results of a managed system, no matter how successful initially, can work for too long; sooner or later, it will have to be either modernized or completely replaced. In this regard, representatives of power have no right to relax and must constantly keep their finger on the pulse, which is precisely what managerial paranoia entails.

An important clarification to Goodhart's law is the so-called de Bruijn wave, which represents a parabolic curve on a plane where the horizontal axis measures the degree of enforcement (level of compulsion) in a management system, and the vertical axis measures the effectiveness of that management system. This curve covers four stages of managerial actions: increasing the transparency of the observed process, training the managed individuals, evaluating management effectiveness, and rewarding

the managed (bonuses/sanctions); the rising curve has an inflection point at the evaluation stage and becomes declining at the sanctions stage (de Bruijn, 2005). Thus, the more management relies on a quantitative system for evaluating effectiveness, the stronger the incentives for workers to engage in counteraction. This again leads to the situation where the ruling elites have no right to relax and must constantly recheck their monitoring system and then restructure the management system, which constitutes the notorious managerial paranoia.

Thus, the managerial paranoia characteristic of Chinese elites is not an anomaly or a pathological trait but represents an absolutely normal and natural phenomenon. What is abnormal is precisely its absence in power circles.

It is interesting that the three aforementioned management principles of the Chinese elites demonstrate a kind of *nesting effect*: the principle of naturalness is always permeated with the requirement of common sense, and managerial paranoia strictly corresponds to both common sense and naturalness. In this way, the managerial elites of the Celestial Empire naturally elevate their activities from ordinary common sense to permanent managerial responsibility.

From a practical point of view, these universal principles are difficult to adopt and copy by other countries and peoples. This is quite understandable, as these principles require a certain unique culture and national mentality. The historically established system of relations in China between elites and masses, based on the “parent-child” principle, plays a significant role here. It can be argued that it is precisely the total common sense, naturalness, and managerial paranoia that constitute the unique cultural core of China, which predetermines its current successes.

Conclusion

Examining the deep-seated factors driving the Chinese elite self-organization model has allowed us to identify its main elements, many of which necessitate a revision of traditional views on the political process.

Firstly, the monopolistic role of the CCP in the power system, contrary to liberal theses, has evident advantages. These include the absence of a struggle for power, which saves costs and allows the party leadership to focus on its primary function—governing the country. Moreover, the CCP’s power monopoly does not lead to discrimination against the rest of society, whose representatives have practically unlimited opportunities to build careers in science, the arts, and business. The restriction on non-party citizens’ access to power is compensated by the heightened activity of party members, who can distinguish themselves both in government and in other spheres of activity.

Secondly, the CCP’s self-organization model comprises six elements (scale, hierarchy, sequential career progression, meritocracy, total absence of immunity from criminal prosecution, and the existence of the death penalty), which possess a natural immunity against degradation and degeneration. The existing model hinders the career advancement of unsuitable personnel while simultaneously allowing for the timely weeding out of “spoiled” individuals. This state of affairs helps maintain the high effectiveness of state governance in the country.

Thirdly, the CCP’s self-organization model is complemented by a system of checks and balances on power, which in China includes not only formal institutions (e.g., the practice of filing complaints against government representatives) but also informal institutions such as the mental and personnel traditions of considering the historical factor. In the first case, political leaders, when making critically

important decisions, take into account as fully as possible both historical retrospection and the historical perspective (their place in the memory of descendants). In the second case, top-level personnel appointments are made considering the opinions of former party and government leaders. All this fosters historical continuity and a state instinct within the elites, which become the key assets of Chinese managers when solving complex issues.

Fourthly, China's refusal to export its model and its adherence to the theory of natural selection in the interpretation of Malthus–Wallace, rather than Darwin, orient its elites towards self-improvement rather than a struggle for primacy. By analogy with the concepts of hard and soft power introduced by Joseph Nye, one can speak of hard and soft hegemony. If the United States traditionally adheres to the doctrine of hard hegemony, China adheres to the doctrine of soft hegemony, which mitigates the excessive aggressiveness characteristic of an era of changing world order.

Fifthly, for the global coordination of all links within a vast and extremely heterogeneous national economy, China operates a special agency – the National Development and Reform Commission (NDRC), a kind of modern-day State Planning Commission of the PRC. Combining the functions of macroeconomic diagnostics and sectoral planning, price regulation, approval/ban of large investment

projects, and product quality control allows it to ensure the timely balancing of all aspects of Chinese society's life.

Sixthly, the activities of Chinese elites are permeated by three dominant principles: common sense, naturalness (conformity with nature), and managerial paranoia. These, in turn, are subject to a nesting effect: the principle of naturalness is always permeated with the requirement of common sense, and managerial paranoia strictly corresponds to both common sense and naturalness. These qualities allow the power elites of the Celestial Empire to elevate themselves from ordinary common sense to permanent managerial responsibility.

Most of the considered institutional elements of the Chinese governance model are not visible or publicly advertised, yet they determine the country's success over the past several decades. Russia, as well as most other countries, would do well to examine these elements most attentively and begin work on adapting them to their own political and economic systems. At the same time, Russia already has a certain foundation for borrowing Chinese experience: the existence of a ruling party (“United Russia”); the presence of special bodies for handling public complaints; the ongoing purification of elites influenced by the special military operation, etc. In the future, this foundation should be strengthened and refined, bringing it to mature institutional forms.

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BUDGET PROCESS DIGITALIZATION AT THE MUNICIPAL LEVEL: PROBLEMS AND PROSPECTS OF DEVELOPMENT



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In recent decades, digitalization has firmly entered the sphere of state and municipal administration, including the budget system of the Russian Federation. Currently, the concept of electronic budgeting is actively developing and being implemented both at the federal and regional levels, which is confirmed by extensive scientific research. However, the issue concerning the use of digital technologies in the budget process remains insufficiently studied. The aim of our work is to identify the problems and prospects of digitalization of the budget process at the municipal level to find effective ways to overcome emerging technical, personnel, organizational and institutional difficulties. For this purpose, we conducted in-depth interviews with 45 experts in the field of budget system development, namely government and municipal employees from various Russian regions, and specialists from federal financial authorities. The paper outlines the specifics of the digitalization

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of the budget process of municipalities, the problems that arise are classified into groups: technical, personnel, organizational, institutional, and the compliance of this issue with international practice is noted. The article reveals that the updating of technologies and the legislative framework does not occur synchronously, which reduces the effectiveness of implementing digital solutions in the budget process. The role of the internal public finance management system is defined, the features of using various software solutions and the problems of their integration with the state integrated information system are presented. The conducted research allowed formulating proposals for improving the digitalization of the budget process, make recommendations on the integration of various information systems, create a single training resource and improve methods of technical and organizational support in the field.

Electronic budget, digitalization, digital technologies, local government, interviews, regions and cities of Russia.

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Introduction

Over recent decades, the development of telecommunication networks, especially the internet, and the active implementation of technologies have significantly transformed approaches to state and municipal governance worldwide. One of the key directions of this new policy has been e-budgeting, which contributes to improving the quality, accessibility, transparency, and speed of providing state and municipal budget services (Leiman, 2011; Abramov, Andreev, 2023). According to data from a separate territorial body of the Federal Treasury, the daily volume of transactions at the regional level has reached an average of over 65 million rubles per day¹.

In Russia, the active use of information and communication technology (ICT) capabilities in the public sector began with the launch of the “Treasury’s Automated System” (PPO AS FK) within the framework of the Federal Target Program “Electronic Russia” in 2002–

2004, and continued with the implementation of the state integrated information system (GIIS) “Electronic Budget”. Since 2011, these measures have led to the formation of more effective revenue and expenditure structures for municipal budgets, simplified administrative procedures for officials, and increased the degree of involvement of interested residents in the processes of budget formation and expenditure (Gron, 2012).

The use of information and communication technologies (ICT) in regional and municipal budget work has many advantages, but only with well-tuned algorithms and uninterrupted operation of equipment and data transmission networks, which is possible with an organized information security system. However, about 24% of Russian organizations still do not use means of protecting information transmitted over global networks². An important remaining factor is the insufficient qualifications of state and municipal employees: according

¹ Federal Treasury Department for the Altai Territory. Quantitative indicators for 2024. Available at: <https://altay.roskazna.gov.ru/o-kaznachejstve/istoriya-ufk/3-sovremennaya-istoriya-razvitiya-ufk-po-altayskomu-krayu/istoriya-v-tsifrah/kolichestvennye-pokazateli-za-2024-god>

² Federal Treasury Department for the Altai Territory. Quantitative indicators for 2024. Available at: <https://altay.roskazna.gov.ru/o-kaznachejstve/istoriya-ufk/3-sovremennaya-istoriya-razvitiya-ufk-po-altayskomu-krayu/istoriya-v-tsifrah/kolichestvennye-pokazateli-za-2024-god>

to data from the Russian Ministry of Digital Development and Rosstat, the share of state and municipal employees who received training in digital transformation competencies was 0.4% in 2021 and only increased to 0.7% in 2022 of the total average number of employees in organizations³. As a result, problems with ICT implementation, including in budget processes, have intensified both in Russia and in other countries worldwide (Losev, Karas, 2018; Wiredu, 2010; Effah, Nuhu, 2017).

The aim of this work is to identify and analyze the problems of digitizing the budget process at the municipal level to determine prospects and develop recommendations for further development. The scientific novelty of the research lies in identifying (using the method of in-depth interviews with a wide range of practicing experts) and systematizing the problems of digitizing the budget process at the municipal level in Russia, which have been classified into groups (technical, personnel, organizational, and institutional). The correspondence of the identified problems with international experience has been established, and systemic and situational difficulties characteristic of the local government level have been specified. Directions for the optimal development of budget process digitization in municipalities are proposed, along with recommendations for forming a unified information system from disparate components, creating a unified educational resource, and improving methods of technical and organizational support on the ground.

Problems of budget process digitalization (literature review)

Based on the analysis of publications by Russian and foreign researchers, we

can distinguish four blocks of problems in budget process digitalization: technological, institutional, organizational, and personnel-related. Let us examine them in more detail.

The most common difficulties remain those related to the technical functioning of information systems used for public finance management. Despite the implementation of the “Electronic Budget” system since 2015, challenges with data entry and processing persist (Podosinnikov et al., 2016). Additional difficulties are caused by a shortage of necessary equipment, the use of morally obsolete technologies, and the absence of modern software solutions, which reduces the efficiency of financial department employees (Losev, Karas, 2018).

Similar problems are observed in other countries worldwide, possibly because the digital transformation of the budget process “has an artificial character, and the system rejects them due to being unprepared for adoption” (Blinichkina, 2024). In local government bodies in Ghana, difficulties with obtaining access arose when using information systems for working with public finance data (Effah, Nuhu, 2017). Insufficient equipment capacity is a challenge faced in South Africa (Hendriks, 2012). Meanwhile, in European countries, investments in digital technologies are recognized as an important factor for socio-economic growth (Rastvortseva et al., 2023; Lnenicka et al., 2024).

Institutional complexities include, for example, the slow change in the regulatory framework to consider the needs for ICT in the budgetary sphere (Ermakova, Gureeva, 2018; Uskov, 2024). Although the regulation of the GIIS “Electronic Budget” is stipulated by the Budget Code of the Russian Federation, the current

³ The number of state (municipal) employees and employees of institutions who have been trained in competencies in the field of digital transformation of public and municipal administration. Available at: <https://www.fedstat.ru/indicator/62111> The average number of employees in a full range of organizations since 2017. Available at: <https://www.fedstat.ru/indicator/58699>

public finance management system does not fully cope with the tasks of effective administration and poorly accounts for regional specificities. This reduces the interest of state and municipal employees in its use (Losev, Karas, 2018).

Organizational complexities include the persistence of internal paper-based document flow, inconsistency in digitalization policies, untimely updates of the regulatory framework concerning functionality (Wiredu, 2010; Hendriks, 2012; Effah, Nuhu, 2017), disruptions in the operation of information systems, and a lack of interaction between different divisions of government bodies (Wiredu, 2010).

Another organizational difficulty is the insufficient realization of one of the key tasks of budget process digitalization – ensuring the accessibility and transparency of financial information for a wide range of citizens. The “Electronic Budget” system lacks the capability to create personalized user accounts, and the presented information is often difficult to understand (Efimov, 2018). This is apparently due to a deeper systemic problem: in Russia, accessible and understandable explanations for most draft laws have still not been developed, which, in turn, reduces citizen engagement in public and legal participation processes (Molchanova, 2017).

The shortage of qualified personnel remains a significant obstacle. Employees are forced to adapt to constantly updating requirements and changes in system operating rules, which not only complicates their work but also leads to a decrease in data processing quality (Losev, Karas, 2018; Timushev, 2023). Similar personnel difficulties are recorded in other countries. For instance, in Chile, Bolivia, and the United Kingdom, a shortage of specialists with the necessary digital competencies is noted, while in South Africa, researchers estimate a significant obstacle is the generally low qualification level of the existing staff (Berthin et al., 2004; Wiredu, 2010; Hendriks, 2012).

Thus, the digitalization of the budget process at the municipal level in Russia faces problems similar to international ones. Solving them requires a comprehensive approach: modernizing information systems, updating legislation, improving organizational structure, and developing personnel.

However, questions remain regarding the scale of e-budgeting implementation in municipalities and the consequences of applying digital solutions. The relevance of studying digitalization is heightened in the context of emerging new technologies – the digital ruble, artificial intelligence, and lean management. Deep analysis and timely elimination of the identified problems will form the basis for a successful transition to new technological solutions and for increasing the effectiveness of public finance management.

Research methodology

To identify the problems and features of budget process digitalization in municipalities, we conducted in-depth interviews with experts and practitioners in the field of the budget process (*Tab. 1*). This methodology aligns with research (Berthin et al., 2004; Effah, Nuhu, 2017) where interviews were conducted with different groups of respondents depending on their role in the budget process.

The respondents for the interviews were employees of organizations and specialists, predominantly with work experience ranging from 10 to 35 years. The duration of each meeting was between 30 minutes and 1.5 hours. Interviews were conducted either in person or by phone.

The main topics covered key aspects of the establishment and development of budget process digitalization, from the first mentions and perception of the idea of implementing the “Electronic Budget”, including the introduction of own financial management systems in

Table 1. Composition of participants in in-depth interviews on budget process digitalization at the municipal level

Group	Category of respondents	Quantity	Organization / region
Internal	Specialists, IT Department	2	Ministry of Finance of the Russian Federation
	Specialist, Department of Legal Regulation of Budgetary Relations	1	Ministry of Finance of the Russian Federation
	State civil servants of regional financial bodies	19	Krasnodar Territory, Stavropol Territory, Khabarovsk Territory, Republic of North Ossetia – Alania, Karachay-Cherkess Republic, Republic of Mordovia, Arkhangelsk, Volgograd, Irkutsk, Kaluga, Kaliningrad, Kirov, Kostroma, Nizhny Novgorod, Novosibirsk, Saratov, Sverdlovsk, Smolensk, Chelyabinsk regions
	Municipal servants	21	6 municipal districts, 3 municipal okrugs, 2 urban okrugs of Stavropol Territory, Republic of Crimea, Vladimir, Volgograd, Vologda, Kaluga, Kirov, Orenburg regions
External	Expert from the ANO "Center for Strategic Research"	1	ANO "Center for Strategic Research"
	Deputy director for business development	1	Company-developer of the GIIS "Electronic Budget"
Source: own compilation.			

regions and municipalities, to the final stage of project implementation, as well as user participation in this process. A separate block of questions, occupying about 60% of the time, was dedicated to identifying problems within the previously outlined categories: technical, institutional, personnel, and organizational. To assess the degree of interaction between levels of government, clarification was also sought on which problems at the local level are the most acute and persistent from the perspective of municipal servants, and which ones are from the perspective of state civil servants.

Research results

The establishment of budget process digitalization in Russia

The digital transformation at the regional and municipal levels began in 2002 with the launch of the Federal Target Program

“Electronic Russia”. However, some regions had already started implementing digital technologies on their own initiative as early as 1992. As one specialist from the Russian Ministry of Finance noted, “regions with greater budgetary capabilities could purchase programs for digitizing individual processes, but there was no unified digitalization strategy”⁴.

Starting in 2002, the active automation of the budget process commenced, and the first information systems for budget planning and execution were developed. From 2011 to 2021, informatization took on a systematic character: a system for interagency electronic interaction was introduced. Within the framework of the state program “Information Society”, the State Integrated Information System (GIIS) “Electronic Budget” was created⁵. This was also accompanied by a growth in expenditures under the “Communications and Informatics”

⁴ Here and below, quotes from the respondents’ answers are given in quotation marks.

⁵ The concept for creation and development of the state integrated information system for public finance management “Electronic Budget”. RF Government Resolution 1275-r dated July 20, 2011.

line item: according to data from the Federal Treasury on the execution of consolidated budgets of the Russian constituent entities, the total volume of expenditures increased from 65.2 to 239.7 billion rubles.

The full-fledged establishment of the digital ecosystem in the budgetary sphere continued amidst the development of the GIIS "Electronic Budget" and the launch of the Unified Budget System Portal between 2012 and 2015. From an architectural standpoint, the GIIS "Electronic Budget" became the main operational environment for participants in the budget process (employees of financial bodies), intended for the planning, execution, accounting, and control of budgetary funds. In turn, the Unified Budget System Portal (UBSP) is primarily an external information resource, the "public face" of the system, ensuring the openness and accessibility of budget data for citizens. The UBSP is functionally and informationally dependent on the GIIS "Electronic Budget," as the data for publication

on the portal is generated and loaded from the GIIS modules. Thus, the GIIS is an internal working tool, and the UBSP is its external interface, ensuring transparency. With the start of active dissemination of information about the UBSP, most state and municipal employees noted that budget digitalization actually began only in 2013–2016. Moreover, municipal employees tended to indicate an even later date. The actual connection to the GIIS for public finance management "Electronic Budget" started in the summer of 2015, from June to September, when authorities at all levels received the obligation to integrate into the system.

As early as the beginning of June 2015, almost a third of the total number of applications for connection from municipalities had been submitted. Active connection dynamics were observed further on, with municipalities connecting more employees – by the beginning of July, more than one employee per organization was already connected (Fig. 1).

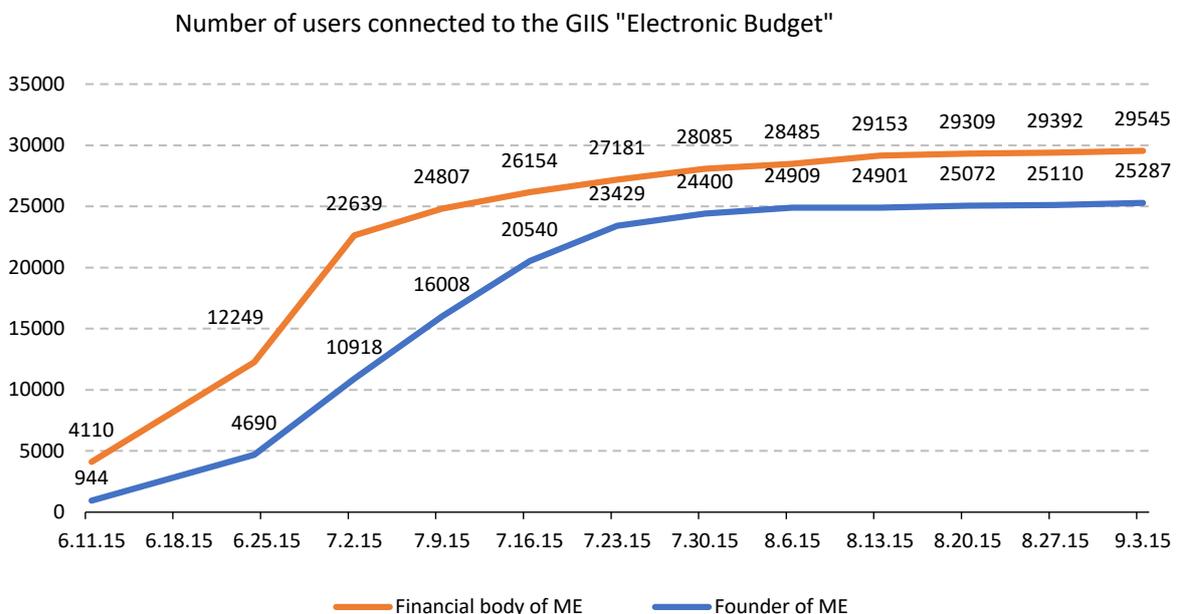


Figure 1. Dynamics of the number of users connected to the GIIS "Electronic Budget" after the portal launch

Compiled based on: statistics on user connections to the State Integrated Information System for Public Finance Management "Electronic Budget" as of June – September 2015. Federal Treasury. Available at: <https://roskazna.gov.ru/gis/ehlektronnyj-byudzhet>

Opinions on the significance of the budget process digitalization were divided. Many interviewees called it “long-overdue” and necessary, noting its potential for optimizing work, increasing transparency, reducing administrative barriers, and accelerating document flow. The creation of a unified digital ecosystem was seen as a step toward modernizing the budgetary system.

However, some respondents, primarily municipal employees, did not have a clear position regarding the reform. According to one specialist, the system seemed “new and incomprehensible”, with information being limited and generalized. Initially focused on the federal level, the system was rolled out to regions and municipalities without considering local specifics, leading to a formalistic attitude towards fulfilling the task.

Technical complexities and system diversity issues

From the start of the “Electronic Russia” Federal Target Program, local financial management systems emerged in each of the analyzed regions and municipalities. For automating accounting and all stages of the budget cycle, software products from third-party developers were used.

The deployment of the GIIS “Electronic Budget” locally was carried out gradually, taking into account the readiness level of individual system components and as relevant regulatory documents were adopted. Starting in 2018–2019, municipal users gained access to the system, which allowed for the legal formalization of agreements on transferring intergovernmental subsidies from regional to municipal budgets.

During 2018–2020, authorities began actively using the Unified Budget System Portal (UBSP), where, in accordance with Order 243n of the Russian Ministry of Finance dated December 28, 2016, they were obligated to post budget

information. This measure ensured centralized data storage and increased the transparency of the budget process.

It was then that a series of technical difficulties emerged – a block of problems noted by over 80% of the surveyed state and municipal employees. The GIIS frequently froze, data uploads failed, and the unified portal operated slowly. A certain pattern in system performance was observed: before noon, the GIIS worked relatively stably, but after the start of the working day in the European part of the country, the system slowed down significantly and sometimes stopped functioning altogether. To complete the process, as noted by a municipal employee from the Stavropol Territory, “one had to work at night”.

Problems also intensified particularly during reporting periods when the load increased. Budget drafting and approval in municipalities occur later than at the federal and regional levels, as it is necessary to consider higher-level plans. However, due to the large number of municipalities and late data uploads, the system could not handle the volume, indicating both technical and organizational issues. This problem was noted by many interviewed state employees who had to monitor municipalities and report on the untimely fulfillment of obligations at the federal level.

A representative of the Russian Ministry of Finance noted that the successful functioning of the GIIS directly depends on the interaction between regions and municipalities, particularly regarding advisory support. In his words, “the Ministry of Finance should not merely parrot instructions”. This means that the responsibility for on-the-ground information support should lie with the constituent entities of the Russian Federation. However, given the advisory nature of this work, in many regions and municipalities, it either was not conducted at all or was carried out to a limited extent and only on the regions’ own initiative.

Personnel-related difficulties of digitalization

Despite the launch of the GIIS “Electronic Budget,” its integration with existing regional and municipal platforms was never realized. One specialist from the Russian Ministry of Finance emphasized that the GIIS does not account for the specifics of local processes. Integration requires the purchase of additional solutions, for which municipalities often lack funds (Lyulko, 2023). According to the data cited earlier, the share of municipal expenditures under the “Communications and Informatics” line item in the consolidated budgets of the Russian constituent entities decreased from 3.8% in 2016 to 1.9% in 2023. The shortage of their own funds slows down the digitalization process at the local level.

In a number of regions that had their own developments in the field of financial management, integration with the GIIS “Electronic Budget” proceeded smoothly. However, for most constituent entities, this opportunity was limited, forcing authorities to manually transfer data into the GIIS. This was accompanied by significant difficulties, especially when preparing reports for the Unified Budget System Portal.

Such problems were apparently caused by methodological uncertainty – the absence of a clearly formulated structure and functionality for the GIIS from the Russian Ministry of Finance and the Federal Treasury. Initially, the “Electronic Budget” was developed for the needs of the federal level; regional proposals were not considered, unlike in the AIS “Finansy” (Finance), where an open approach with pilot regions and surveys was used. As one respondent noted, “they stopped asking because there was a lot of negative feedback regarding the final implementation”, which led to constant negativity and a lack of motivation among users to work within the system.

The personnel problem was noted by respondents as significant: without technical support from the financial bodies of the Russian

constituent entities and developer companies, the implementation of internal systems and the GIIS would have been impossible. This problem remained unresolved for a long time, although specialists from the Russian Ministry of Finance suggested the possibility of addressing it through “programs to improve competency levels” in municipalities.

At the time of the study, regions were experiencing an acute shortage of qualified personnel, especially in the field of information technology. As the survey showed, not a single municipality had its own in-house system administrator. All configuration and maintenance work was performed remotely by employees of developer companies or specialists from the financial departments of the Russian constituent entities. For municipalities, digitalization created additional difficulties.

Staff training was fragmented. Only a portion of the employees (18% of those surveyed) participated in webinars, mainly organized by regional authorities. For instance, in the Vologda Region, the initiative to train employees was taken on by the Department of Finance and Tax Policy. The program included system installation and initial connection. To monitor material comprehension, especially in remote districts, checklists were used to assess how effectively the instructions were conveyed.

In the Novosibirsk Region, training for employees of municipal financial bodies took place at an institution subordinate to the regional financial authority. The seminars aimed to improve staff qualifications and enhance their interaction with the system. However, in a number of constituent entities, training either was not conducted at all or was limited to self-learning the system through “trial and error”.

Many municipal employees were also unaware of the opportunity to participate in video conferences and webinars organized by the Russian Ministry of Finance and the Federal Treasury. While information about such

opportunities was communicated centrally in regional bodies, at the municipal level, it often was not disseminated properly.

It should be noted that, despite initial plans, a unified training resource for working with the GIIS “Electronic Budget” has not been created to this day. According to one Ministry of Finance employee, “the idea of creating such a platform did not receive proper development” and, ultimately, remained unrealized.

Organizational complexities

In addition to personnel and technical difficulties, significant organizational problems emerged during the implementation and operation of the GIIS “Electronic Budget”. Difficulties arose with using electronic signatures and data entry, exacerbated by the lack of official instructions and lists of authorities. Sometimes data were displayed incorrectly or failed to load altogether.

Particular difficulty was caused by the daily posting of information according to Order

243n: the system’s interface was inconvenient, filters were absent, and published information could not be edited, which increased the risk of errors and complicated work.

Uploading information to the registry of budget process participants was also accompanied by failures. Municipal employees attributed this to a lack of clear methodological guidelines – the available materials were too general.

When technical errors occurred, contacting the support service often did not yield quick results: resolving problems took weeks, and sometimes help was not provided at all. Municipalities were forced to turn to regional financial bodies or seek help from colleagues in other municipalities.

In remote settlements, the situation was complicated by poor internet connectivity. In some cases, authority to work with the system was transferred to the regional level. Despite improvements, internet access in government bodies still does not exceed 60% (Fig. 2).



Figure 2. Share of organizations (by OKVED Section O "Public Administration and Military Security; Social Security") using the internet, as a percentage of the total number of registered organizations in OKVED Section O

Note: before 2016 – Section L "Public Administration and Military Security; Social Security". Data for 2020 are excluded due to the use of a different methodology for indicators. For 2021 and 2022, data on the use of fixed (wired and wireless) internet are used.

Calculated based on: Information on the use of digital technologies and the production of related goods and services (results of statistical observation form No. 3-inform). Available at: <https://rosstat.gov.ru/statistics/science>; Number of organizations according to state registration data from 2017. Available at: <https://fedstat.ru/indicator/58109>; Number of organizations according to state registration data up to 2016. Available at: <https://fedstat.ru/indicator/42930>

In one municipal district, a hacker attack was recorded, which led to the complete destruction of data and the impossibility of restoring it from backups. The new antivirus protection for the server proved ineffective, which became a reason for further use of paper-based document flow, as employees lost trust in new data storage methods and cloud technologies.

Institutional problems

During digitalization, institutional difficulties arose, related to the different speeds of change in technology and the legislative framework. The system’s functional capabilities often lagged behind the requirements established by regulatory legal acts. Municipal employees noted that in some cases they needed to post information using features that had not yet been implemented in the GIIS “Electronic Budget” at that time. This led to difficulties in fulfilling duties and created a situation

where compliance with legal norms became technically impossible.

Digital technologies in the budget process cannot keep up with legislative requirements, especially in emergency cases. One example of the system’s operational adaptation was the implementation of functionality for accounting for medical and child payments during the COVID-19 pandemic, which required prompt changes to the GIIS “Electronic Budget.”

Summary of problems and development prospects

Thus, the digitalization of the budget process not only complicated the work of municipal employees but also led to a number of situational problems, most of which were directly related to the system implementation stage and were resolved promptly, and systemic problems, requiring a comprehensive solution. Their list is presented in *Table 2*.

Table 2. Systemic and situational problems of implementing and operating internal systems and the GIIS "Electronic Budget" in the budget process at the municipal level

Type of problems		Systemic problems	Situational problems
Technical		Technical difficulties and inconvenience in data entry	System malfunctions
			Problem with Internet access
			Lack of software
			Hacker attacks
Organizational		Absence of a unified methodology for working within the system	
		Lack of consideration for regional and municipal specificities	
		Preservation of internal paper-based document flow	
		Disintegration of information systems	
Institutional		Different speeds of changes in the regulatory framework and technology implementation	
Personnel	Internal	Shortage of human resources	
		Shortage of IT specialists	
		Lack of qualified specialists	
	External	Limitations of participatory budgeting	
		Complexity and incomprehensibility (lack of transparency) of budget data for citizens	

Source: own compilation.

The digitalization of the budget process at the municipal level is already demonstrating positive results. The GIIS “Electronic Budget” operates stably, except during scheduled maintenance and reporting periods. The ability to filter and edit data has improved work flexibility; for example, at the request of employees in the Kostroma Region, a function for adjusting regulatory acts was added.

Nevertheless, problems such as delays in data updates, failures when filling out public pages, and the absence of a unified methodological manual persist. Although technical support responds within three days, the need to contact regional financial bodies and the Federal Treasury remains.

Looking ahead, an expansion of the system’s functionality is expected – the implementation of electronic signatures, services based on artificial intelligence, and voice interfaces. A complete transition of regions and municipalities to the GIIS, abandoning local solutions, is also possible.

The Russian Ministry of Finance plans the integration of subsystems and a transition to domestic software. Key development directions will be data protection, increased processing speed, and transparency. As a result, digitalization will bring benefits both to participants in the budget process and to citizens, enhancing information accessibility.

Conclusions and recommendations

Today, municipal employees acknowledge that the implementation of the GIIS “Electronic Budget” has increased the transparency of the budgetary system, but it has not led to a noticeable increase in efficiency. On the contrary, the duplication of functions with internal systems has increased the workload and complicated task completion.

Based on the conducted analysis, we conclude that regional characteristics critically influence the effectiveness of digitalization. Municipalities

with a high level of budgetary capacity and developed IT infrastructure adapt solutions faster and more successfully. At the same time, for many regions, key constraining factors are low population density, remoteness of territories, and a chronic shortage of qualified personnel. This negates the advantages of standardized digital solutions “tailored” to the federal level. Thus, the unification of processes without flexible adaptation to local conditions creates additional organizational and technological barriers rather than overcoming them.

To improve work within the system, it is necessary to develop accessible guidelines and implement an AI-powered chatbot to assist users. Modernizing subsystems to account for regional specifics and enabling open evaluation of functionality through the portal are also required.

The problem of internet access in remote regions remains relevant and can be addressed by connecting municipalities to federal programs for eliminating the digital divide. This would reduce the burden on district administrations and partially solve the personnel shortage.

To attract specialists, it is worthwhile to create programs similar to the “Zemsky Doctor” initiative. Technical issues should be handled by qualified IT specialists with decent remuneration (Zhulin et al., 2020).

It is necessary to include in plans professional development training on working with updates and integrating the GIIS with local systems. Regular webinars by the Russian Ministry of Finance and the Federal Treasury will help improve user competencies and reduce the number of support requests.

An important step will be synchronizing legislative changes with system updates, as well as implementing cloud data storage to enhance security.

Creating personal accounts for citizens within the GIIS will strengthen their participation in local budget processes.

Thus, budget digitalization has entailed both positive and negative effects. Implementing the proposed solutions will help eliminate the problems, and further research should be aimed at improving the efficiency of the digital budget at all levels of government.

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METHODOLOGICAL POSSIBILITIES FOR ASSESSING THE INVESTMENT POTENTIAL OF THE RUSSIAN REGIONS UNDER ECONOMIC UNCERTAINTY



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The complex uncertain economic conditions developing in a multi-layered regional space have created a number of obstacles to realizing the investment potential of the regions of the Russian Federation. These problems are superimposed on the significant socio-economic differentiation of the territories, which actualizes the need to find and implement new analytical tools capable of diagnosing investment opportunities and priorities in the implementation of investment decisions in the region. The prevailing economic conditions and uncertainty trends have led to a research interest formulated in the form of a goal related to the analysis and specification of key methodological tools and algorithms that allow the regional management system to effectively assess investment positions and priorities in a complex economic space, as well as to assess the investment potential, on the realization of which the productivity and viability of the entire national system depend. The scientific novelty of the research

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lies in monitoring the most relevant methods and approaches to assessing the implementation of the investment potential of the region, which, in conditions of economic uncertainty, contain various sources and databases accumulating heterogeneous parameters and indicators. The paper concludes that building complex methodologies and tools on such a complex structured basis allows taking into account the multidirectional, multilevel nature of modern regional investment processes. The theoretical and methodological basis of the research consists of works in the field of analysis and evaluation of investment processes. In the course of the work, methods of structural and logical analysis of sources and databases reflecting key parameters and metrics of the investment development of the region were applied. The analysis results made it possible to identify significant approaches and techniques that help assess regional investment processes in conditions of economic uncertainty. The results of the conducted research are of interest to federal and regional relevant agencies in terms of developing an investment strategy, forming the main provisions of economic policy and determining priorities in investment development.

Methodological approach, investment potential, regional investment conditions, investor, regional management system, priority areas of development, spatial heterogeneity, investment strategy.

Introduction

In the contemporary economic reality, characterized by high dynamism of financial and economic processes and intensifying competition for key types of resources, financial investments, as well as the monitoring and forecasting of key indicators of regional investment potential, are acquiring critical importance. This task is relevant both for potential investors, enterprises, and organizations seeking new sites for capital allocation, and for the regional governance system striving to ensure sustainable socio-economic development of a territory. This implies that without timely and sufficiently accurate assessment of a region's investment opportunities, effective strategic planning appears challenging.

Understanding the current situation and forecasting future trends help in making informed investment decisions at all levels of governance. In this context, the strategic plan for the socio-economic development of a region serves as a key instrument, unifying a multitude of documents regulating

investment activity (Shuliko, 2018). Namely, documents of this kind clearly define priority development directions, mechanisms for attracting investments, and criteria for evaluating the effectiveness of implemented projects (Kuchkovskaya, Novikova, 2018). Furthermore, constant evaluation of such activity is necessary, both across territories and in terms of key investment metrics, which will allow for the selection of promising projects and the implementation of comprehensive solutions that account for the most significant factors (Peshcherov, Solodilov, 2018).

The regional governance system, in addition to developing a set of strategic planning and forecasting documents, is tasked with forming investment priorities, which are currently constrained primarily by the limitation of financial resources (Solodilov, 2018). Accordingly, the ongoing foreign economic transformations and key national trends require not only administrative measures but also systematic work to improve the legislative framework, simplify

registration and licensing procedures, and enhance the transparency of government bodies' activities (Podmolodina et al., 2022), as these processes directly impact the effectiveness of implementing regional investment projects.

Conditions of economic instability predetermine a whole range of additional barriers, including investment barriers (Panenko, 2023), which are superimposed on a regional space characterized by significant differentiation of territories, including in the context of center-region relationships (Kuchkovskaya, Novikova, 2018). In particular, the uneven distribution of investment resources leads to increased economic inequality and deepens disparities between regions (Markova, 2022). The situation is exacerbated by the fact that in certain regions, significant capital outflow to more developed agglomerations is observed, leading to slower economic growth rates and socio-economic problems (Khmeleva, Treshchev, 2023).

For example, as of early 2025, the growth rate of civilian production is rapidly declining, which is associated with the tight monetary policy of the Central Bank, leading to decreased investment activity in the construction sector and a slowdown in consumer demand growth (Pozdnyakov, Markova, 2022). This creates a risk of crisis trends emerging in certain regions, including relatively developed ones (Krasnodar Territory; Leningrad, Sverdlovsk, and Novosibirsk regions, etc.) (Khashir et al., 2023). Solving such problems requires a comprehensive approach, encompassing not only economic but also legal, political, and social aspects, which should be combined within new mechanisms and algorithms for stimulating investments, including in depressed regions, by accumulating financial resources and creating favorable conditions

for the development of economic entities (Tishchuk, 2023). Contemporary conditions have predetermined the primary role of state institutions as key actors in investment activity, which, at the regional level, set strategic benchmarks for realizing investment potential (Perina, 2023). This means that the problem of assessing investment potential and selecting evaluation tools is one of the most important when developing strategic priorities for a region's economic development.

This formulation of the problem places upon the regional governance system not only the tasks of developing and adopting relevant laws and bylaws but also constant monitoring of their effectiveness, as well as adaptation to changing economic conditions based on the introduction of new methodological tools and algorithms that account for regional specifics, the degree of intra-regional differentiation, initial investment positions, etc. (Urasova, 2022). Thus, within the framework of this work, it is appropriate to consider the key methodological tools and algorithms that allow the regional governance system to effectively assess investment positions and priorities in a complex economic space, as well as to evaluate the investment potential, the realization of which determines the productivity and viability of the entire national system.

Methodological foundations

In scientific literature, the issue of assessing the development of regional investment potential is addressed using a range of methodological approaches. Primarily, one can speak of a macro approach, which is based on key macroeconomic indicators, such as production volume, gross domestic product, aggregate demand/aggregate supply,

inflation rate, etc. (Ershov, 2011). Experts note that most methodological approaches suffer from a drawback such as the linearization of investment processes, which oversimplifies the entire complexity of ongoing changes, affecting the nature of forecasts that are essentially extrapolations.

Currently, methodologies based on non-linear analysis methods are actively developing. For example, we can note a methodology based on “penetrating indicators” which allows for creating a regulated forecast of the investment process (Ershov, 2011). Such an approach entails computational complexity, sensitivity to initial data, difficulties in interpreting results, high demands on computational resources, etc. Furthermore, a methodology of scientific interest is one based on measuring the spatial heterogeneity of investment resource distribution across the constituent entities of the Russian Federation, serving as a form of assessing the relationship between investments and the real sector of the economy. In particular, such an approach utilizes spatial autocorrelation according to P. Moran’s method and the construction of L. Anselin’s spatial interdependence matrices (Naumov, 2021). This allows for identifying regions with a high concentration of investment resources, as well as mechanisms for reducing the heterogeneity of the spatial localization of investments (Naumov, 2021). However, this approach is associated with complexities such as the static nature of the set of spatial weights, errors with a small number of objects, false results under conditions of high data polarization, the inability to interpret the clustering of territories, etc.

Other authors use models of graphical

maps of the investment market, which are informationally updated, representing interest for direct participants in investment development from the standpoint of positioning themselves and their competitors. In this context, the key problems are the effective collection and analysis of regional data (Tyurin, 2025), as well as the difficulty of organizing regular observations.

Direct investment processes are assessed using the Gini coefficient, the Herfindahl coefficient, the decile differentiation coefficient, etc. (Tyurin, 2025), which are also highly dependent on the quality of the initial data.

A fairly widespread methodological approach involves measuring the integration activity of participants in investment interaction in regions based on constructing integral synthetic indicators, which typically involves various groupings of indicators (Karelina, 2016; Shekhovtseva, Safonova, 2022). In this case, the selection of the set of indicators, justification of their sufficiency and comprehensiveness, present extreme difficulty.

In general, it must be stated that the methodological approach to assessing investment processes at any level of management must consider the connectivity of the national economic space, adjust for changes in investment conditions and participants’ positions, and contain algorithms for overcoming conditions of economic uncertainty.

Thus, it is appropriate to present a systematization of key methodological approaches to assessing the investment potential of the Russian Federation’s regions under conditions of economic uncertainty (*Tab. 1*).

Based on this, three groups of methodological approaches can be distinguished, each focusing differently on investment processes.

The first group of approaches (e.g., macroeconomic, non-linear) views investment processes as an integration of key participants, whose consensus on price predetermines spatial changes (Goodwin et al., 1999; Barrett, 2001). That is, investments are considered integrated if prices for the same goods coincide (Glushchenko, 2017). This means investment processes encounter various difficulties, such as differences in regional prices within average transport costs, and trade flows separated in time (Spatial Development..., 2020). Using this approach makes it possible to detail delocalization processes in regional space and obtain aggregated estimates regarding the connectivity of the economic space

(Yazgan, Yilmazkuday, 2011). This approach is also applicable when analyzing long-term investments and the positions of key participants in a region.

The second group of approaches (e.g., externalities-based) is founded on the thesis of the spatial conditioning of economic changes, expressed in spatial externalities as the influence of some market elements on others (Anselin, 2003; Capello, 2009). Methodologies within this approach do not limit the channels for transmitting spatial externalities, which avoids the need for deep theoretical justification of the calculations. Key analysis methods here are spatial econometrics methods, which consider regions, municipalities, and other territorial units as objects of analysis. In the context of investment development, regional and local investment systems are

Table 1. Systematization of key methodological approaches to assessing the investment potential of the Russian Federation's regions under conditions of economic uncertainty

Approach name	Methods used	Outcome
Macroeconomic	Analysis of key macroeconomic indicators (production volume, gross domestic product, aggregate demand/supply, inflation rate, etc.)	Accumulation of investments is achieved through the influence of external factors affecting regional investment processes
Non-linear	Methods for calculating leading indicators, econometric analysis methods	Effectiveness of investment development as a result of interaction among participants in the investment process
Price-based	Assessment of price response to spatial changes, aggregated estimates regarding the connectivity of economic space	Investment balance is achieved in case of progressive movement of capital by origin and use over a certain period
Externalities-based	Measurement of spatial externalities as the influence of investments on regional development, methods of spatial econometrics and multilevel modeling	Consolidation of investments as a result of interaction among participants, creation of common structures
Balance-based	Interregional balance models, cooperative game theory, aggregated methods	Accumulation of investments is achieved through forming linkages between participants, establishing a favorable investment climate
Source: own compilation.		

distinguished, and their development is assessed based on the average statistical elements of such subsystems (Kolomak, 2010). To assess investment processes involving the merger of market structures, proponents of this approach resort to a synthesis of spatial econometrics methods and multilevel modeling (Corrado, Fingleton, 2012). Alternatively, the use of methods within the framework of Markov chain theory is proposed, which allows for accounting for the relative dynamics in the development of elements of the national economic space (Bufetova, 2016). As a result, assessments of investment process development at a more general level emerge.

The third group of approaches (e.g., price-based, balance-based) conveys the hypothesis that investment balance is established when connections are formed between economic agents operating in a region, resulting in mutually reinforcing positive effects. Key methods within this approach include interregional balance models and cooperative game theory (Miller, 1969; Granberg, Suspitsyn, 1988; Suslov, 1991). The realization of these effects is based on the consolidation of investments through active economic exchange. Here, investment development is not tied to specific types of investments; instead, the application of structural models reveals multipliers of interregional balances and the economic interconnections of regional investment systems. In practice, research builds both aggregated and detailed assessments of a region's investment potential realization. For instance, one can note models reflecting

the process of decentralization and the formation of investment directions along the “center-periphery” axis (Robinson, Miller, 1991). In this context, the functioning of price mechanisms is of secondary importance (Dzhurka, 2021).

Thus, the first group of approaches conducts analysis at a more general level, assessing investment development as a result of consolidation; the second group focuses on the significance of external factors determining the development of the regional investment system; the third group allows for assessing the processes of consolidating regional investments in the context of systemic effects. The synthesis of these key approaches generates a diversity of methodologies that reveal various aspects of investment activity in a region.

Research materials and methods

Considering the available sources and databases in the public domain that specialize in accumulating indicators and parameters of regional investment development, one cannot overlook the methodology of the rating agency “Expert RA”¹. Its foundation is index-based assessments comprising over 60 indicators distributed across five groups: infrastructure, economic, social, financial, and environmental. Weights (levels of significance) are determined for each indicator group. The data used as a basis come from official statistics, the Central Bank of the Russian Federation, the Federal Treasury, the Russian Ministry of Finance, the Russian Ministry of Internal Affairs, etc.

Thus, the level of a region's investment attractiveness is determined (*Fig. 1*).

¹ Methodology of the rating agency “Expert RA”. Available at: https://raexpert.ru/researches/regions/invest_regions_2023/?ysclid=m7326ro62f524868447 (accessed: 06.02.2025).



Figure 1. Level of investment attractiveness of Russian constituent entities for 2024

Source: https://raexpert.ru/researches/regions/invest_regions_2023/?ysclid=m7326ro62f524868447#lg=1&slide=0

As can be seen from the provided data, one can speak of a substantial differentiation among Russian constituent entities in terms of investment attractiveness. The best positions are held by the Primorye Territory, Krasnodar Territory, the Republic of Tatarstan, and the Yamal-Nenets Autonomous Area. The lagging regions include the Irkutsk Region, the republics of Buryatia, Tuva, Kalmykia, Kabardino-Balkaria, Karachay-Cherkessia, etc.

This methodology allows for obtaining a differentiated investment assessment across groups of indicators. On the other hand, weighting these groups makes it possible to adjust the integral assessment relative to individual groups. However, this approach leaves the list of indicators open to additions

and variations, and the final results may become “blurred” in relation to the overall assessment.

Another effective methodology is the rating system of the Agency for Strategic Initiatives²). It comprises a system of indicators and a methodology for calculating metrics, including over 200 indicators grouped into four categories: regulatory environment, institutions for business, infrastructure and resources, and support for small and medium enterprises. The sources of information include surveys of entrepreneurs and experts, as well as statistical data. This methodology emphasizes the managerial processes of the regional governance system aimed at creating favorable business conditions, thereby accumulating the best regional practices.

² Methodology of the Agency for Strategic Initiatives. Available at: https://asi.ru/government_officials/rating/?ysclid=m734v8pxzu830813685 (accessed: 04.02.2025).

The compiled data is normalized to a unified scale from 0 to 100 and is also weighted within each category. Accordingly, the integral index is the sum of scores across all categories.

Among the regions lagging in these metrics are the Republic of Kalmykia, Kirov Region, etc. Some constituent entities of the Russian Federation were unable to confirm their status as investment regions (Bryansk Region, Nenets Autonomous Area (NAA), Altai Republic).

The leaders of the rating for the state of the investment climate in Russian constituent entities for 2024 are presented in *Figure 2*.

This methodology is also rating-based, which, on the one hand, allows for the addition and adjustment of initial data, and on the other hand, provides a sufficiently general assessment within the boundaries of an integral indicator.

Another relevant methodology is the approach presented on the portal “Investment Projects of the RF”³. It is based on data from over 25,000 projects at various stages of implementation. Based on this data, a forecast for project completion and the efficiency of investment is calculated. The “Investment



Figure 2. Leaders of the investment climate rating in Russian constituent entities for 2024

Source: https://asi.ru/government_officials/rating/

Projects of the RF” platform is an information resource where data on announced and ongoing investment projects in industrial and civil construction, both in Russia and CIS countries, is entered. The platform developers receive information from relevant government agencies and update the project database daily. Accordingly, since the database contains all projects supervised and coordinated by relevant agencies of the Russian Government, the sample can be considered representative.

As a result, a database on the implementation of investment projects in more than 20 economic sectors across Russian regions is formed (*Fig. 3*).

Such a methodology, based on qualitative parameters, allows for building an understanding of the implementation stages of investment projects both by sector and by region. However, the analysis results face limitations due to incomplete project data, characterizing this methodology as dependent on the database and its updates.

Thus, it can be noted that the most relevant methodologies include rating-based approaches, combine quantitative and qualitative data groups, and are oriented toward building a competitive model in interregional development.

Within the framework of our work, it seems appropriate to apply a rating methodology that incorporates an indicative methodological approach, as it most fully reflects and accounts for the multifaceted nature of a region’s investment potential and also provides an opportunity to enhance the efficiency of the tasks being solved. Furthermore, the choice of logical-structural and content analysis applied to the most relevant methodological tools and techniques allowed for identifying the criteria and metrics that reflect the processes of realizing a region’s investment potential.

³ Investment Projects of the RF. Available at: <https://investprojects.info/materials> (accessed: 02.02.2025).

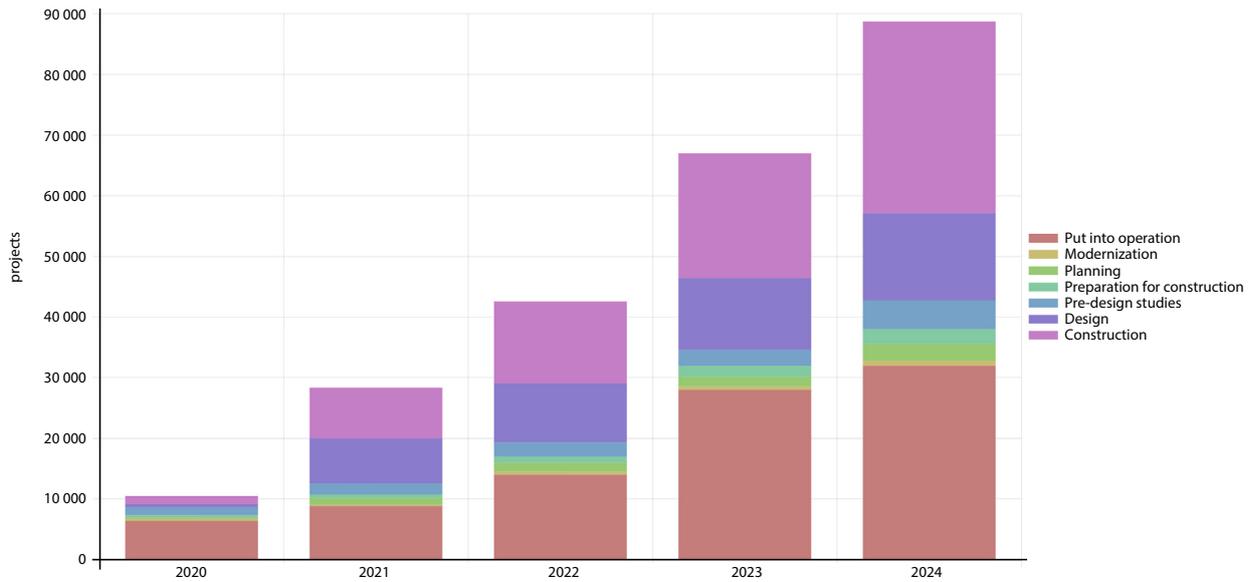


Figure 3. Dynamics of investment project development in Russian constituent entities, 2020–2025

Source: <https://investprojects.info/regions/>

Research results

Let us examine the process of implementing investment projects in key economic sectors across the constituent entities of the Russian Federation to

identify the most significant trends and tendencies in investment decision-making (Fig. 4). The analysis is based on data concerning the implementation of 142,000 projects across 20 sectors⁴.

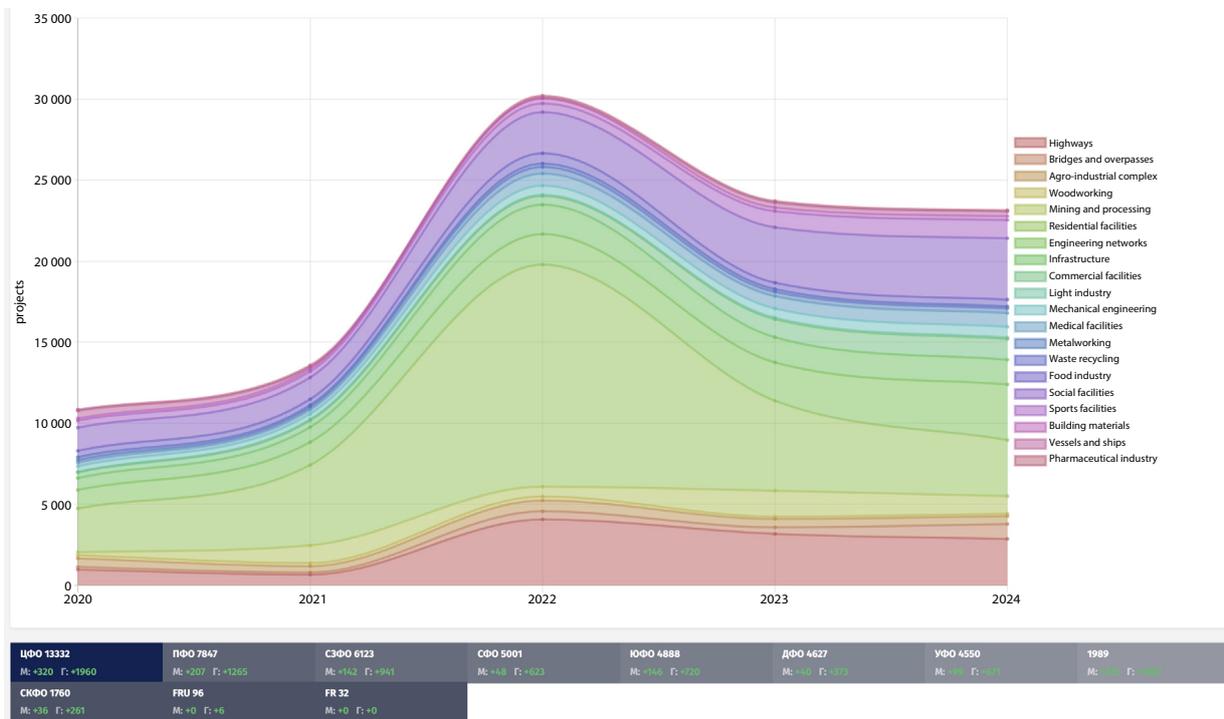


Figure 4. Sectoral dynamics of the number of investment projects in federal districts of the Russian Federation, 2020–2024

Source: <https://investprojects.info/regions/>

⁴ Investment Projects of the RF. Available at: <https://investprojects.info/materials> (accessed: 02.02.2025).

A negative trend in the number of investment projects in federal districts from 2020 to 2024 is noted in almost all areas and sectors, with the exception of the road industry and road infrastructure objects. This may be linked to the imperative of road maintenance and the long-term planning of construction projects whose implementation fell within this period. The decline in dynamics may be associated with the start of the special military operation and the reduction in budgetary support for a number of sectors (Khanin, 2022). At the same time, it should be noted that in terms of the number of investment projects, the Central Federal District holds the leading position (with over 15,000 projects), followed by the Volga Federal District (over 8,000 projects). The other districts occupy roughly similar positions, except for the North Caucasus Federal District, which concludes the conditional ranking. Among the priority sectors for financing are infrastructure (engineering, transport) and the construction industry.

To examine intra-district dynamics, let us separately highlight the trends in implementing investment projects in the Ural Federal District in 2024 (Fig. 5).

In terms of investment development, the Ural Federal District represents a rather unbalanced meso-formation, as the Sverdlovsk Region outpaces other regions by almost two times, and the gap with the lagging region (Kurgan Region) reaches six-fold. Furthermore, it cannot be said that the other subjects occupy equal positions; it is sufficient to compare the indicators of the Tyumen and Chelyabinsk regions (over 800 projects) with those of the autonomous areas (over 500 projects). This situation may be due to the fact that the Ural Federal District includes regions with significant differences in economic structure and varying levels of socio-economic development (Voronov, 2022). Such differences predetermine not only asymmetric characteristics in the level of investment attractiveness and substantial differentiation of basic investment indicators but also hard-to-measure investment opportunities. This

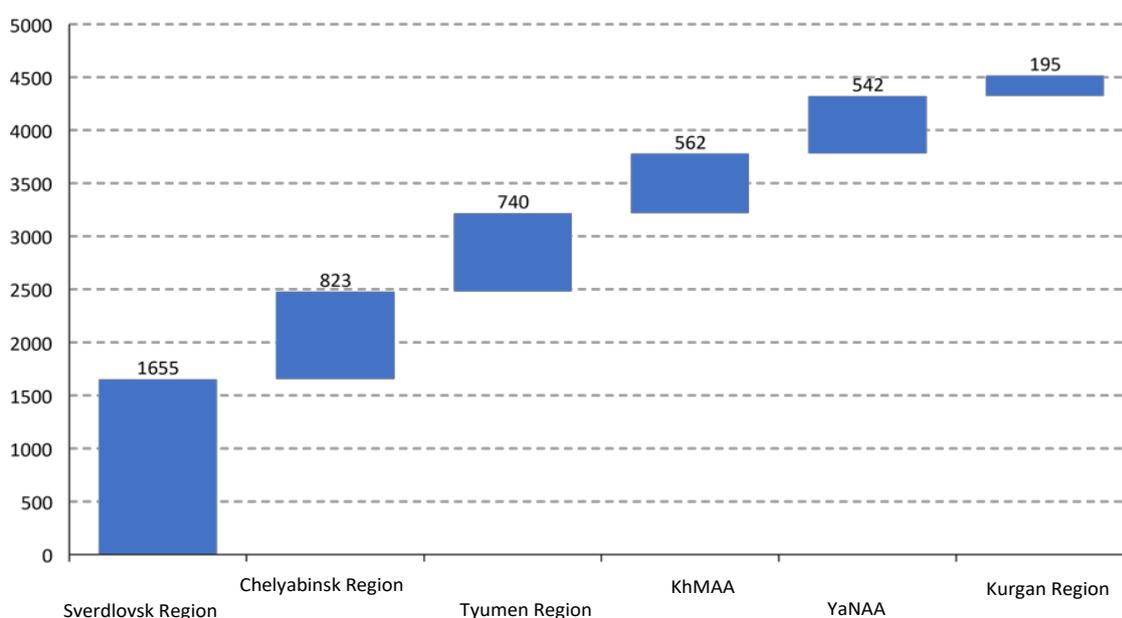


Figure 5. Number of investment projects being implemented in constituent entities of the Ural Federal District in 2024

Source: <https://investprojects.info/regions/chart>

explains the configuration of strategic priorities, investment goals, and objectives, which, under negative external economic circumstances, have varying effectiveness and degrees of realization, bringing industrial territories to the forefront (Demyanko, 2019). Thus, the effectiveness of implementing investment policy within the entire network of relationships among investment market participants largely depends on the activity and initiative of regional executive authorities (Gusmanov et al., 2024; Kvon, 2019). The thesis about bringing industrial territories to the forefront, coupled with the initiative of the regional establishment, is vividly demonstrated by the dynamics of investment project emergence in the regions of the Volga Federal District in 2024 (Fig. 6).

The Volga Federal District includes a large number of traditionally industrial regions.

However, the presented quantitative sample does not reflect a direct dependence between the level of industrial production and the number of investment projects. This compels a search for reasons in the influence of other factors. Leading positions are held by the Nizhny Novgorod Region, the republics of Bashkortostan, and Tatarstan. Following with a significant gap are the Perm Territory and the Samara Region. Then, with an even larger gap and a sequential decrease in the indicator, the remaining regions are positioned. We should note, for example, the distinct industrial profile of the Republic of Udmurtia. At the same time, it must be emphasized that without considering the cost of investment projects, an analysis based solely on their number only allows for judgments about general trends in this sphere and does not reflect all aspects of realizing a region's investment potential.

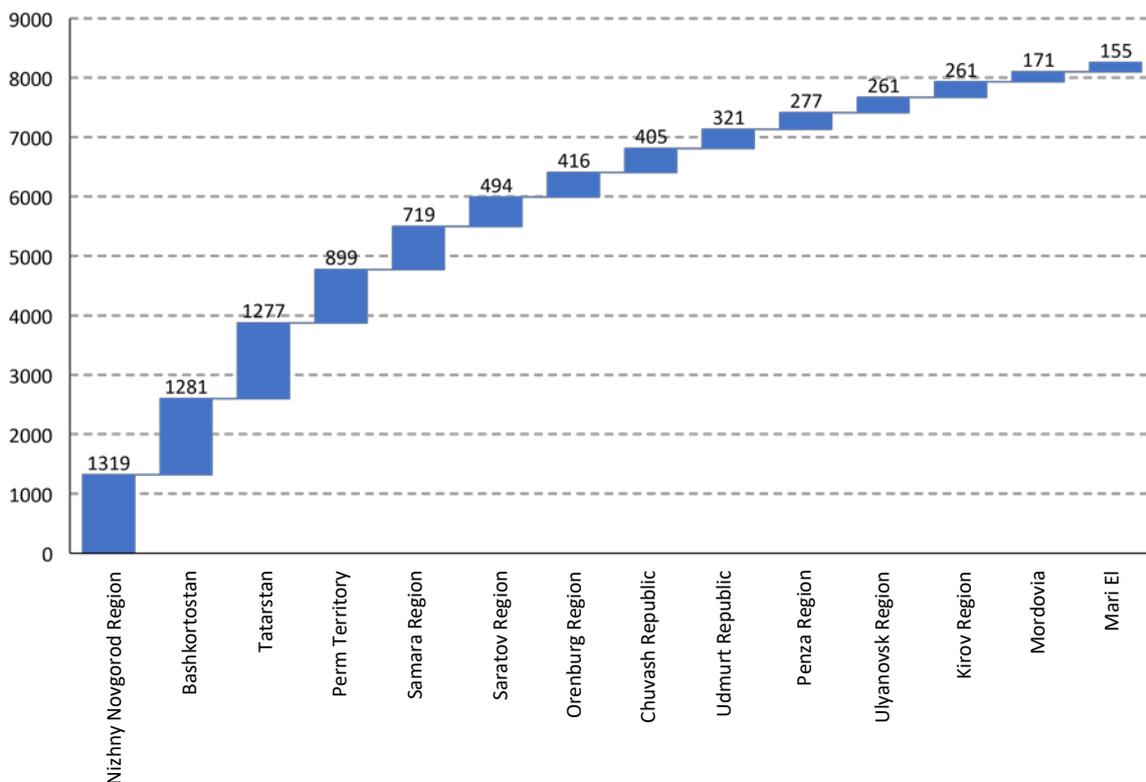


Figure 6. Number of investment projects in regions of the Volga Federal District in 2024

Источник: <https://investprojects.info/regions/chart>

Overall, the rating methodological approach, whose possibilities are demonstrated above, can be considered one of the most important in constructing and forming the methodological foundations of a region's investment development. This is because it allows for demonstrating the positions of Russian constituent entities within the framework of investment indicators, including in relation to other metrics of the territorial system's development (Kolmakova, 2015). Such an approach enables the assessment of sectoral investment parameters (e.g., the level of existing infrastructure or the volume of available resources, etc.) within rating groups and blocks. The effectiveness of applying this approach is linked to implementing procedures for searching and selecting investment indicators, and to the validity and comprehensiveness of a set of measures and actions, the implementation of which determines the investment environment and the level of favorability. This, in turn, predetermines the achievement of socio-economic effects and the region's competitiveness indicators (Krivenko et al., 2023). Thus, the procedures for searching for and substantiating indicators constitute the most important methodological task. Solving it entails the necessity of choosing methods and tools for conducting an indicative analysis, aimed at accelerating the process of realizing a region's investment potential amid the entire set of influencing factors that significantly affect the region's transformation processes as a whole.

As practice shows, using individual investment indicators for specific regions is not very effective, since all indicators are systemically interconnected, each reflecting certain aspects of investment changes. Therefore, conducting a regular indicative analysis can help identify problem areas and potential reserves when situational investment decisions are necessary. Implementing a rating approach that includes indicative analysis can not only ultimately lead to a reduction in the time required for coordinating and implementing investment programs but also

increase the reliability of investment scenarios. However, such a system, which divides indicators into thematic groups, is based on comparing actual and forecasted indicator values while ignoring the need for an in-depth retrospective analysis. This blurs the final assessments, simplifying a significant portion of the obtained results.

Thus, the implementation of investment policy in the Russian Federation is based on the traditional approach, where economic activity is conducted based on the need to attract and implement investments, which are a key driver of economic growth (Maltsev, 2024). At the same time, considering the non-linear nature of investments, the necessity for their non-linear measurement and evaluation arises, including assessing the dependencies between investment and socio-economic indicators.

The thesis is undeniable that the problems of realizing a region's investment potential are especially large-scale during periods of economic transformation and phenomena of uncertainty, when all participants in the investment process become most vulnerable (Pyankova et al., 2022).

This situation leads to the fact that the constituent entities of the Russian Federation are forced to search for additional resources and funding sources, retaining potential investors, maintaining the level of investment attractiveness, and preserving established interconnections with other sectors of the economy. In this sense, the indicative approach, if implemented at the managerial level, is capable of forming such monitoring mechanisms that, one way or another, account for the most significant external factors, allowing for measuring their impact. Thereby, it enhances the effectiveness of investment measures by considering threshold values of indicators, weighting coefficients, and risk indicators. That is, adhering to such nuances requires constant improvement of the principles for applying the indicative approach to maintain the dynamic nature of calculations and to account for the complex, constantly changing

conditions of the external environment and the influence of significant macroeconomic factors. Such improvement should include the modification and adaptation of the methods and calculation principles used within the framework of monitoring the implementation of regional investment policy.

The complexity of transformation processes and the existing investment differentiation among the constituent entities of the Russian Federation create a broad research context for searching and developing new methodological approaches, tools, individual mechanisms, and algorithms. These should make it possible to account for the level of transformation, the multifaceted nature of external factors, and the wide coverage of analyzed metrics (Urasova, 2022).

Thus, among the methods popular in the scientific community, characterized by sufficient development, one can list comparative and correlation-regression analysis, econometric modeling, spatial autocorrelation algorithms, cluster methodologies, etc. However, none of them alone allows for a progressive and systemic solution to the problem of assessing a region's investment development.

In this sense, most methodologies involve the synthesis and various configurations of existing methods, modifications of individual formulas and algorithms. Therefore, in most cases, when solving specific tasks, it is possible to establish:

- secondary and indirect factors identified and measurable from the perspective of analyzing investment processes in the region;
- boundaries of measurable parameters and weighting coefficients according to which the assessment is made;
- interconnections between mechanisms and models of transforming the region's investment space;
- forecast parameters of aggregated metrics and indicators of socio-economic processes in

relation to the results of implementing specific investment decisions and projects.

A rating methodology that incorporates an indicative methodological approach most fully reflects and accounts for the multifaceted nature of a region's investment potential and also provides an opportunity to enhance the efficiency of the tasks being solved. This allows it to be considered as an element of the planning system in a region. Rating is inherently linked to continuity in the system of public administration, as ratings or ranking systems for various elements of the investment process exist at all levels of management. However, due to the fragmented presence of these elements, any comprehensive assessment of realizing regional investment potential is hindered and does not fully reflect local specifics and transformation constraints, which precludes a deep justification for the investment decisions being developed.

The prevailing transformation conditions, combined with regional investment trends, create research demand for solving the task related to searching for and implementing new advanced approaches to realizing investment potential (Urasova, 2022).

Based on the results of the conducted analysis, let us outline the transformational aspects that should be accounted for within an improved methodological approach:

- the creation of new types of resources (e.g., digital), whose distribution among regions needs to be measured and redistributed;
- the development of social responsibility in connection with investment processes;
- the engagement of the potential of all participants in the region's investment process, including enterprises;
- the alignment of the developed regional investment development plans with strategic priorities at the national level.

The transformation period of regional investment potential relies on a complex of

resources: administrative resources as the aggregate potential of municipal and regional authorities; material resources (financial and non-financial sources); institutional resources as framework conditions determining opportunities for acquiring new resource sources.

Consequently, the key tasks for the regional governance system include regular comprehensive analysis and monitoring of investment plan implementation and assessing the pace of investment potential realization. The success in solving these tasks is directly linked to data quality.

In addition to the rating methodology and indicative approach, a differentiated approach can be identified. Within this framework, parameters reflecting the characteristics of uneven investment development of regions in various directions come to the fore. As elements, one can consider dynamic indicators of the speed of transformation processes, characteristics of the uneven implementation of investment resources; procedures for monitoring the achievement of key planned indicators. The implementation of this approach directly depends on the distribution and concentration of resources and is expressed in reducing the dispersion of regional indicators.

At the same time, any methodological approach requires the formation of an effective system of financial support from the executive authorities of Russian regions and the investment participation of economic entities. It also requires regulatory and legal reinforcement of transformational changes and investment priorities while preserving the possibility for sequential preventive actions in case of rising uncertainty and for participation in creating institutional infrastructure. That is, any implemented approach entails a significant sequence of managerial actions.

Thus, under modern conditions, clearly defining investment boundaries acquires particular importance. This is a key step toward effective resource management and regional development, encompassing not only the formation of an investment planning system but also the active integration of methodological tools into the existing governance system. Such a setup allows for creating a more flexible and adaptive investment environment capable of effectively responding to emerging transformational changes (Sitokhova et al., 2022). In this context, one of the important tasks is the assessment and analysis of the investment potential of each region. Therefore, it is necessary to consider not only quantitative but also qualitative characteristics, such as the level of personnel training, availability of infrastructure, access to financial resources and innovative technologies, etc. All these factors collectively necessitate the development of a new methodological approach that would activate the process of realizing regional investment potential. This approach should be aimed at adapting the established interconnections between various economic entities to transforming national and regional conditions (Sorokina, Prokhorov, 2012). This implies transforming not only the interaction between state bodies but also the system of cooperation with the commercial sector, scientific institutions, and public organizations involved in the investment process. It is important to create investment mechanisms that will facilitate the exchange of resources, ideas, and experience, which, in turn, will help increase the investment attractiveness of regions. Considering the existing administrative and functional boundaries of resource exchange, the implementation of any methodological approach must utilize established mechanisms, including clusters, cooperative structures, public-private partnerships, etc. An interesting

example is the agricultural sector, where interaction is organized between farmers, processors, and scientific institutions, helping to improve production efficiency and introduce new technologies. Thus, for the progressive investment development of regions, it is necessary to form solid institutional boundaries, an effective system of state subsidies, and a system of interaction among participants in the investment process.

It can be concluded that under conditions of economic uncertainty, it is advisable to turn to various sources and databases that accumulate heterogeneous parameters and indicators. Constructing comprehensive methodologies and tools based on such a complexly structured foundation allows for accounting for the multidirectional and multi-level nature of investment processes.

Conclusion

The analysis of methodological approaches and tools reflecting the process of realizing the investment potential of Russia's regions revealed a critical dependence of the efficiency of using available resources on the methods of their identification and subsequent implementation. The absence of a single universally accepted approach to this process is due to a number of factors whose influence is difficult to assess. Firstly, it is the constantly changing landscape of economic reality, characterized by the unpredictability of transformational trends and conditions of economic uncertainty. Globalization, technological breakthroughs, and shifts in world politics are global trends shaping a dynamic and uncertain environment in which regional investment strategies must be developed. Secondly, the significant diversity of the constituent entities of the Russian Federation necessitates accounting for their unique characteristics – from the sectoral

structure of the economy and resource potential (e.g., presence of minerals, developed agriculture, or high-tech industry) to the level of infrastructure development, workforce qualifications, and investment climate. Substantial differences make the application of universal solutions impossible and require an individual approach. Therefore, developing an effective investment development strategy for each region is a complex, multi-level task demanding deep analysis of a range of significant factors. This means that, at the methodological level, it is necessary to consider not only the current economic state but also to forecast future trends, assessing potential risks and opportunities.

The diversity of approaches to assessing and realizing investment potential opens new opportunities for improving state programming and enhancing the efficiency of coordinating the efforts of all participants in the investment process. This implies creating an effective system of interaction between various stakeholders: authorities at federal and regional levels, business representatives, scientific institutions, public organizations, and local communities.

Despite the fact that most tools used by major analytical agencies/organizations primarily employ rating methodologies aligned with the spatial conditioning of economic changes and the influence of some market elements on others, there remains a broad horizon for developing assessment tools by incorporating new methodological principles and frameworks.

The successful implementation of investment projects requires from the regional establishment not only a deep understanding of current transformational trends but also the ability to quickly adapt to changes, respond flexibly to new challenges, and effectively utilize available

resources. This implies the application of appropriate methodologies and tools, including procedures for monitoring the economic situation, analyzing market conditions, forecasting future changes, and timely adjusting investment strategies. A

comprehensive approach that integrates various aspects of regional development will allow for the most efficient use of investment potential and ensure sustainable economic growth for each constituent entity of the Russian Federation.

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SUSTAINABLE DEVELOPMENT OF TERRITORIES, BRANCHES, AND PRODUCTION COMPLEXES

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THE IMPACT OF THE LIVESTOCK INDUSTRY ON THE ECOLOGICAL DEVELOPMENT OF RURAL AREAS



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The relevance of the sustainable development agenda of the Russian Federation and its territories remains at the present time, even taking into account the difficult external economic and geopolitical situation in the world. The relatively recent changes in Russian legislation are characterized by the fact that now not only the country as a whole is considered in the sustainable development paradigm, but also rural areas, which should also follow the path of the sustainable development. In this regard, the article defines the constituent entities of the Russian Federation according to a certain range of indicators, where the trends of the sustainable rural development are manifested. Our method of two-stage analysis allows first assessing the development of one of the agricultural branches – regional animal husbandry, and then determining its impact on the sustainable development of rural areas. To do this, we introduce several special coefficients that make it possible to summarize

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the data set in a regional context and identify current trends. As a result, the paper concludes that the sustainable development of rural areas is influenced by a number of factors, among which are: the composition and quantity of feed consumed by cattle, the number of heads in the herd, state support for agricultural producers from budgets of different levels. Theoretically, the article has elements of scientific novelty and is distinguished by the fact that, along with the economic and social components, it allows taking into account the equally important environmental component of the triad of the sustainable development. In practical terms, the article may be useful to the authorities of the constituent entities of the Russian Federation responsible for achieving the targets for sustainable rural development, as it identifies current trends and identifies factors affecting the development of both the industry and the territory, which contributes to the adoption of scientifically sound management decisions.

Agriculture, regional animal husbandry, government support, net financial result, efficiency coefficient, cattle, profitability of goods sold.

Introduction

The understanding of the concept of sustainable development that has formed within the global community, characterized fundamentally by the unity of its three components (economic, social, and environmental), their interdependence and mutual influence, is associated not only with the balanced development of all its components in the current period but also with shaping the future socio-ecological-economic potential of a territory, considering the perpetual improvement of the population's quality of life. This understanding of the concept follows from the very term "sustainable development" as reflected in the report "Our Common Future" by the World Commission on Environment and Development¹, as well as from numerous

publications available in scientific and specialized literature (Kozlov et al., 2024; Kalitseva, Charaeva, 2023; Akim, 2023; Alferova, 2023; Erokhina, 2022; Amirova et al., 2022; Bolshakov, Shamaeva, 2017).

The Russian Federation has ratified several international conventions and protocols² and has legally formalized its own regulatory documents in this sphere³. Thus, it has not only joined global trends in sustainable development but has also assumed certain limitations and obligations to comply with and implement the prescribed regulations.

Federal Law 160-FZ adopted last year (dated June 22, 2024) introduced the term "sustainable development of rural territories" into legal discourse through Article 4.1. This term is to be understood as a quantitative increase in specific economic and social indicators. In

¹ Our Common Future: Report of the World Commission on Environment and Development. United Nations General Assembly. 1987. Available at: <https://www.are.admin.ch/are/en/home/media/publications/sustainable-development/brundtland-report.html> (accessed: 27.08.2025).

² On the Adoption of the Paris Agreement: RF Government Resolution 1228, dated September 21, 2019. Available at: <https://www.garant.ru/products/ipo/prime/doc/72661694/?ysclid=m1zeo8dzm0623948623> (accessed: 27.08.2025); On the Ratification of the Kyoto Protocol to the United Nations Framework Convention on Climate Change: Federal Law 128-FZ, dated November 4, 2004. Available at: <http://www.kremlin.ru/acts/bank/21599> (accessed: 27.08.2025); On the Ratification of the United Nations Framework Convention on Climate Change: Federal Law 34-FZ, dated November 4, 1994. Available at: <https://clck.ru/36vPKw> (accessed: 27.08.2025).

³ On Certain Measures to Improve the Energy and Environmental Efficiency of the Russian Economy: Presidential Decree 889, dated June 4, 2008. Available at: <http://www.kremlin.ru/acts/bank/27565> (accessed: 27.08.2025); Strategy for the Socio-Economic Development of the Russian Federation with Low Greenhouse Gas Emissions until 2050: RF Government Resolution 3052-r, dated October 29, 2021. Available at: <https://clck.ru/36vPQZ> (accessed: 27.08.2025).

particular, the law mentions “increasing the volume of agricultural production” (economic component) and “achieving full employment of the rural population” (social component)⁴. That is, sustainable development of rural territories is defined without fully accounting for another, no less important component – the environmental one. It should be noted here: the legally presented definition refers to only one component of the natural environment – “rational use and protection of lands”; other environmental objects are not specified.

However, it is not only land but the environment as a whole that is significantly impacted by agriculture, particularly one of its sub-sectors – animal husbandry, including negative impacts. According to some expert estimates, methane (CH₄) emissions into the planet’s atmosphere from cattle alone account for about 15%, with two-thirds of this attributed to cows. The peculiarity of this gas is that, compared to carbon dioxide (CO₂), it heats the Earth dozens of times faster and retains heat for a longer period, which ultimately leads to the greenhouse effect, exacerbates the environmental problem of global warming, and consequently does not contribute to the sustainable development of a territory.

Certain Western European countries are seriously concerned about this problem and, in order to resolve it, are proposing rather radical measures: some – introducing a tax on methane emissions from livestock (for example, Denmark has already calculated a tax rate for cows and pigs); others – culling dairy cows (for instance, Irish authorities plan to eliminate 200 thousand out of 1.6 million head; similar actions are being

considered by the authorities of France and the Netherlands).

According to official data from the Federal State Statistics Service of the Russian Federation (Rosstat)⁵, in 2023, Russia had 17.1 million head of cattle, of which 7.5 million were cows (~44%). On average, a single animal “produces” about 100 kg of methane per year – illustrating the scale of the problem both globally (with about 1.8 billion head worldwide) and for individual countries (for example, in Brazil, according to a 2021 industrial cattle farming portal, the number of cows and bulls exceeded the country’s human population).

According to the Food and Agriculture Organization of the United Nations (FAO), in rankings of countries engaged in agricultural production, Russia is frequently positioned among the leading nations. However, our country’s leading positions are noted in sub-sectors of crop farming associated with harvesting specific crops: wheat, rye, barley, and buckwheat. Furthermore, it should be noted that compared to animal husbandry, crop farming in recent years has shown a net financial result that is 30% higher, and profitability ratios that are 3–4 times greater (for instance, in 2022, the profitability of sold products in animal husbandry was 11.5%, while in crop farming it was 34.9%; in 2021, the profitability in animal husbandry was 12.6%, compared to 48.5% in crop farming).

In light of this, as well as considering recent amendments to Russian legislation and the intentions of some states regarding tax initiatives and livestock culling, there is a need to conduct a sectoral analysis of the sustainable development of Russia’s rural territories based on regional animal husbandry (cattle farming).

⁴ On Amending Article 19 of the Federal Law “On Peasant (Farm) Enterprises” and the Federal Law “On the Development of Agriculture”: Federal Law 160-FZ, dated June 22, 2024. Available at: <https://docs.cntd.ru/document/1306440348?section=text> (accessed: 27.08.2025).

⁵ Agriculture in Russia. 2023. Information by Constituent Entities of the Russian Federation: Appendix to the Collection. Available at: <https://rosstat.gov.ru/folder/210/document/13226> (accessed: 27.08.2025).

Literature review

If we employ the conceptual framework of regression analysis, then in the article by A.Kh. Blieva, sustainable territorial development is considered as the independent variable (regressor) that influences the dependent variable (regressand) – the agricultural economy. This formulation of the question is scientifically interesting because, firstly, it a priori defines a unidirectional causal relationship, and secondly, it contrasts with the now common viewpoint where sustainable development is considered the regressand, not the other way around. As a result, the author concludes that sustainable development of rural territories is an “important factor for the agricultural economy and the agro-industrial complex” (Blieva, 2023). In another article examining various problems of rural territories, the author analyzes the three components of sustainable development (social, economic, and environmental) in blocks and concludes that state support is needed for “innovative transformations” in the form of innovative programs, as well as “the introduction of new agricultural technologies that will increase its productivity while reducing negative environmental consequences from economic activity” (Bratarchuk, 2022). In the article by S.A. Andryushchenko and M.Ya. Vasilchenko, strategies for the development of dairy cattle farming in various constituent entities of the Russian Federation are substantiated. Based on a performed critical analysis of theoretical and methodological approaches to addressing issues of spatial organization in the livestock sector, the authors, from a methodological standpoint and in accordance with the postulates of sustainable development, conclude that it is advisable to improve the location of livestock production facilities (Andryushchenko, Vasilchenko, 2023). Another article is also devoted to issues of location and efficient functioning of livestock

sectors: its authors examine specific factors that can increase productivity in agriculture (Gubanov et al., 2023). The emphasis here is on the inherent features and regional differences of the Russian federal subjects.

Special attention to issues of managerial activity in the context of sustainable development of rural territories is given in an article where the authors analyze the planning system, management processes, interaction schemes, etc., which ultimately allows for the development of a “model for managing the sustainable development of a region’s rural territory” (Soldatov et al., 2022). In another article also considering management processes, state regulation of agriculture and its sub-sectors is linked to the implementation of various functions, among which are highlighted “creating and ensuring sustainable development of rural territories <...>; solving specific environmental tasks” (UTerritoryntseva, 2023). In a collective monograph (Khagurov, 2020), using rural districts of the Krasnodar Territory as an example, the main factors influencing the stability of living systems are examined. In a similar vein, the article by A.I. Surov and co-authors analyzes the problem of mismatch between the available cattle population and harvested pasture fodder in the Stavropol Territory. Within the scientific approach to sustainable development, conservation, and reproduction of natural ecosystem potential, the researchers conclude on the necessity for rational use and restoration of natural environment elements (Surov et al., 2024).

The literature review, including the aforementioned works as well as some other scientific publications on the research topic (Uskova, 2009; Popova et al., 2020; Solopov et al., 2022; Sergienko, 2023; Sashkova, Erokhin, 2024; Bovkun-Saass, 2025; Yurkova et al., 2020), allows for several conclusions. On one hand, there is an insufficient number of publications assessing

the impact of agricultural activities, broken down by various sub-sectors of the regional economy (including animal husbandry), on the environment and the sustainable development of rural territories; the patterns and factors shaping current development trends for both the industry and the territory are not defined. On the other hand, it is precisely their consideration that becomes unquestionably necessary, as it is directly linked to the formation of sustainable development of the rural territory. Furthermore, it can be noted that current publications are characterized by insufficient elaboration of issues such as the location of various branches and sub-branches of animal husbandry at the regional level; comprehensive consideration of endogenous and exogenous conditions and factors influencing their location and, consequently, the sustainable development of Russia's agricultural territories. All of this underscores the relevance of the article's topic and defines the practical significance of the conducted research.

Research objective and methodology

The objective of the research is to determine current trends and the degree of influence of the animal husbandry sector on the environmental

component of a region in the context of sustainable development of Russia's rural territories, through conducting a territorial-sectoral analysis of the constituent entities of the Russian Federation. The authors' focus is primarily on the economic-environmental aspects of sustainable development of the country's rural territories.

The research methodology comprises several stages. At the first stage, based on official data from the Federal State Statistics Service (Rosstat), initial data for the years 2015, 2018, 2019, 2020, 2021, and 2022 (this is the time interval available in domestic statistics) are collected for all 85 constituent entities of the Russian Federation according to the following indicators.

1. "Cattle population" (CP). This indicator is fundamental, as it accounts for all cattle (in all categories of farms: agricultural organizations, peasant (farmer) households, and households) within each region, belonging to the category of ruminant animals that produce methane, which negatively affects the environment, and is perceived as a factor in the territory's sustainable development. Overall, Russia exhibits a downward trend in the values of this indicator (*Fig. 1*).

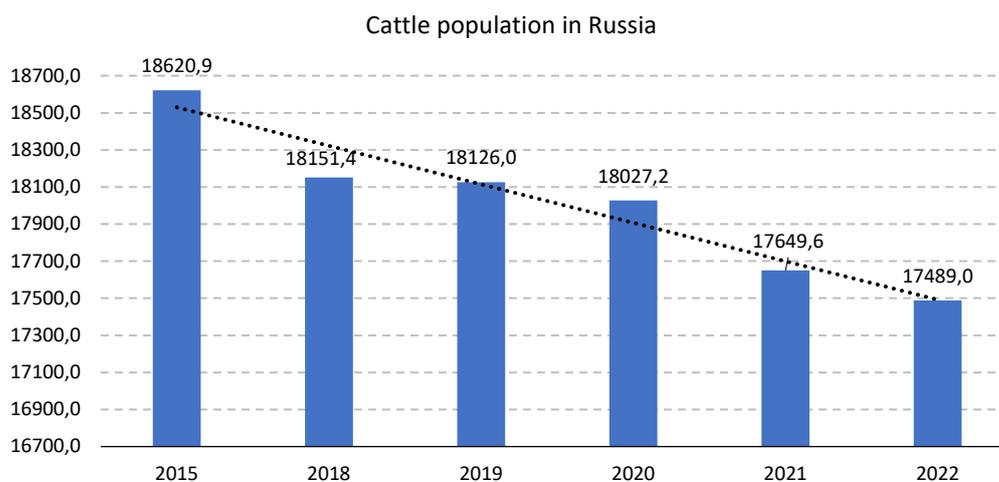


Figure 1. Dynamics of changes in the cattle population in the Russian Federation for the period 2015–2022, thousand head

Source: Rosstat data.

2. “Feed consumption per conventional head of cattle”⁶. This indicator is necessary in the analysis because: 1) it reflects a moderate positive correlation with milk yield per cow (an additional calculation of the linear Pearson correlation coefficient demonstrated the closeness of the relationship between the variables: $r = 0.37$), meaning the amount of feed can influence livestock productivity (the study did not account for various additives and supplements that increase animal productivity); 2) it is one of the indicators of efficiency in animal husbandry, as, being an expense item in the accounting balance, it directly affects the financial and economic indicators of economic entities, and thus generally reflects the economic efficiency of the sector in the region – the less spent on feed procurement without decreasing milk yields, the higher the efficiency; 3) it is used in calculating the coefficient of animal husbandry efficiency in the region (coefficient $C_{\text{ahe}} = \text{“cattle population”} / \text{“feed consumption per conventional head of cattle”}$; this coefficient is calculated by analogy with the production efficiency indicator in economics, which determines maximum results with minimal costs; the coefficient is calculated for each federal subject); 4) the calculated coefficient is used in subsequent stages for the overall assessment of sustainable development of rural territories.

3. “Net financial result (profit minus loss) of organizations” (N_{fr}), reflecting the economic viability of this type of activity.

4. “Profitability of sold goods, products (works, services) of organizations” (P_{sg}), reflecting the economic efficiency of this type of activity.

The last two indicators are the key financial and economic metrics for organizations operating in animal husbandry. Their values can fundamentally influence

the indicators of sustainable development in rural territories.

In the second stage, the time series for all indicators are normalized for each constituent entity of the Russian Federation by calculating the arithmetic mean for the analyzed period.

In the third stage, the regional animal husbandry efficiency coefficient (C_{ahe}) is calculated for each entity by dividing the average values: “cattle population” / “fodder consumption per standard cattle unit”.

In the fourth stage, the value and contribution of each constituent entity of the Russian Federation to the development of animal husbandry in Russia is determined. This is done by calculating the specific weight of the regional animal husbandry efficiency coefficient relative to the animal husbandry efficiency coefficient for the Russian Federation as a whole.

In the fifth stage, a statistical summary of the calculated regional animal husbandry efficiency coefficients is compiled and compared with the financial and economic indicators of organizations (the arithmetic mean of the time series in each region). For the final summary, the data array is grouped according to the indicator of the specific weight of the regional efficiency coefficient, considering the following ranges of variability:

1) 0.00–0.99% – constituent entities of the Russian Federation with an insignificant share of agriculture in the regional economy (C_{ahe} – low);

2) 1.00–1.99% – constituent entities of the Russian Federation with a significant share of agriculture in the regional economy (C_{ahe} – medium);

3) 2.00% and above – constituent entities of the Russian Federation with a high share of agriculture in the regional economy (C_{ahe} – high).

⁶ Exactly corresponds to the indicators calculated by national statistics (Agriculture in Russia. 2023: Statistical Collection. Rosstat. Moscow, 2023. P. 71; Table 4.12).

At the final (sixth) stage, the sustainability of rural territory development is determined. For this purpose, two coefficients are calculated, demonstrating the degree of participation of regional economic entities in environmental restoration and the expenses they incurred to compensate for negative impact on the regional ecosystem: 1) the coefficient reflecting “current expenditures on atmospheric air protection and climate change prevention” per “head of cattle” in the region (C_{aap}); 2) the coefficient reflecting “investments in fixed capital aimed at atmospheric air protection”, also per “head of cattle” in the region (C_{ifc}). The development of rural territories can be considered sustainable if each coefficient has a value above 1.00. The source data for the calculation correspond to the following time interval (according to available Rosstat data): 2015, 2017, 2019, 2021. The calculation of the aforementioned coefficients is based on the arithmetic mean value.

Research results

Following the sequential implementation of the stages described above, three groups of regions were formed based on the established criteria. The group with a high share of agriculture in regional development includes 17 constituent entities of the Russian Federation (*Tab. 1*).

This group of regions is characterized by rather ambiguous results. Thus, despite similarly high animal husbandry efficiency coefficients, the average values of the “net financial result (profit minus loss) of organizations” indicator differ substantially between the entities. For example, within the same group, one can find both regions ranked in the top-10 with the highest values in Russia (Republic of Tatarstan, Voronezh Region, Novosibirsk Region, and Krasnodar Territory – the latter also having the highest profitability in Russia and being in the top-10 regions for this indicator) and the most loss-making regions, which are in the bottom-10 in Russia (Orenburg Region,

Table 1. Russian regions with a high share of animal husbandry in the Regional economy

No.	RF constituent entity	C_{ahe}		N_{fr} million rubles	P_{sg} %
		coefficient value	% relative to the RF		
1	Republic of Dagestan	37.64	5.98	28.83	5.63.
2	Republic of Bashkortostan	26.98.	4.28	1034.5	7.98.
3	Republic of Tatarstan	26.70	4.24	4594.83	9.07
4	Trans-Baikal Territory	21.32	3.38	5.83	-9.52
5	Orenburg Region	20.86	3.31	-225.5	1.75
6	Rostov Region	20.46	3.25	-15197.7	1.73
7	Altai Territory	19.07	3.03	2982.5	15.52
8	Krasnodar Territory	17.04	2.71	6802.83	21
9	Voronezh Region	16.98	2.70	6206.333	16.75
10	Republic of Buryatia	16.41	2.61	376.17	16
11	Republic of Kalmykia	16.00	2.54	77	-0.13
12	Bryansk Region	15.37	2.44	-830.5	6
13	Stavropol Region	14.24	2.26	2357.17	12.48
14	Saratov Region	14.16	2.25	824	11.45
15	Volgograd Region	13.98	2.22	762.67	11.43
16	Novosibirsk Region	12.77	2.03	4535.833	14.82
17	Republic of Tyva	12.61	2.00	-1.66667	-9.3

Source: Rosstat data.

Rostov Region, Bryansk Region). Furthermore, two other regions should be noted – Trans-Baikal Territory and the Republic of Kalmykia – where the net financial result is positive, while profitability is negative.

The second group includes 19 RF constituent entities. Overall, they are also characterized by multifaceted results, but more smoothed out (Tab. 2, C_{ahe} – medium).

Attention is drawn to four RF constituent entities (Belgorod Region, Kursk Region, Leningrad Region, and Republic of Mordovia), which have the highest financial and economic indicators in Russia: they are in the top-10 regions of the country (an exception: Leningrad Region is not in the top-10 for the “profitability” indicator, but its profitability is almost twice the average value for the group).

The next group of RF constituent entities is characterized by an insignificant share of agriculture in the regional economy – $C_{ahe} < 1\%$

(the remaining 49 RF constituent entities, not presented in Tables 1 and 2). However, even here, the group’s multifaceted nature is observed: regions with the lowest values for the net result and profitability (Sakhalin Region, Murmansk Region, Khanty-Mansi Autonomous Area, Yamal-Nenets Autonomous Area, etc.) coexist with regions that, on the contrary, possess the highest values in Russia for financial and economic indicators (Lipetsk Region, Pskov Region, Oryol Region, Ryazan Region, Republic of Mari El, and Republic of Crimea).

The obtained results reveal the following trends.

1. A positive net financial result (profit minus loss) coincides with negative profitability of sold products. This first trend is characteristic of a specific group of regions, which includes 10 RF constituent entities: Trans-Baikal Territory, Kamchatka Territory, republics of Kalmykia, Sakha (Yakutia), Alania, Karelia, Arkhangelsk

Table 2. Russian regions with a significant share of animal husbandry in the regional economy

No.	RF constituent entity	C_{ahe}		N_{fr}	P_{sg}
		coefficient value	% relative to the total	million rubles	%
18	Astrakhan Region	12.46	1.98	38.17	4.17
19	Belgorod Region	11.15	1.77	26582.12	21.1
20	Irkutsk Region	11.01	1.75	2571.67	9.63
21	Omsk Region	10.88	1.73	2205	11.08
22	Krasnoyarsk Territory	9.62	1.53	3797.5	10.43
23	Republic of Altai	9.09	1.44	-8.33	-5.78
24	Udmurt Republic	8.76	1.39	2729.83	8.8
25	Sverdlovsk Region	8.70	1.38	3802.167	6.3
26	Republic of Sakha (Yakutia)	8.51	1.35	17.67	-32.53
27	Tyumen Region without AA	8.45	1.34	3068.17	11
28	Kabardino-Balkarian Republic	8.42	1.34	80.33	9.93
29	Chechen Republic	8.27	1.31	-16	-28.4
30	Nizhny Novgorod Region	7.83	1.24	2261.667	8.47
31	Republic of Mordovia	7.82	1.24	7474.33	20.02
32	Chelyabinsk Region	7.74	1.23	1453.83	5.05
33	Kursk Region	7.38	1.17	7001.67	27.63
34	Perm Territory	7.08	1.12	1862.5	4.73
35	Leningrad Region	7.06	1.12	6697.167	10.32
36	Chuvash Republic	6.44	1.02	-887.333	9

Source: Rosstat data.

Region, city of Moscow, Nenets and Chukotka autonomous areas.

Negative profitability is possible, at least in two cases: a) profit is insufficiently high due to a limitation in the profit margin itself (e.g., when market conditions and other circumstances do not allow for increasing prices of sold products), and b) an increase in the cost of production occurs in certain regions, which is confirmed by aggregated data for Russia as a whole when considering the cost structure for production and sales of products (Fig. 2).

This situation is quite challenging from a practical standpoint, as this type of activity is economically loss-making. Consequently, livestock farms cannot independently improve the level of social well-being of their workers, which directly depends on the economic performance of this industry. Theoretically, one might consider abandoning unprofitable livestock farming in such a region. However, the Food Security Doctrine of the Russian Federation does not allow for such speculative decisions. Therefore, authorities (both federal and regional) must make decisions based not on the economic outcome, but on the principle that ensures the fulfillment of the state's strategic objectives. This trend reveals territories with

unstable development, even without analyzing its third component – the ecological one. In this case, state support for the industry at the federal level is required to ensure minimum allowable indicator values.

2. A negative net financial result (profit minus loss) coincides with negative profitability of sold products. This second trend is characteristic of a group of regions which includes 13 RF constituent entities: republics of Tyva, Altai, Chechen, Karachay-Cherkess, Samara, Sakhalin, Magadan, Murmansk regions, Primorye and Khabarovsk territories, Khanty-Mansi Autonomous Area (KhMAA), Yamal-Nenets Autonomous Area (YNAA), and the Jewish Autonomous Region. The reasons for obtaining negative values in financial and economic indicators are typical for all regions (see the first and third trends). However, their parameters are significantly influenced by natural and climatic conditions, production and consumption volumes, the composition and nomenclature of the cost structure, and other circumstances reflecting the specifics of regional development and the particularities of livestock farming in different RF constituent entities. From a socio-ecological-economic point of view, this situation leads to conclusions

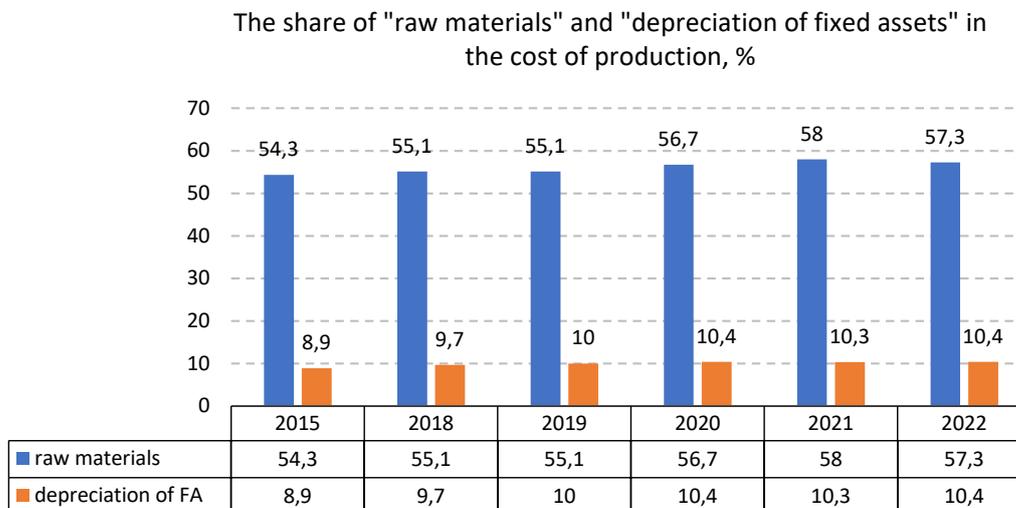


Figure 2. Dynamics of changes in the share of individual components in the cost structure, %

Source: Rosstat data.

similar to those from the analysis of the first trend – regions within this group should be considered as having unstable development. As in the previous case, state support for the industry is required, but this time from both federal and regional authorities.

3. A negative net financial result (profit minus loss) coincides with positive profitability of sold products. This trend is characteristic of a group of regions which includes six RF constituent entities: Orenburg, Bryansk, Rostov, Kaluga regions, Chuvash Republic, Republic of Adygea. In this study, the average value over a series of years was calculated (a mathematical mean). Therefore, the obtained result does not mean that every year ended with a negative balance and that agricultural organizations were loss-making annually. For example, the Bryansk Region showed a negative financial result in 2015 and 2018, which in absolute terms “outweighed” the positive financial result for all subsequent years – from 2019 to 2021. However, this means (this is the trend) that, depending on external and other factors, agricultural producers in certain regions of the country periodically face the problem of generating profit in the current year, and their further “survival” depends either on previously formed reserves and accumulated resources (material, financial, etc.), the so-called “safety cushion”, or on state support in the form of various subsidies, grants, and other payments from budgets of different levels. That is, positive profitability (the average value over

a series of years) makes the development of agriculture (livestock farming in particular) in such regions relatively promising in the future. But in the present – due to the negative net financial result – they should be considered as rural territories with conditionally stable development. In this case, the actions of regional authorities to support agricultural producers may be of a sporadic nature.

4. A positive net financial result (profit minus loss) coincides with positive profitability of sold products. The fourth trend is characteristic of all remaining regions not listed in points 1–3, with the exception of the city of Saint Petersburg, for which data on cattle population were unavailable. While such a situation raises no doubts from a socio-economic point of view, it becomes ambiguous when considering the environmental component – an integral part of the triad of sustainable development of rural territories. For instance, in the Republic of Tatarstan and the Novgorod Region, with the same profitability (9%) and different net financial results (in Tatarstan it is 12.25 times larger), the negative environmental impact (methane emissions) also differs: in Tatarstan, the average for the analyzed years was 979.47 thousand head, while in the Novgorod Region it was 29.91 thousand head. Consequently, the negative environmental impact in Tatarstan is 32.75 times greater. This raises the question: which region, then, should be considered a region with sustainable development?

Aggregated data for the four trends discussed above are presented in *Table 3*.

Table 3. General characteristics of sustainable development trends in Russian rural territories

Trend	N _{fr}	P _{sg}	Development characteristic	Number of RF constituent entities
first	positive	negative	unsustainable	10
second	negative	negative	unsustainable	13
third	negative	positive	conditionally sustainable	6
fourth	positive	positive	conditionally sustainable	55

Source: own compilation.

Discussion

To answer the question posed, it is necessary to proceed to the implementation of the sixth stage. The calculation of the corresponding coefficients (C_{aap} and C_{ifc}) was carried out for the RF constituent entities with a significant (“high” and “medium”) share of agriculture (livestock farming) in the regional economy. The results of the calculations are presented in *Table 4*.

The obtained results allow for another significant conclusion. In certain constituent entities of the Russian Federation (Krasnoyarsk Territory, Sverdlovsk, Tyumen, Chelyabinsk,

Irkutsk, Omsk regions, etc.), where the animal husbandry efficiency coefficient meets the “high” or “medium” criteria, the sustainable development of rural territories depends to a considerable extent on the level of industrial production development in that entity: the higher it is, the more sustainable the development of rural territories in this region will be, since revenues from industry can compensate for the negative environmental impact caused by animal husbandry. This pattern should be taken into account when implementing regional sustainable development policies.

Table 4. Russian regions with sustainable / unsustainable development of rural territories

No.	RF constituent entity	C_{aap}	C_{ifc}	C_{ahe}	Development of rural territories
1	Republic of Dagestan	0.05	no data	high	unsustainable
2	Republic of Bashkortostan	1.46	1.34	high	sustainable
3	Republic of Tatarstan	3.51	1.67	high	sustainable
4	Altai Territory	0.60	0.06	high	unsustainable
5	Krasnodar Territory	1.45	1.16	high	sustainable
6	Voronezh Region	1.30	0.17	high	unsustainable
7	Republic of Buryatia	1.19	0.15	high	unsustainable
8	Stavropol Region	1.19	0.52	high	unsustainable
9	Saratov Region	2.28	1.22	high	sustainable
10	Volgograd Region	11.06	3.45	high	sustainable
11	Novosibirsk Region	1.49	0.27	high	unsustainable
12	Astrakhan Region	1.68	0.09	medium	unsustainable
13	Belgorod Region	6.62	2.20	medium	sustainable
14	Irkutsk Region	10.90	10.63	medium	sustainable
15	Omsk Region	4.06	5.35	medium	sustainable
16	Krasnoyarsk Region	13.12	33.08	medium	sustainable
17	Udmurt Republic	0.62	0.08	medium	unsustainable
18	Sverdlovsk Region	18.97	10.23	medium	sustainable
19	Tyumen Region without AA	1.33	3.40	medium	sustainable
20	Kabardino-Balkarian Republic	0.10	no data	medium	unsustainable
21	Nizhny Novgorod Region	2.76	0.90	medium	unsustainable
22	Republic of Mordovia	0.51	0.12	medium	unsustainable
23	Chelyabinsk Region	18.64	18.74	medium	sustainable
24	Kursk Region	0.82	0.05	medium	unsustainable
25	Perm Territory	8.08	0.61	medium	unsustainable
26	Leningrad Region	7.93	13.41	medium	sustainable

Source: Rosstat data.

Conclusion

Currently, experts propose several ways to solve the problem of methane emissions from ruminants. Some advocate for changing the type of feed and diet by including various additives that would reduce CH₄ emissions. Others propose breeding a special type of cattle with lower atmospheric “exhaust”. Yet others suggest somehow collecting the gas produced by each animal and using it purposefully. There are other methods as well. However, none of them has so far led to significant success or proven its effectiveness for widespread long-term application.

At the same time, attention should be paid to significant factors that substantially influence the sustainable development of rural territories and must be considered both for forming sustainable development trends and for making relevant management decisions by authorities:

1) not only the composition but also the quantity of consumed feed and various additives in the animals’ diet; more progressive (advanced, innovative) nutrition for cattle should contribute to solving a dual task: on the one hand, reducing the cost of livestock rearing due to a smaller volume of feed in the diet (the economic component of sustainable development), and on the other hand, reducing

methane emissions by including appropriate components in the diet (the ecological component of sustainable development). Thus, this factor directly links the economic and ecological components of sustainable development;

2) the number of cattle heads, as it is decreasing worldwide for various reasons: in the USA, the number decreased by 3% in 2022; in France, by 2.7%; globally, by ~50 million head; in Russia, the number was 18.6209 million head in 2015 and 17.6496 million head in 2022; therefore, considering this global trend, it can be stated that the economic component directly influences the ecological component of sustainable development; at the same time, the overall reduction in the number of cattle should be ensured by their productivity (for example, according to Rosstat, the level of self-sufficiency in basic food products in Russia is quite high; in particular, for meat, it was 101.8% in 2022);

3) state support for agricultural producers from budgets of different levels; according to domestic statistics, state expenditures on agriculture increase product profitability by an average of 4–5% (in animal husbandry), which undoubtedly positively affects the economic, ecological, and social components of the triad of sustainable development of rural territories.

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METHODOLOGICAL APPROACHES TO THE INTEGRATION OF SUSTAINABLE DEVELOPMENT PRINCIPLES INTO REGIONAL STRATEGIES FOR SOCIO-ECONOMIC DEVELOPMENT



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In less than five years, the period of implementation of most socio-economic development (SED) strategies at both the federal and regional levels will end, which coincided with the action of a set of interrelated challenges (geopolitical, economic, demographic, etc.). In the context of the climate agenda actualization, the transition to a closed-loop economy and digitalization of management, the need to rethink the strategic tools of regional planning is increasing. The study's objective is to develop and scientifically substantiate methodological approaches to the integration of sustainable development principles into regional strategies. The article presents the results of an analysis of the current practice of integrating sustainable development principles into regional strategies. The results of the content analysis revealed significant heterogeneity in the degree and form of integration of sustainable development principles into regional strategic planning documents, as well as the fragmentary and / or declarative nature of the

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use of the main provisions of the sustainable development concept. Separately, it is necessary to note the preponderance of the content of the first two components (economic and social) and weak disclosure of the environmental component of sustainable development in regional strategies, as well as the lack of coordinating and corrective mechanisms aimed at implementing sustainable development in the long term. The approaches to fine-tuning the regional strategy process at its various stages (analysis, scenario planning, mission and priority formulation, implementation mechanisms, monitoring and adaptation, coordination of priorities) are proposed and described, which can ensure compliance with the achievement of long-term regional development priorities taking into account the impact of modern global challenges. The study used methods of comparative analysis and synthesis, economic and statistical analysis. The research results can serve as a basis for improving the methodological tools of strategic planning and developing new recommendations at the federal level.

Sustainable development, strategy, content analysis, socio-economic development, constituent entities of the Federation.

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Introduction

The 2030 Agenda for Sustainable Development (SD)¹, adopted by the United Nations General Assembly, establishes universal benchmarks and goals that require adaptation at national and sub-national levels. For the Russian Federation, characterized by pronounced territorial differentiation and a heterogeneous institutional environment, the issue of integrating sustainable development principles into regional-level strategic documents is particularly relevant. Despite the existence of a normative foundation for strategic planning (specifically, Federal Law 172-FZ² and methodological recommendations from the Russian Ministry of Economic Development³), the current socio-economic development strategies of the Russian federal subjects were developed and/or updated

at different times and, for the most part, conform to federally approved methodological requirements more formally than substantively (Budaeva, Klimanov, 2014; Shelomentsev et al., 2017). Insufficient methodological support, as well as the lack of regionally adapted indicators for achieving sustainable development goals, hinder the implementation of a systemic approach to strategic management.

It should be emphasized that current federal regulation does not contain a direct mandate for the federal subjects to obligatorily include sustainable development principles in their regional strategies. This adds further significance to the research: sustainability is viewed not as a formally imposed construct, but as a possible conscious choice by regional authorities aimed at ensuring long-term effectiveness and coherence of development.

¹ Transforming Our World: The 2030 Agenda for Sustainable Development. Available at: <https://sdgs.un.org/ru/2030agenda> (accessed: 19.06.2025).

² On Strategic Planning in the Russian Federation: Federal Law 172-FZ dated June 28, 2014. Available at: <http://pravo.gov.ru/proxy/ips/?docbody&nd=102354386> (accessed: 19.06.2025).

³ On Approval of Methodological Recommendations for the Development and Adjustment of the Socio-Economic Development Strategy of a Subject of the Russian Federation and the Plan of Measures for Its Implementation: Approved by Order 132 of the Ministry of Economic Development of Russia dated March 23, 2017. Available at: https://economy.gov.ru/material/dokumenty/prikaz_minekonomrazvitiya_rossii_ot_28_iyunya_2024_g_397.html (accessed: 19.06.2025).

The aim of this study is to develop and provide a scientific rationale for methodological approaches to integrating sustainable development principles into regional socio-economic development strategies. In this regard, the following research questions are proposed:

1. What models and approaches to territorial planning based on SD principles, implemented in international practice, can be adapted to Russian conditions?

2. What is the nature and content of the current strategic planning system for sustainable development at the regional level: do the current strategies of the Russian federal subjects declare and/or adapt sustainable development principles? Do regional strategies account for the influence of global challenges on the long-term development parameters of a territory?

3. How can the interrelationship between sustainable development goals and goal-setting in the strategic documents of the Russian federal subjects be formalized?

4. What should be the framework for developing a strategy based on sustainable development principles?

Answers to these questions will form a scientifically grounded and applied basis for improving the quality of regional strategic planning, taking into account the imperatives of sustainable development.

The scientific problem of the research lies in the absence of a theoretical-methodological framework that would allow for identifying and measuring the degree of institutionalization of sustainable development principles in regional-level strategic documents. Despite the practical need for integrating sustainability principles, a reproducible toolkit for comparing the declarative elements of strategies with their actual managerial implementation has not been developed to date. This creates a gap

between the substantive and institutional levels of strategic planning, the bridging of which requires the development of a methodology that combines formalized text analysis with empirical verification of implementation mechanisms.

The scientific novelty of the research is associated with the development and testing of a methodological approach to assessing the degree of institutionalization of sustainable development principles in regional-level strategic documents. The proposed model combines content analysis with elements of management practice verification, enabling a shift from the declarative description of strategies to empirically verifiable assessments of their substantive and institutional maturity.

Theoretical and methodological foundations of the research

The concept of sustainable development has become established in the international scientific and political-management agenda as a response to the escalation of environmental, social, and institutional risks that limit the effectiveness of traditional growth models. The classic definition of sustainable development, proposed in the report of the World Commission on Environment and Development “Our Common Future” (1987)⁴, implies meeting the needs of the present generation without compromising the ability of future generations to meet their own needs. This definition laid the foundation for forming a holistic framework in which development is viewed as a balance of three interconnected dimensions – economic, social, and environmental.

In the following decades, the theoretical understanding of sustainable development evolved along several lines. In ecological-economic theories (Daly, 1991; Pearce, Barbier, 2000), the priority of environmental constraints

⁴ Report of the World Commission on Environment and Development “Our Common Future”. Available at: <https://www.un.org/ru/ga/pdf/brundtland.pdf> (accessed: 19.06.2025).

and the need to reassess the production-consumption paradigm are emphasized. Within the institutional approach (North, 1990; Ostrom, 2009), sustainability is understood as the capacity of systems for self-regulation and adaptation through robust institutions and governance mechanisms. Social theories of sustainability focus on equity, social inclusion, and participation (Sen, 1999; Raworth, 2017), complementing the economic-environmental frameworks with a humanitarian component. The contemporary interdisciplinary framework for sustainable development is enshrined in the 2030 Agenda and the Sustainable Development Goals (SDGs), adopted by the UN in 2015. Comprising 17 goals and 169 targets, they cover key aspects of socio-economic, environmental, and institutional transformation. The SDGs are universal in nature but assume territorial localization and adaptation considering the context of specific countries and regions.

In this regard, the importance of the regional level as an intermediary link between global priorities and local implementation is increasing.

For regional strategic planning, sustainable development represents not only a substantive framework but also a methodological guideline. However, as research shows (Spangenberg, 2004; Haughton, Counsell, 2004), integrating sustainable development into territorial planning requires rethinking the very logic of planning: shifting from linear, technocratic models to systemic, adaptive, and reflexive ones.

Several key directions can be distinguished in domestic research dedicated to territorial planning based on sustainable development principles. One actively developing direction focuses on adapting international benchmarks of sustainable development (Agenda 21, SDGs, the ESG agenda) to the Russian institutional and regulatory environment (Bobylev et al., 2025; Lanshina, 2019; Ryazanova, Menshov, 2018; Sakharov, 2025). Research is also being

conducted on the specifics of implementing the ESG concept into the system of regional and corporate governance (Zaitsev, Khapilina, 2022; Izmaylova, 2023; Kalitseva, 2023; Lektorova et al., 2024), including assessing the influence of corporate practices on territorial development. Another prominent direction is related to building ratings and methodologies for measuring the sustainability of territorial systems using unified indicators (Bobylev et al., 2018; Burenina, Byl, 2016; Ershov et al., 2022; Novoseltseva et al., 2023). Furthermore, attention is increasing towards greening territorial development management and analyzing regional strategies in the context of decarbonization and “green” modernization (Gainanov et al., 2023; Karanina, Kartavykh, 2023; Turtseva, 2022; Sakharov, 2024).

Finally, a separate branch of research is forming, dedicated to the sustainable development of urban and rural areas: circular economy and “green” infrastructure in cities (Erznkyan, Fontana, 2021; Amiantov, 2022; Gagarina, 2023), as well as inclusive and creative development of rural territories (Akimova et al., 2022; Ivanyuga, 2025; Miroshnichenko, 2023; Polushkina et al., 2022).

These directions reflect the gradual formation of a systemic approach to regional sustainable development in Russian science – from the conceptual adaptation of international principles to the search for its own methodologies and indicators. However, in Russian practice, the integration of SD principles into the socio-economic development strategies of the Russian federal subjects remains limited so far. Empirical research demonstrates that the mention of SDGs in strategies is often declarative, and their implementation mechanisms are not formalized (Korshunov, 2022). This is due to both methodological and institutional barriers, including weak interdepartmental coordination, a lack of indicative tools, and poor stakeholder engagement.

Examples of incomplete/partial implementation of sustainability principles can also be found in certain foreign countries. For instance, a study of Italian municipalities shows that the adoption of SDGs is used primarily as a rhetorical or symbolic resource, without being embedded in the procedures of goal-setting, programming, and monitoring (Guarini, 2021). Similar problems have been identified in urban planning and tourism management in Kazakhstan, where sustainability is declared but not operationalized through indicators and assessment mechanisms (Mamutova, 2020).

Several key approaches to strategic planning for sustainable development are distinguished in the scientific literature:

1) an integrative approach, implying cross-sectoral coordination and the comprehensiveness of strategies covering the economy, society, and the environment (Spangenberg, 2004; Komarov et al., 2021);

2) adaptive planning, based on continuous monitoring, strategy adjustment, and consideration of external environmental uncertainty (Walker et al., 2001);

3) an indicator-based approach, involving the use of quantitative and qualitative indicators to measure progress towards sustainable development goals; these are not necessarily universally accepted indicators (like Gross Regional Product) but can also include various types of aggregated indices (Cobb, 2007; Moldan et al., 2012; Costanza et al., 2016);

4) context-sensitive planning, where a strategy is based on the specificities of the local context, the level of vulnerability, and the potential of regional communities⁵.

The conceptual framework of this study is built on a synthesis of integrative and indicator-based approaches, similar to the methodology of territorial system sustainability viewed as complex socio-ecological systems (SES) (Folke et al., 2010). First, sustainable development is considered a cross-cutting principle that should be embedded in the goal-setting, program measures, and monitoring of regional development strategies. Second, special attention is paid to the localization of sustainable development principles in the regional context, which involves adapting indicators, considering territorial vulnerabilities, and engaging local actors. Third, a sustainable regional strategy is understood as a document that ensures coherence between short-term development priorities and the long-term imperatives of environmental, social, and institutional sustainability.

Thus, sustainable development in regional planning represents not merely a thematic direction, but a methodological paradigm implying a systemic, reflexive, and managed process of shaping a region's future under conditions of constraints and uncertainty.

Before proceeding to the analysis of regional socio-economic development strategies, it is advisable to examine the extent to which sustainable development principles are considered in federal-level strategic documents that form the framework for regional policy. In this context, the Spatial Development Strategy of the Russian Federation for the Period up to 2030 with a Forecast up to 2036⁶ is of key importance, as it sets the priorities, mechanisms, and model for managing territorial development.

⁵ OECD. (2020). A territorial approach to the Sustainable Development Goals: Synthesis report. OECD Publishing. DOI: <https://doi.org/10.1787/e86fa715-en>

⁶ Spatial Development Strategy of the Russian Federation for the Period up to 2025: Approved by RF Government Resolution 207-r dated February 13, 2019. Available at: https://www.economy.gov.ru/material/dokumenty/rasporyazhenie_ot_13_fevralya_2019_g_207_r.html (accessed: 19.06.2025).

The Spatial Development Strategy of Russia allows for the identification of individual elements relatable to the logic of sustainable development, despite the absence of a direct declaration of sustainability principles or references to the UN SDGs. However, even though the document serves as one of the key instruments for implementing state regional policy and strategic territorial planning, sustainable development does not occupy a conceptual and methodological place within it.

The Strategy outlines several provisions related to ensuring balanced socio-economic growth of territories, reducing interregional disparities, improving quality of life, access to basic services, and adaptation to climate risks. Collectively, these priorities can be interpreted as an aspiration to form sustainable models of regional growth. Significant attention in the document is given to the climate agenda; nevertheless, the environmental component of sustainable development is considered predominantly through the lens of adapting to the global agenda, rather than as a value-normative foundation for long-term regional policy. The economic dimension of sustainability in the Strategy is implemented through a series of measures (developing clusters, cooperation); however, these are more oriented towards ensuring technological and territorial sovereignty than transitioning to a low-carbon or circular economy.

Thus, although the Strategy is not based on sustainable development as its methodological and value foundation, it contains a number of provisions that can be thematically and functionally linked to its key dimensions. These provisions could serve as a starting point for institutionalizing sustainable development in regional strategies, provided there is subsequent methodological reinforcement and the introduction of indicator-based systems.

The next analytical step involves examining how sustainable development principles are reflected in strategies at the regional level.

Data and methods

To assess the degree of integration of sustainable development principles into the regional socio-economic development strategies of the constituent entities of the Russian Federation, a content analysis of the official strategy texts was conducted, based on a formalized set of criteria.

In the first stage, a selection of socio-economic development strategies for the constituent entities of the Russian Federation was made using a method of clustering regions based on two indicators: 1) the value of Gross Regional Product per capita in 2022; 2) the growth rate of per capita GRP for the period 2007–2022 (indicators are presented in comparable form). Clustering of the federal subjects was performed based on the values of these two indicators using the k-means method (number of groups – 5). Subsequently, for each group, two regions were selected (from among the leaders and the outsiders), and their strategies were included in the sample.

A sample based on clustering was used to eliminate the influence of political, climatic, and geographical factors. For instance, selecting subjects from a single federal district for assessment could result in a sample containing regions with similar socio-economic profiles and exposure to the same environmental and climatic challenges. Furthermore, the existence of a common political course within a federal district could also lead to reduced variability in strategy texts. Selecting subjects from the edges of the groups (leader and outsider) will also allow for a comparison of strategies from regions with similar levels of per capita GRP and its growth rates.

In the second stage, a frequency analysis of the strategy texts from the sampled regions was conducted to determine the frequency of key

research phrases: “sustainable development”, “sustainability”, “challenge”, i.e., to identify the degree of sustainability terminology declaration. The process included the following steps: data preparation (loading strategy texts, text cleaning, standardization to a single registry); tokenization (splitting into units); lemmatization (reducing words to their base form); frequency counting; analysis and visualization of results. Clustering and frequency analysis were performed in the RStudio environment. The results of the computer frequency analysis were subsequently verified by expert review (regarding the use of terms in context).

In the third stage, an actual content analysis of the strategy texts was conducted. The goal of the analysis was to identify not declarative, but structural-functional consideration of sustainable development as a category of strategic planning. Special attention was paid to eliminating subjective interpretation by using binary logic (0/1) for each parameter.

The analysis was conducted according to six main criteria, allowing for the identification of both the fact of including sustainability principles in the document’s structure and the depth of their operationalization (i.e., the translation of goals into a list of actions).

C0 “Sustainable Development”. The presence of a direct mention of the term “sustainable development” in the strategy text – indicates recognition of the corresponding agenda at the level of conceptual apparatus.

C1 “Challenges”. Mention, classification, and ranking of global challenges in the strategy text – is important for forming a set of sustainable development priorities for the region.

C2 “Systematicity”. The presence of a systematic approach to sustainable development, i.e., its integration into key structural elements of the strategy: goals, objectives, principles, priority areas. Sustainability is considered not as a separate section but as a methodological framework for planning.

C3 “Economy”, “Social Sphere”, “Ecology” (1 point for each dimension). Reflection of the three interconnected dimensions of sustainable development: economic, social, and environmental. Examples of the presence of goals/tasks by dimension: economic (growth of labor productivity, economic diversification, support for small businesses), social (improving quality of life, reducing poverty, improving demographics), environmental (nature protection, reducing pollution, rational use of resources). Each dimension was assessed based on the presence of corresponding goals, objectives, or priorities.

C4 “Indicators”. The presence of specific sustainability indicators or metrics that allow for progress monitoring (e.g., emission levels, environmental quality, human development index, etc.) – indicates an attempt to operationalize the sustainability concept.

C5 “Mechanisms”. The presence of mechanisms for implementing and monitoring sustainable development goals (whether the strategy documents procedures for regular assessment, systems of indicative reporting, structural implementation mechanisms, such as special coordinating bodies or digital platforms).

“Final Score”. The maximum possible score for each document is 8. The obtained values allow for the construction of a consolidated regional ranking based on the degree of SD principle integration, as well as for identifying dominant types of strategic approach (declarative, fragmented, comprehensive).

Thus, the methodology involves collecting representative heterogeneous material to assess strategies from the standpoint of sustainable development.

Results

Characteristics of the subject sample.

The conducted clustering of Russian federal subjects based on per capita GRP levels for 2022 and GRP growth rates for 2007–2022 allowed for the identification of five regional groups, from each of which two subjects were subsequently selected (*Fig. 1, Tab. 1*).

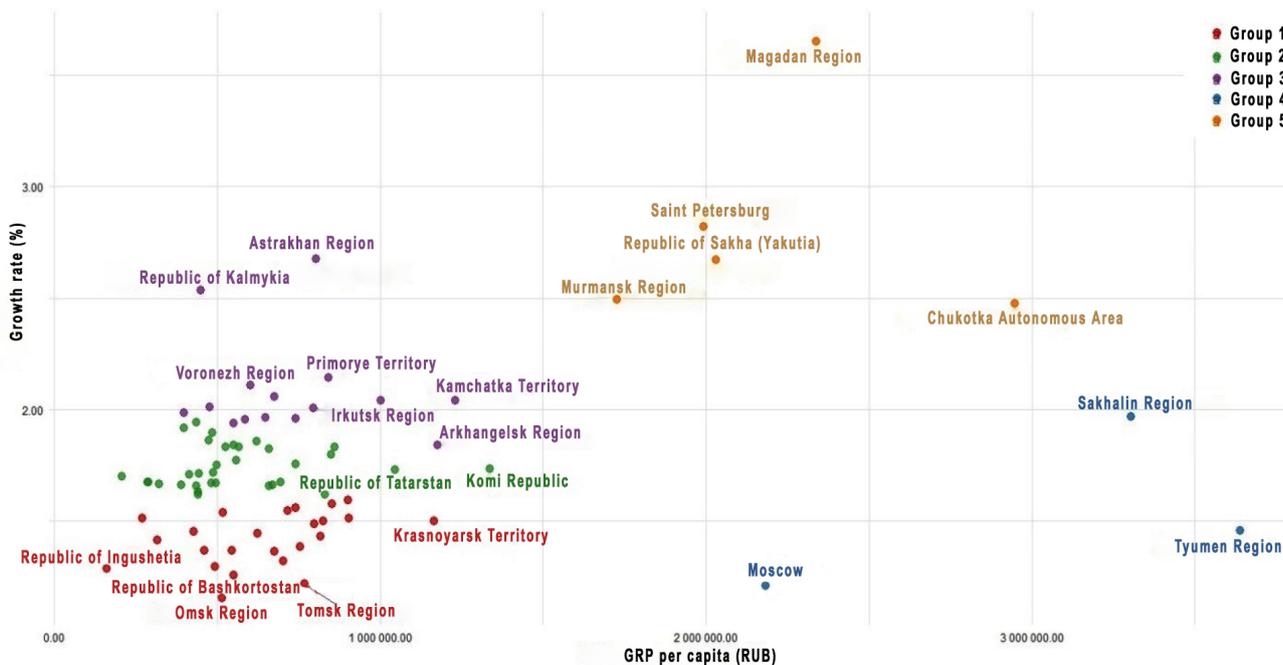


Figure 1. Visualization of the clustering of Russian federal subjects based on two indicators (per capita GRP in 2022 and GRP growth rate in 2007–2022)

Source: Calculated and visualized in the RStudio software environment.

Table 1. Characteristics and composition of the groups of Russian federal subjects obtained as a result of clustering

Group	GRP per capita value ranges in 2022	GRP growth rate ranges 2007–2022	Number of subjects in the group	List of Russian federal subjects	Group characteristics
1	159 603,50–1 164 188,70	1.16–1.59	24	Republic of Ingushetia; Karachayevo-Circassian Republic; Republic of North Ossetia – Alania; Chuvash Republic; Republic of Buryatia; Volgograd Region; Omsk Region; Tver Region; Jewish Autonomous Region; Republic of Bashkortostan; Yaroslavl Region; Chelyabinsk Region; Lipetsk Region; Kaliningrad Region; Republic of Karelia; Samara Region; Tomsk Region; Perm Territory; Sverdlovsk Region; Leningrad Region; Orenburg Region; Moscow Region ; Vologda Region; Krasnoyarsk Territory	Low level of GRP per capita; low growth rates of per capita GRP 2007–2022.

End of table 1

Group	GRP per capita value ranges in 2022	GRP growth rate ranges 2007–202	Number of subjects in the group	List of Russian federal subjects	Group characteristics
2	206 751,30 – 1 335 846,20	1.62–1.94	33	<i>Chechen Republic</i> ; Republic of Dagestan; Kabardino-Balkarian Republic; Republic of Tyva; Republic of Mari El; Ivanovo Region; Stavropol Territory; Republic of Altai ; Pskov Region; <u>Altai Territory</u> ; Republic of Mordovia; Kurgan Region; Penza Region; Kostroma Region; Kirov Region; Tambov Region; Saratov Region; Ulyanovsk Region; Orel Region; Trans-Baikal Territory; Rostov Region; Ryazan Region; Kursk Region; Republic of Khakassia; Novgorod Region; Republic of Udmurtia; Novosibirsk Region; Nizhny Novgorod Region; Khabarovsk Territory; Kemerovo Region; Belgorod Region; Republic of Tatarstan; Komi Republic	Low level of GRP per capita; medium growth rates of per capita GRP 2007–2022
3	395 639,80– 1 228 904,50	1.84–2.68	15	<i>Republic of Adygea</i> ; Republic of Kalmykia; Bryansk Region; Smolensk Region; Vladimir Region; Voronezh Region; Kaluga Region; Tula Region; Krasnodar Territory; Amur Region; Astrakhan Region ; Primorye Territory; Irkutsk Region; <u>Arkhangelsk Region</u> ; Kamchatka Territory	Medium level of GRP per capita; medium growth rates of per capita GRP 2007–2022
4	2 182 863,00 – 3 637 116,50	1.21–1.97	3	<i>Moscow</i> ; Sakhalin Region ; Tyumen Region	High level of GRP per capita; low growth rates of per capita GRP 2007–2022
5	1 735 233,40– 2 946 171,50	2.48–3.65	5	<i>Murmansk Region</i> ; Saint Petersburg; Republic of Sakha (Yakutia); Magadan Region; Chukotka Autonomous Area	High level of GRP per capita; high growth rates of per capita GRP 2007–2022

Legend:

Federal subject – group outsider based on GRP per capita value in 2022.

Federal subject – group leader based on GRP per capita value in 2022.

Federal subject – group outsider based on GRP per capita growth rate value in 2007–2022.

Federal subject – group leader based on GRP per capita growth rate value in 2007–2022.

Calculated using clustering tools in the RStudio software environment based on:

Gross Regional Product since 1998. Rosstat. Available at: <https://rosstat.gov.ru/statistics/accounts> (accessed: 17.06.2025); Consumer price indices for goods and services for the Russian Federation, federal districts and constituent entities of the Russian Federation (since 1992). Available at: <https://rosstat.gov.ru/statistics/price> (accessed: 17.06.2025).

Table 2. Characteristics of the selected Russian federal subjects

Federal subject	Group	GRP per capita in 2022		Growth rate of per capita GRP 2007–2022		Position in group
		value, RUB/person	rank	value	rank	
Republic of Ingushetia	1	159 603,50	80	1.29	76	Outsider
Orenburg Region	1	850 040,20	18	1.58	56	Leader
Republic of Mari El	2	388 519,70	73	1.66	49	Outsider
Belgorod Region	2	859 545,10	17	1.84	28	Leader
Republic of Adygea	3	395 639,80	72	1.99	15	Outsider
Irkutsk Region	3	1 001 234,60	14	2.04	12	Leader
Tyumen Region	4	3 637 116,50	1	1.46	65	Leader
Murmansk Region	5	1 735 233,40	8	2.48	6	Outsider
Chukotka Autonomous Area	5	2 946 171,50	3	2.48	7	Leader

Calculated using clustering tools in the RStudio software environment based on: Gross Regional Product since 1998. Rosstat. Available at: <https://rosstat.gov.ru/statistics/accounts> (accessed: 17.06.2025); Consumer price indices for goods and services for the Russian Federation, federal districts and constituent entities of the Russian Federation (since 1992). Available at: <https://rosstat.gov.ru/statistics/price> (accessed: 17.06.2025).

The subject sample (*Tab. 2*) includes nine representatives from seven federal districts. It should be noted that from the fourth group (high GRP level; low growth rates), only the Tyumen Region was selected (the group's outsider – the city of Moscow – currently lacks an approved strategy text).

Frequency analysis of the strategy texts of Russian federal subjects. For the selected federal subjects, the texts of current socio-

economic development strategies⁷ were downloaded, and frequency and content analyses were conducted.

The results of the frequency analysis demonstrate differences in the occurrence of key research phrases (“sustainable development”, “sustainability”, “challenges”) (*Fig. 2*). The leaders in the frequency of the term “sustainable development” are the Republic of Adygea and the Republic of Mari El

⁷ On the Strategy for Socio-Economic Development of the Republic of Ingushetia for 2009–2020 and for the Period up to 2030: Decree 49 of the Government of the Republic of Ingushetia dated February 16, 2009. Available at: <http://pravo.gov.ru/proxy/ips/?docbody=&prevDoc=134037015&backlink=1&&nd=134061743&rdk=1&refoid=134061830> (accessed: 01.07.2025); On the Strategy for Socio-Economic Development of the Orenburg Region up to 2030: Decree 551-PP of the Government of the Orenburg Region dated August 20, 2010. Available at: https://minsport.orb.ru/upload/uf/8eb/post_prav_oo_20082010_551pp.pdf (accessed: 01.07.2025); On Approval of the Strategy for Socio-Economic Development of the Republic of Mari El for the Period up to 2030: Resolution 12 of the Government of the Republic of Mari El dated January 17, 2018. Available at: <http://pravo.gov.ru/proxy/ips/?docbody=&prevDoc=146014231&backlink=1&&nd=146077596> (accessed: 01.07.2025); On Approval of the Strategy for Socio-Economic Development of the Belgorod Region for the Period up to 2030: Decree 371-pp of the Government of the Belgorod Region dated July 11, 2023. Available at: <http://publication.pravo.gov.ru/document/3100202307130022> (accessed: 01.07.2025); On the Strategy for Socio-Economic Development of the Republic of Adygea up to 2030: Decree 286 of the Cabinet of Ministers of the Republic of Adygea dated December 26, 2018. Available at: <https://www.economy.gov.ru/material/file/dae08b9c55943f5a7c6fefdf554abfcb/61218ra.pdf> (accessed: 01.07.2025); On Approval of the Strategy for Socio-Economic Development of the Irkutsk Region for the Period up to 2036: Law 15-OZ of the Irkutsk Region dated January 10, 2022. Available at: https://irkobl.ru/region/gov_programms/economy/strategiya.doc (accessed: 01.07.2025); On Approval of the Strategy for Socio-Economic Development of the Tyumen Region up to 2030: Law 23 of the Tyumen Region dated March 24, 2020. Available at: <https://sapp.duma72.ru/zakonotvorchestvo/zakonoproekty-vnesennyye-v-tyumenskuyu-Regionnuyudumu/2883> (accessed: 01.07.2025); On the Strategy for Socio-Economic Development of the Murmansk Region up to 2020 and for the Period up to 2025: Decree 768-PP/20 of the Government of the Murmansk Region dated December 25, 2013. Available at: https://minec.gov-murman.ru/ppmo-ot-25.12.13--768_pp_20_v-red.-ot-10.07.17_.pdf (accessed: 01.07.2025); On Approval of the Strategy for Socio-Economic Development of the Chukotka Autonomous Area up to 2030: Decree 290-RP of the Government of the Chukotka Autonomous Area dated July 16, 2014. Available at: <https://чукотка.рф/files/docs/Strateg-CEP-CHAO.doc> (accessed: 01.07.2025).

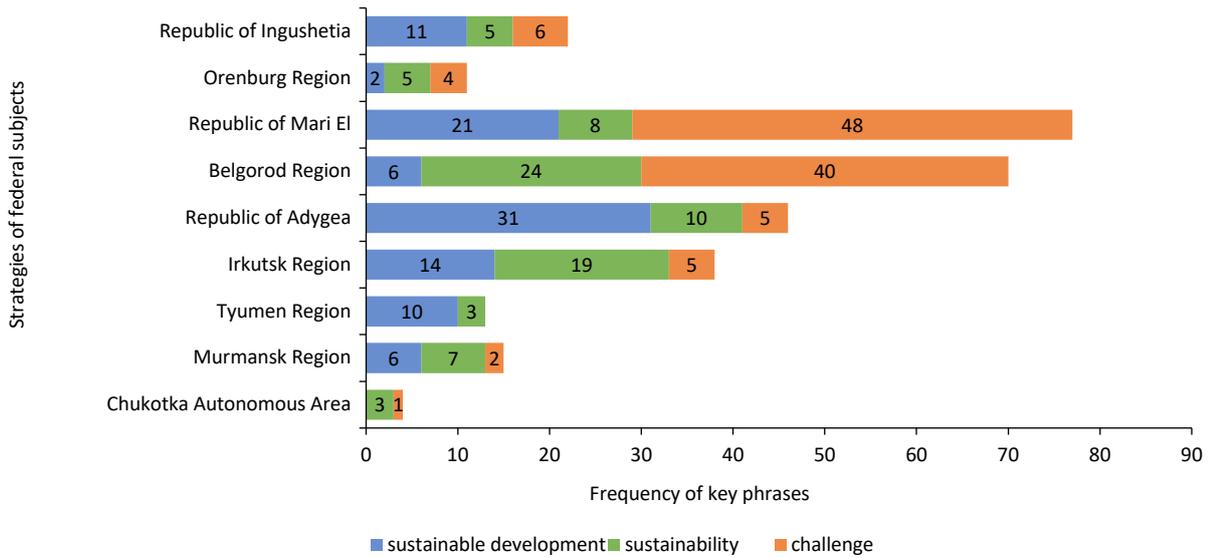


Figure 2. Visualization of the results of the frequency analysis of strategy texts after verification

Source: Calculated in the RStudio software environment.

(both regions are outsiders in their groups). At the same time, the term “sustainable development” is not mentioned in the strategy of the Chukotka Autonomous Area.

Content analysis of the texts of selected strategies of Russian federal subjects. Let us examine how the results of the frequency

analysis align with the results of the structural-content analysis of the strategy texts, as the declaration of sustainable development does not always translate into actual tools for ensuring it.

The content analysis of the selected strategies revealed significant variability in the degree of SD principle integration (Tab. 3).

Table 3. Results of the point-based assessment of socio-economic development strategies of Russian federal subjects based on content analysis

Federal subject	Group	C0: Sustainable Development	C1: Challenges	C2: Systematicity	C3: Economy	C3: Social Sphere	C3: Ecology	C4: Indicators	C5: Mechanisms	TOTAL (out of 8)
Republic of Ingushetia	1	1	1	0	0	0	0	1	0	3
Orenburg Region	1	1	1	1	1	1	1	1	0	7
Republic of Mari El	2	0	1	0	1	1	0	0	0	3
Belgorod Region	2	0	1	1	1	1	1	1	1	7
Republic of Adygea	3	1	1	1	0	0	1	1	0	5
Irkutsk Region	3	1	1	1	1	1	1	1	1	8
Tyumen Region	4	0	0	1	1	1	1	1	1	6
Murmansk Region	5	0	1	1	1	1	1	1	0	6
Chukotka Autonomous Area	5	0	1	0	0	0	0	0	1	2

Source: own calculation based on content analysis of strategies of the selected Russian federal subjects.

The leaders are the Irkutsk Region (8 out of 8 points), Belgorod and Orenburg regions (7 out of 8 points). Their strategies demonstrate a systematic elaboration of sustainable development as a methodological framework. In them, sustainability is present across all structural blocks – from goal formulation to implementation mechanisms and indicator systems. In the Belgorod Region, sectoral aspects are developed, including food security, processing, and cooperation. The Irkutsk Region focuses on climatic and environmental risks, incorporating indicators for emission reduction, water resource protection, and reforestation.

The outsiders are the Chukotka Autonomous Area (2 points) and the republics of Ingushetia and Mari El (3 points each). It should be noted that both republics are outsiders within their groups and have low per capita GRP levels, while the Chukotka Autonomous Area, conversely, is a leader in the overall ranking but in fact has the least developed strategy among all. The strategies of these regions lack conceptual and structural inclusion of sustainable development, and they do not specify/describe implementation mechanisms or a monitoring system. The emphasis is shifted towards economic growth, while environmental and institutional sustainability are not established as managerial guidelines.

Regions with intermediate results (4–6 points) demonstrate the presence of individual sustainability elements (e.g., goals or indicators) but without systemic integration. In some cases, declarativeness is observed: the term “sustainable development” is mentioned but is not methodologically substantiated.

Such heterogeneity necessitates moving to an analysis of the individual criteria used to assess the degree of integration of sustainable development principles into the structure of regional strategies.

Criterion 0. Mention of the term “sustainable development”: from declaration

to institutionalization. The term “sustainable development” is present in the strategies of most subjects, but the degree of its substantive elaboration varies. In a number of cases, it appears as a rhetorical formula or a fragmentary slogan, not supported by conceptual or instrumental elaboration. For instance, the strategy of the Republic of Ingushetia, despite containing the term “sustainable development,” does not elaborate on it as a concept. The strategy text of the Chukotka Autonomous Area presents only a declarative description of the key directions for the region’s development. Thus, the formal presence of the term “sustainable development” cannot be a sufficient basis for recognizing a strategy as aligned with sustainability principles.

Criterion 1. Mention of the term “challenges”, classification and ranking of regional development challenges during strategy formulation. In half of the strategies, the study of the influence of global challenges on sustainable development is considered within a conducted SWOT analysis; however, its results are practically not used in formulating the region’s development goals and objectives.

As a positive example, one can note the strategy of the Belgorod Region, for which countering global geopolitical challenges is critically important (compared to other regions). This is reflected in the text of the Region’s strategy as a separate subsection “Development Challenges and Risks”, which lists geopolitical, economic, environmental, and demographic risks and challenges. The strategy of the Republic of Mari El can also be noted, where for each strategic task, a block is presented with key challenges the region faces in achieving the specific goal within that section. In contrast, one can highlight the strategy of the Murmansk Region; although its text includes a section dedicated to “strengthening the geopolitical and resource-economic significance of the Arctic...”, the

system of goals and objectives does not reveal directions for overcoming the challenges and negative factors identified during the analysis.

Criterion 2. Systematicity of sustainable development inclusion. Sustainable development as a methodological framework for strategic planning is recorded only in a limited number of regional strategies.

A clear example of a systemic approach is the text of the Belgorod Region's strategy, which, despite not explicitly embedding SD principles, is systematized, including in the context of coordinating the region's development across three key areas: "economy", "human capital", and "space." This is also characteristic of the Irkutsk strategy, which builds a chain of "priority – socio-economic development sphere – direction of state policy – tactical goal – tactical tasks – activities – target indicators".

Criterion 3. Representation of the three dimensions of sustainable development. The analysis of strategies showed that the economic and social dimensions of sustainability are represented in almost all regions. For example, for the Irkutsk Region, measures to combat poverty, expand access to services, social support, and justice are described: "reducing the poverty level", "systematic support and improving the quality of life for senior citizens", "developing a system for early diagnosis and identification of children with disabilities", "preventive medicine", "vagueness of social support measures... fair and effective social policy". However, there are strategies that only describe the basic strategic vision for the region's development without specifying priority areas down to SD goals and tasks for individual spheres (e.g., the Republic of Ingushetia or the Chukotka Autonomous Area).

Criterion 4. Presence of an indicative system reflecting sustainability. Indicators of sustainable development, particularly the

environmental component, are most fully disclosed in the strategy of the Irkutsk Region. It uses indicators of population quality of life (share of the population provided with drinking water meeting safety requirements; level of self-sufficiency in certain food products) and environmental development (reduction in wastewater discharge volumes into water bodies; share of eliminated unauthorized landfill sites; forest cover of the territory, etc.). In the strategies of the republics of Ingushetia and Mari El, the system of indicators is poorly formalized and not structured according to the three dimensions, which limits the possibilities for monitoring sustainability. The strategy of the Chukotka Autonomous Area lacks an indicator system altogether.

Criterion 5. Implementation and monitoring mechanisms. Only a limited number of documents have developed implementation mechanisms aligned with sustainable development goals. The strategy of the Irkutsk Region lists a set of tools: "regulatory legal acts; activities of the region's development institutions; inter-regional and intraregional cooperation, agreements with economic entities". The Belgorod strategy structures the implementation toolkit into regulatory-legal, financial-economic and investment, organizational-managerial mechanisms, and mechanisms for public-private partnerships. At the same time, in most strategies, implementation mechanisms are either absent or presented as general formulations not linked to sustainable development as a managerial category (the strategy of the Republic of Ingushetia).

The results of the conducted analysis must be interpreted considering a number of methodological and empirical limitations.

First, the socio-economic development strategies of the federal subjects considered in the study were developed and approved in different years – from the early 2010s to the mid-2020s. This leads to significant heteroge-

neity in their substantive structure, priorities, and conceptual framework. Consequently, the level of inclusion of sustainable development topics may reflect not so much the actual institutional orientation of the region, but rather the relevance of this agenda at the time of the document's preparation. This is especially evident in strategies adopted before the release of international and national benchmarks (the 2030 Agenda or updated methodological recommendations from the Russian Ministry of Economic Development).

Second, the research is based solely on documentary analysis of official strategies, without involving additional information about their development process, implementation mechanisms, and actual execution. Thus, a gap may exist between the content of strategic documents and real management practices. A document containing detailed indicators and formal mentions of sustainability may remain ineffective in implementation, and conversely – a strategy with formally limited coverage may be accompanied by active institutional work.

Third, the methodology used relies on a formalized criterion of the presence/absence of sustainability elements (e.g., indicators, mechanisms, mentions), which ensures reproducibility but limits the depth of interpretation. Such binary logic does not allow for accounting for qualitative differences between regions in the degree of elaboration, conceptual integrity, or originality of approach. Furthermore, it does not capture contextual features of regional development, including demographic pressure, climate challenges, institutional maturity, and political will.

Finally, sustainable development in strategies may manifest in an implicit form, through value orientations, institutional mechanisms, or risk management systems, which are not necessarily labeled with the concept of “sustainability”. Such an approach may elude formalized

analysis, necessitating the supplementation of quantitative methods with qualitative procedures of expert assessment and comparative analysis.

It should be noted that the applied methods of content analysis and formalized coding of strategic documents, despite their reproducibility and transparency, have a number of limitations. They do not allow for fully accounting for the context of decision-making, the motivation of strategy developers, and informal management practices. Furthermore, the results depend on the quality of the source documents and the researcher's interpretation of the categorical scheme, which introduces an element of subjectivity and requires subsequent verification with data from independent sources.

To overcome the identified gap between the content of strategic documents and real management practice, using combined methodologies in future research seems promising. First, it is advisable to include procedures for expert surveys and interviews with developers and implementers of regional strategies. This would help reveal actual managerial motivations, the degree of institutional support, and barriers to implementing sustainable development principles. Second, conducting case studies of individual regions demonstrating differences between formal and actual strategy implementation could be undertaken, followed by a comparative assessment of factors contributing to successful realization. Finally, to objectify the results of documentary source analysis, the data triangulation method can be used – comparing strategy texts with budget reporting data, program implementation statistics, and regional socio-ecological indicators.

Overall, the content analysis of regional socio-economic development strategies revealed significant heterogeneity in the degree and form of integrating sustainable develop-

ment principles into regional strategic planning documents:

1) sustainable development is not a universal methodological guide for regional strategies; although the term “sustainable development” is mentioned in half of the analyzed documents, only in isolated cases does it acquire the status of a strategic framework shaping goals, priorities, and implementation mechanisms; many strategies are limited to a declarative mention of sustainability;

2) analysis of the three dimensions of sustainable development shows a clear predominance of the first two components; economic and social priorities (GRP growth, employment, standard of living, demography) are presented in strategies quite broadly and in detail, while the environmental component is often presented fragmentarily or is absent altogether. This indicates a persistent perception of sustainable development primarily through the lens of socio-economic growth;

3) not all regions have recorded attempts to institutionalize sustainability by including specific indicators and implementation mechanisms. However, in most cases, the monitoring system is formalistic or absent, which limits the ability to assess the effectiveness of implementing sustainable strategies;

4) there is a deficit of coordinating and corrective mechanisms aimed at realizing sustainable development in the long term. Even when goals and indicators exist, the corresponding implementation tools – such as action plans, interdepartmental platforms, reporting mechanisms – are either absent or poorly formalized.

Thus, in the strategic planning of the sampled regions, models of fragmented or declarative integration of sustainable development prevail. This indicates the need for both normative-

methodological and institutional reinforcement of strategic approaches.

The necessity for methodological and institutional reinforcement of strategic approaches becomes especially pressing in the context of the current socio-economic dynamics of the regions. Current trends show that the actual conditions for implementing sustainability principles differ significantly: some regions experience growth in industrial production and increased investment activity (e.g., Tyumen, Irkutsk, Belgorod regions), creating potential for transitioning to more resource-efficient and environmentally balanced growth models; in others, a decline in manufacturing sectors, a decrease in household income, and limited budget capacities are recorded, especially in the republics of the North Caucasus and certain subjects of the Volga Federal District.

These disparities directly affect regions' ability to adopt sustainable practices: economically strong territories can invest in 'green' modernization, digitalization of environmental monitoring, and developing sustainable infrastructure, while regions with limited resources are forced to concentrate on maintaining basic social stability. Therefore, integrating sustainable development principles requires considering each region's current socio-economic cycle: for industrial subjects, it is a transition to innovative and low-carbon models; for less affluent ones, it is strengthening social and institutional resilience.

Methodological approaches to integrating sustainable development principles into regional strategies. In the current regulatory, legal, and methodological framework for strategic planning in the Russian Federation, integrating sustainable development principles into regional-level documents is not mandatory and does not constitute an imperative requirement.

This study proposes integrating SD principles into strategic planning at the regional level, as the methodology of sustainable development offers the following advantages:

1) it can serve as a productive foundation for forming long-term strategies, ensuring the integrity of goal-setting, harmonizing economic, social, and environmental priorities, as well as adaptability to changing external conditions;

2) it establishes a systemic and interdisciplinary approach, allowing not only for structuring strategic priorities but also for balancing short-term tasks with long-term challenges (global, national, and regional);

3) it contributes to strengthening institutional coherence, increasing trust among citizens, businesses, and external partners in regional policy;

4) it allows for synchronizing regional strategies with the global and national agenda – the UN 2030 Agenda, the tasks of ESG transformation, green growth, and the low-carbon transition;

5) it contributes to enhancing the instrumental robustness of regional strategies – allowing for the adaptation of accumulated international SD experience using indicator-based models, monitoring systems, assessment of climate and social risks, as well as stakeholder engagement schemes.

Given the voluntary nature of including sustainable development in regional strategies, the methodological support for such inclusion should not be universal and abstract, but adapted to the socio-economic and institutional specificities of the constituent entities of the Russian Federation.

When adapting international sustainable development practices to Russian conditions, it is important to account for differences in the institutional environment, the distribution

of powers, and the resource capabilities of the regions. Approaches applied in OECD and EU countries are based on a high degree of autonomy for regional authorities and developed mechanisms for horizontal coordination. In the Russian context, their functional reinterpretation is appropriate: indicator-based sustainability models can be integrated into the state strategic planning system through existing instruments – state programs (federal, regional), national projects, and monitoring of sustainable development goals. Analytical tools actively used in international practice (benchmarking, stakeholder mapping, territorial impact assessment) can be adapted to domestic realities as forms of expert assessment and public consultation of strategies without creating new bureaucratic structures. Such a transfer of practices will preserve the scientific validity of international approaches without violating the principles of hierarchy and legal unity in Russian strategic management.

The approaches proposed below are oriented towards embedding sustainable development principles into the existing managerial and analytical contours of regional strategic planning, without the need to create new externally imposed constructs.

1. Analytical component: Sustainability as a risk factor and sustainability as potential. At the stage of situational analysis, a strategy may include identifying risks associated with sustainability deficits: unstable demography, single-industry dependence, infrastructure degradation, environmental pollution, or vulnerability to climate change. This does not require new categories, but merely a shift in focus: the assessment should be aimed not only at identifying potentials but also at diagnosing the sustainability of the region's current development model.

The following analytical tools are applicable: maps of environmental and climate

risks, for example, zones at risk of flooding, soil degradation, temperature anomalies; benchmarking with regions having a similar economic structure but better sustainability indicators (e.g., in waste processing, in sustainable agriculture); assessment of dependence on resources with exhaustible cycles and scenarios of their depletion; consideration of institutional sustainability: budget stability, reliability of implementation mechanisms, capacity for multi-level interaction.

2. *Scenario planning: Sustainability as an axis of differentiation.* Scenarios for socio-economic development should be constructed based on differences in levels of systemic sustainability, not just on GRP growth rates or population size. This could include a baseline (inertial) scenario, which maintains current institutional and resource practices; an adaptive scenario, which enhances economic diversification and introduces measures for the sustainable use of natural resources; and a transformation scenario – involving a reorientation towards developing ‘clean’ production, ecological modernization, and community engagement.

This approach allows for linking sustainability to manageable variables: economic structure, investment priorities, and the nature of migration.

3. *Formulating mission and priorities through sustainability principles.* When formulating the mission, goals, and objectives of a strategy, it is proposed to rely on the basic principles of sustainable development rather than on external indicators. Among the applicable principles are: intergenerational responsibility (long-term protection of natural resources, minimization of infrastructure wear); balance (harmonizing sectoral, territorial, and social interests); inclusivity (engaging various population groups in decision-making processes); resource efficiency considering regional specifics: minimizing losses in production cycles, energy saving, water conservation, recycling.

Targets can be formulated in the logic of “minimizing vulnerabilities and stabilizing basic development conditions” – this is closer to the managerial practice of Russian regions than concepts like “green growth” or ESG, which are perceived as external.

4. *Implementation: Sustainability as an investment and organizational priority.* In the implementation block, it is important to establish mechanisms that make sustainability not a declaration but a basis for project management. This can include: prioritizing financing for infrastructure projects with sustainable effects (e.g., modernization of water supply, energy-efficient lighting, renovation of public spaces); support programs for local production and processing, especially in agricultural and forested territories; expanding mechanisms for local public-private partnerships (PPP) focused on urban improvement, transport, and utilities with social or environmental returns; developing standard solutions for sustainable settlements – considering energy efficiency, compactness, integration with the natural environment.

Continuing the list of mechanisms, the environmental dimension can be addressed through a separate section via a set of project selection and management criteria integrated into existing procedures. For infrastructure, local processing, PPP, and standard settlement solutions, 4–5 KPIs are established, correlated with relevant UN SDGs (water, sustainable cities, responsible consumption, climate): share of the population with access to safe drinking water and share of wastewater treated to standard; share of municipal solid waste processed; energy intensity/specific greenhouse gas emissions per unit of GRP; provision of green urban infrastructure. Implementation is ensured by SEA (Strategic Environmental Assessment) of key programs, a regional MRV (Monitoring, Reporting and Verification) system for emissions and

pollution, and 'green' procurement / budget tagging; monitoring of KPIs is integrated into the overall indicator system of the strategy, which eliminates the identified deficit in environmental operationalization found in practice.

5. *Monitoring and adaptation: Tracking sustainability without excessive bureaucracy.* The monitoring system can be based on accessible and already collected indicators, transformed from a sustainability perspective: share of budget expenditures on maintaining/modernizing infrastructure; share of recycled waste; resource intensity coefficients (water intensity, energy intensity of the economy); employment indicators in sustainable sectors (processing, agroecology, social economy).

6. *Approval stage: Sustainability as a social contract.* Realistic mechanisms for engaging stakeholders in the context of Russian regions could include: public discussion of the strategy via executive authority platforms, considering public comments; conducting expert panels with representatives from science, business, and local self-government; introducing observer or advisor status for major public associations (environmental, youth, professional) during the monitoring of strategy implementation. This approach enhances the social legitimacy of the document and facilitates the consideration of risks overlooked in a purely administrative logic.

Unlike previous works focused primarily on the quantitative accounting of SDG mentions or environmental indicators, this study reveals the institutional level of sustainable development inclusion – through the analysis of management mechanisms, coordination structures, and implementation tools recorded in the strategies.

Overall, the proposed methodological approaches suggest a gradual institutional incorporation of sustainability as a managerial logic. This is especially important in the context

of Russian federalism and the limited resource and personnel capabilities at the regional level.

Conclusion

Integrating sustainable development principles into regional socio-economic development strategies is not a normatively prescribed but a substantively significant task. The conducted analysis has shown that, despite an active international and federal sustainability agenda, the inclusion of its principles in regional strategic planning remains predominantly fragmented, declarative, or implemented in an implicit form. The main obstacles are the lack of methodological guidelines, institutional imperative, as well as limited resources and managerial inertia on the ground.

At the same time, examples of successful institutionalization of sustainable development in the strategies of a number of subjects have been identified, where sustainability is interpreted not as an external mandate but as a managerial logic that allows for balancing economic, social, and environmental priorities. This confirms the potential for scaling and adapting such approaches.

The methodology for content analysis of strategies proposed in the article has allowed for identifying both the level of formal recognition of the sustainability concept within them and the depth of its operationalization – through goals, indicators, and implementation mechanisms. Furthermore, a set of realistic methodological solutions applicable in the context of Russian regional policy has been developed. These are focused on adapting sustainability principles to the analytical, scenario-based, goal-setting, and managerial elements of a strategy, without the need for direct borrowing of external conceptual frameworks.

Thus, sustainable development can be considered a strategic resource for regional policy – not only in the long term but also

in the current managerial perspective. Its institutionalization in the strategies of the Russian federal subjects requires a comprehensive approach, including regulatory adjustments, the development of standardized methodological solutions, the creation of

incentives for sustainable practices, and the growth of an expert community. This will not only improve the governability of regional development but also ensure its alignment with modern challenges and requirements for comprehensive effectiveness.

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INDUSTRIAL SECTOR OF THE ECONOMY OF THE NORTHWEST OF RUSSIA: CONTINUED ADAPTATION TOWARD SANCTIONS PRESSURE



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Russian enterprises continue adapting to changing geopolitical conditions and increased sanctions pressure. The end of the acute phase of the crisis and the process of transformation of logistics and supply chains in the economy of the Northwest of Russia is evidenced by the dynamics of the manufacturing sector. Tracking its work based on expert surveys of representatives of enterprises allows adding another perspective to highlight the subjective problems of its functioning. Expert surveys provide an opportunity to compare official statistics with real assessments of the situation of participants in production activities. The paper presents the dynamics of the main processes taking place at enterprises in the Northwest of Russia, highlights key trends and trends, and determines the reactions of the management of organizations to important external and internal factors. The aim of the work is to establish the consequences of increased sanctions pressure on enterprises in the sector, and to identify the most

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effective measures, according to respondents, to adapt to the situation of economic uncertainty. The information base of the study was the work of Russian and foreign scientists, Rosstat statistics and data from questionnaires conducted in 2022–2025. The questionnaires include questions that make it possible to characterize the main areas of activity of enterprises, to show the presence or absence of transformations in production and distribution chains, to reflect the specifics of investment processes, personnel policy and relations with authorities. The survey participants are experts – managers of large, medium and small enterprises of the macro-region’s manufacturing sector, which makes it possible to formulate a number of recommendations for improving its working conditions. The results obtained can be taken into account when making changes to economic policy and appropriate government support measures. The study is of interest to specialists in the field of regional economics and regional authorities in developing programs to stimulate the manufacturing sector of the Northwestern Federal District.

Industrial sector, Northwest Russia, sanctions, adaptation, business executives, barriers, government regulation.

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Introduction

In 2024, the problematic situation related to the shortage of qualified personnel, which negatively affected the country’s industrial sector, was aggravated by an increase in the key interest rate. During the year, the Bank of Russia decided to increase the key rate three times, and as a result, its level increased by 5 percentage points to 21%. As a result, many companies noted difficulties in financing, investment cycle, and increased debt burden¹. The key rate became an amplifier and catalyst for other problems that hindered the work of the industry, including high prices for raw materials and components, a shortage of qualified personnel, sanctions pressure and restrictions on access to foreign technologies, infrastructure problems, as well as the volatility of the national currency and rising costs for manufacturers.

It is necessary to monitor its activities, define the main trends and barriers to successful operation for identifying the problems faced

by a manufacturing company. The relevance of the research is to highlight the factors affecting the functioning of the industrial sector and to identify the most effective measures to support and stimulate it. The work contributes to studying the regional economy: it complements the statistics of its industrial sector with subjective assessments, allows identifying trends in its development, as well as determining difficulties and obstacles in this process and, taking into account their specifics, developing appropriate recommendations for this economic sector in the context of the adaptation period.

The aim of our study is to reflect the effects of prolonged sanctions on the industrial sector of the Northwest Russia, to identify the most successful adaptation measures used by enterprises in the sector.

We solved the following tasks to achieve the aim:

– it is presented the dynamics of changes in subjective assessments of the work of the

¹ The key to the finish line: How the Russian industry suffers from high loan rates. Forbes. Available at: <https://www.forbes.ru/biznes/524672-kluc-na-finis-kak-rossijskaa-promyslennost-stradaet-ot-vysokih-kreditnyh-stavok>

industrial sector of the Northwest Russia by business executives;

- it is identified the most effective measures taken to maintain the stable functioning of enterprises;

- it is defined changes in production and distribution chains;

- it is analyzed the dynamics of interaction between enterprises of the macro region's industrial sector and representatives of federal and regional authorities.

The contribution of the research to solving the scientific problem is a combination of official statistics and expert surveys, which allows for a deeper understanding of the processes of adaptation of the regional industrial sector to external pressure.

Brief literary review

The activation of the industrial sector makes it possible to use the available internal resources of the region more efficiently, and the modernization of enterprises helps optimize the consumption of used raw materials and energy. For constituent entities of the country with a high share of industrial sectors in the economic structure, stable operation of the industrial sector is the basis for sustainable and confident development (Lukin, Uskova, 2018; Uskova et al., 2020; Treyer, 2025). The focus on the dominant sectors in the region's economy allows for maximum effect when stimulating them, which implies taking into account the specifics of the territorial structure of production (Lazhentsev, 2024; Kirillova, Orlova, 2024; Volkov, 2024). In conditions of economic uncertainty and geopolitical tension, the continued functioning of all sectors of the economy requires additional government support measures (Stepanova, 2024; Mironova, 2024). Manufacturing industries are under increased pressure due to the reduction in foreign trade volumes, as well as the strategic

goals of achieving technological sovereignty (Kozin, 2024; Akberdina, 2022; Abdikeev, 2022; Tavrikov, Yashalova, 2024). The country is experiencing difficulties in restructuring logistics and finding new consumers in the markets of friendly states in the context of ongoing sanctions in many sectors of the economy (Lavrentiev, 2024; Rozhko, Katsenko, 2024; Demchenko, Demchenko, 2025; Grigoryan, 2024). Adaptation processes and new trends, as well as an increase in the key rate, make it relevant to study the work of enterprises in the industrial sector and monitor trends and problems (Kuvalin et al., 2024).

Scientific papers track the influence of external and internal factors and digitalization trends (Hicham, Hamza, 2024; Jaradat et al., 2025) in the industrial sector. Continued sanctions and new requirements for the activities of the industrial sector have led to the publication of works on the possibilities of enhancing its development (Chernova, Balashova, 2024) and the analysis of production efficiency indicators (Ponomarev, Gorokhov, 2024). There are studies by foreign authors regarding changes in the economy or the industrial sector as a result of sanctions (Stępień et al., 2024), but they focus on digital transformation (Jeske et al., 2021) and the "green transition" (Allan et al., 2021). Monitoring of the work of enterprises in the industrial sector is aimed at recording and tracking important trends and identifying areas of support that will effectively offset the impact of negative factors.

Vologda Research Center of RAS has been conducting monitoring since 1993, including a survey of business executives in the industrial sector. Since 2022, a survey has been conducted in the Northwest Russia, in which questions are updated depending on the situation, which allows finding out the attitude of experts to the most significant events of the previous year (Shirokova, Lukin, 2024).

Research methodology

Expert targeted surveys conducted in April – May 2022–2025 are the methodological and informational basis of the study. The method of collecting information is a questionnaire. The survey is representative by size of enterprises and industries, all regions of the Northwestern Federal District are represented, and the method and sample size are consistent. Heads of large and medium-sized enterprises of the NWFD regions of the main industries acted as experts in monitoring the industrial sector of the Northwest Russia: ferrous metallurgy, electric power industry, timber industry, mechanical engineering and metalworking, food and light industry, fishing and fish farming. The questionnaire consisted of six blocks of questions that made it possible to assess the overall status of the enterprise, its production potential, the state of production and distribution chains, as well as the level of investment and innovation, product competitiveness, human resources and attitude to government actions. In the study, the responses from 2025 were compared with the results of the previous surveys and official statistics. In the 2022 survey, 100 business executives took part, 101 – in 2023, 99 – in 2024, and 105 – in 2025. We used standard and modern methods of statistical analysis adopted in economic and sociological research: descriptive, comparative, inferential, and predictive.

The presented technique fully complies with the basic principles of the Delphi method, but it has its own specifics, since it is its monitoring modification. Iterativity is achieved not through quick rounds with a single pool of experts, but through annual repetition of the survey using a comparable methodology followed by a comparative analysis of data over several years. Thus, we can confirm that classical Delphi has been adapted for the tasks of long-term tracking of subjective assessments of the business community, which makes the

methodology scientifically sound and relevant for studying the adaptation of enterprises to changing external conditions.

Results of the study

General trends in the industrial sector development

The Northwest Russia is an industrial macro region, the subjects of which develop mining (Komi Republic, Nenets Autonomous Area) and manufacturing (Saint Petersburg). In 2024, the share of shipped manufacturing products in Saint Petersburg amounted to 47.5% of the output of these industries in the NWFD, and the share of output in extractive industries in the Komi Republic and the Nenets Autonomous Area was 39.2% and 33.6%, respectively.

After the imposition of sanctions against Russia by unfriendly countries, the NWFD suffered severely due to the breakdown of cooperation with trading partners from the United States and Europe. The timber processing complex (TPC), which produces goods for countries that have ceased foreign trade cooperation with the Russian Federation, was most seriously affected. However, in 2024, the enterprises of the complex showed positive dynamics, which indicates the effectiveness of government support measures and the continuation of the adaptation period. The positive dynamics in the TPC indicates the overall effectiveness of government support measures to stabilize the industry at the macro level (*Fig. 1*).

Industrial production continues growing rapidly in the Northwest Russia (105.3%), the depth of decline for the extractive industries is decreasing (99.2% compared to 2023), growth was recorded in the sector of providing electricity, gas and steam (103.6%). The industrial sector continues adapting to the situation of simultaneous sanctions pressure and unstable geopolitical situation.

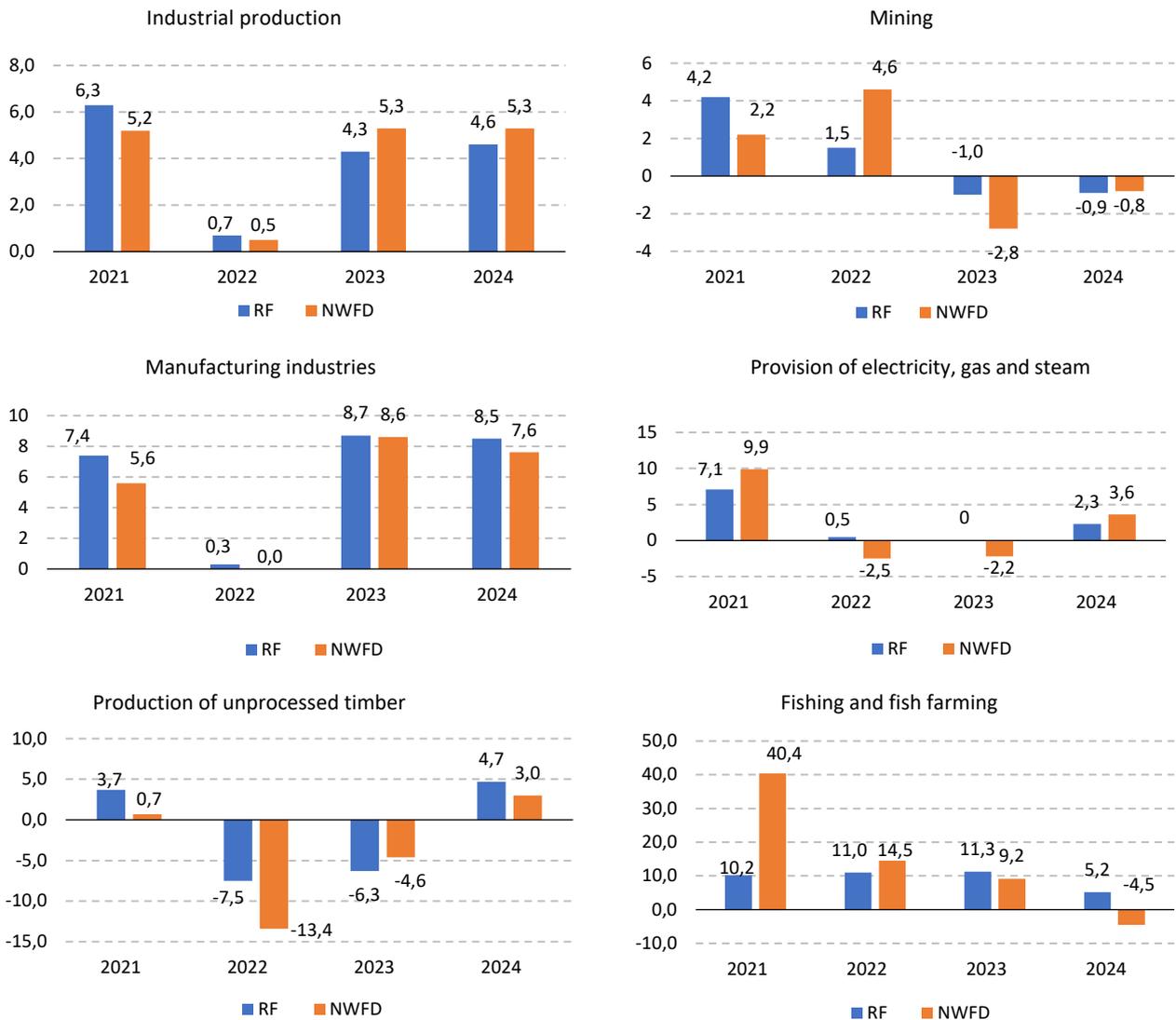


Figure 1. Dynamics of the industrial sector development of the RF and NWFD economy, % compared to the previous year

Source: Rosstat data.

Large, medium and small enterprises participate in surveys of business executives of the industrial sector of the Northwest Russia. The share of experts in enterprises employing over 1,000 people in a survey conducted in early 2022 was 30%, in 2023 – 41%, in 2024 – 54%, in 2025 – 53%. The share of respondents at the business executives with 250 to 1,000 employees was 40% in 2022, 22% in 2023, 25% in 2024, and 20% in 2025. Taking this into account, it is worth noting that the survey data make it possible to identify the main trends in the functioning of enterprises in the industrial sector, which have

a significant impact on the economy of the Northwest Russia subjects and can be taken into account when reviewing industrial policy and developing measures to support the economy.

Over the previous year, the share of business executives who gave an average assessment of their company's performance in modern conditions has increased significantly (67%; +26 p.p.). The share of high ratings over three years continues declining; in 2025, it amounted to 20% (-45 p.p. from 2022), and the share of low ratings over the previous year it decreased by half (-8 p.p., from 15 to 7%; Fig. 2).

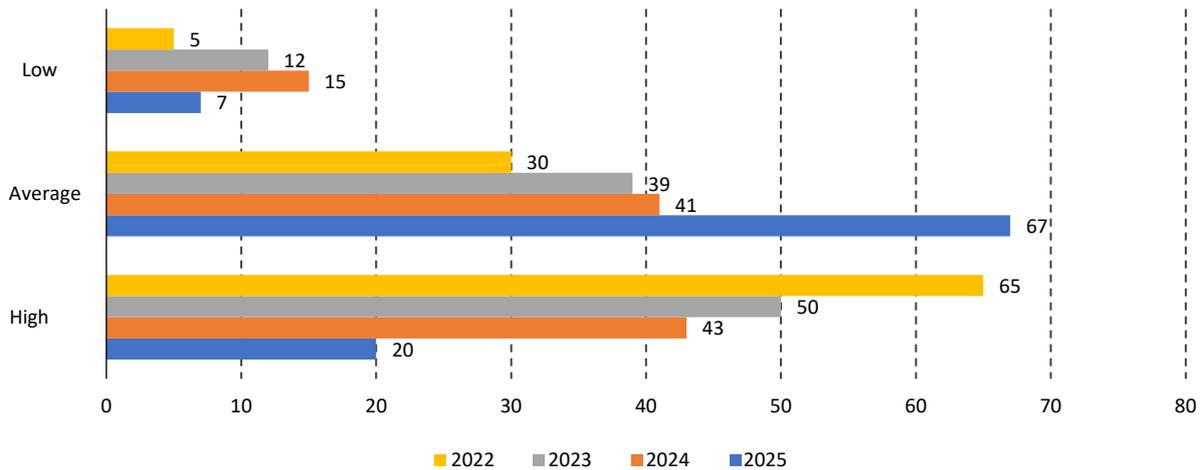


Figure 2. Distribution of responses to the question "How do you assess the work of your company in modern conditions?", % of respondents

Source: VoIRC RAS survey data.

Over the previous three years, the share of respondents who report an increase in natural output has increased (35, 37, and 47%, respectively), and throughout the NWFD surveys, the share of those who report an

increase in stocks of finished products has decreased (18; 17; 13%). Also, starting in 2022, the share of enterprises that continue increasing employee salaries is becoming smaller (86; 69; 68; 67%; *Tab. 1*).

Table 1. Assessment of changes in the main performance indicators of the enterprise, % of the number of respondents

Indicator	2022			2023			2024			2025		
	G	S	R	G	S	R	G	S	R	G	S	R
Natural output volume	63	25	12	35	44	22	37	26	37	47	27	20
Capital investment volume	47	37	16	18	50	32	37	35	28	27	47	27
Stocks of finished products	40	55	5	18	73	9	17	63	20	13	47	27
Prices for manufactured products	78	18	4	66	23	11	56	31	14	60	33	7
Prices for purchased products	87	13	0	92	4	4	97	3	0	73	27	0
Cost of production	77	20	3	89	8	3	93	7	0	80	20	0
Demand for products in the domestic market	51	42	7	20	66	14	28	54	18	20	60	20
Demand for products in foreign markets	50	30	20	13	44	43	12	52	36	13	47	7
Profit	56	24	20	40	22	38	19	23	58	33	27	40
Number of employees	35	55	10	18	59	23	30	43	26	20	47	33
Salaries of employees	86	11	3	69	27	4	68	29	3	67	27	0
Average level of production capacity utilization	49	44	7	16	57	27	31	44	25	27	47	27

Note: P – growth, S – the same level, R – reduction.
Source: VoIRC RAS survey data.

The transition to a new, more stable, albeit negative, development phase is evidenced by the predominance of the share of business executives who note the preservation of the previous (reduced) level of the main performance indicators of enterprises, rather than their further decline. In the 2025 survey, 40% of experts said the profit level was declining, but in the previous survey, it was 58% of respondents, which is a positive trend. The decrease in the share of enterprises raising salaries is an indicator of the transition from shock adaptation to a new, more severe economic reality. The business faced three main challenges: squeezed profits, catastrophically expensive loans, and uncertainty. In these conditions, companies are forced to reduce costs and maintain the current level of personnel costs to maintain financial stability.

The main reason for the changes in the main indicators in the work of enterprises in the industrial sector is the transition from the phase of active transformation to a new more complex reality. For example, the share of enterprises increasing the volume of natural products is growing, and the share of respondents increasing stocks of finished products is decreasing. The most striking negative trends were a serious drop in profits in organizations and a slowdown in wage growth, which indicates the need to save money and reduce costs. Evidence of stabilization in the economy is the softening of price pressure (drop in the share of responses about rising prices for consumed products), stagnation of investment activity (low share of enterprises increasing the volume of capital investments) and compression of demand (only 20% of managers noted an increase in demand in the domestic market).

Only 7% of respondents stated that the economic situation was improving in 2024, 13% of respondents already planned to improve it in 2025, and 40% of experts are already considering such a development in the longer term. At the same time, the share of responses

about the absence of a negative impact of sanctions pressure on the company increased significantly: the share of business executives who deny it exceeded 53% (+28 p.p.). In 2022, 71% of respondents noted the presence of such influence, in 2025 their share decreased to 40% (-30 p.p.). At the same time, the most acute problem related to the imposition of sanctions in 2025 was the increase in prices within the country, which was noted by 73% of business executives. This is followed by difficulties in obtaining imported raw materials (53%) and an increase in the cost of credit (53%).

More than a third of the respondents did not feel any effects from the imposition of sanctions on their company in 2024 (33%), 33% of experts considered them negative, and 27% indicated that some of them had a negative impact on their company, while others had a positive impact. Only 33% of respondents are confident that there will be no effects of sanctions until the end of 2025, while 27% are convinced that sanctions will continue having a negative impact; 20% of business executives found it difficult to answer this question, and another 20% spoke about the ambiguity of the impact of sanctions by the end of 2025.

Given the ongoing adaptation processes in the manufacturing sector, the question of how management strategies are transforming to best adjust to economic uncertainty is of significant interest. The decline from 60% to 47% in the share of enterprises that continue actively searching for new domestic suppliers suggests that a significant portion of manufacturers have largely reconfigured their most critical supply chains. However, this process remains relevant for almost half of the surveyed companies, indicating a transformation that is ongoing but entering its final phase.

The same trend is observed when choosing the answer to the search for suppliers abroad. From 2022, when 59% of managers carried out such searches, to 2026 (forecast) the decrease was 46 p.p.

due not only to the fact that new partners were found abroad, but also to the transfer of enterprises to the territory of the Russian Federation, the termination of interaction with former foreign trade partners. According to the survey of respondents, many of the activities planned for 2025 will be prolonged (reduction of the number of employees,

activation of advertising activities, reduction of investment costs, etc.). We should note a sharp increase in the share of managers who noted the need to reduce production volumes (+6 p.p., to 13%), sale and lease of premises in the future (+14 p.p., to 27%) to adapt their company to the existing economic conditions (Fig. 3).

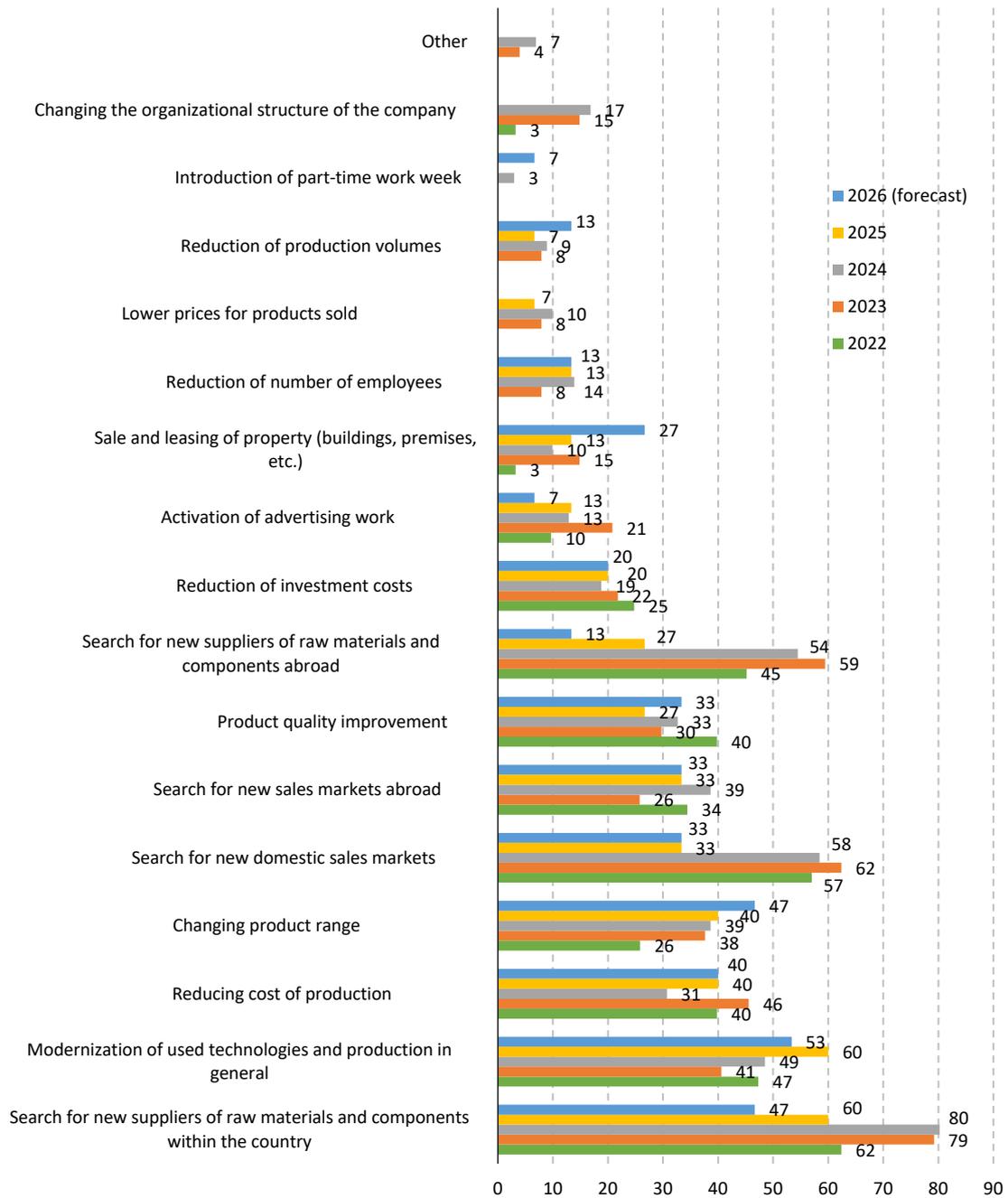


Figure 3. Distribution of responses to the question "What measures are used in your company to adapt to the existing economic conditions?", % of the respondents

Source: VoIRC RAS survey data.

According to the business executives in the industrial sector, the barriers that previously hindered the active growth of production have increased in 2025. In recent surveys, a high percentage of commercial loans was identified as an obstacle by a maximum of 35% of respondents (2024), but the increase in the Bank of Russia rate led to an increase in the proportion of respondents concerned about this to 47% and the persistence of this problem in 2026 (40%; *Tab. 2*).

At the same time, the growth showed a high level of taxation. This barrier was noted by 27% of respondents, its level has almost returned to the 2022 level, and more than a third of respondents are confident that it will increase in 2026 (33%). We would like to emphasize that the importance of many of these barriers for business executives of the industrial sector has decreased: lack and interruptions in the supply of raw materials (-11 p.p., up to 7%), deterioration and lack of equipment (-13 p.p., up to 13%), lack of skilled workers (-13 p.p., up to 27%) and high prices for raw materials, fuel, energy and materials (-15 p.p., up to 40%).

The share of managers noting the presence of idle capacities has not changed since last year (53%), while only 20% of them can increase output by 21 to 30% at their expense, none of the respondents noted the possibility of increasing output by more than 50%. This may indicate the problems of finding new sales markets, consumers, and the inflexibility of logistics chains.

For the first time in four years of surveys, 20% of business executives said that their company could go bankrupt, in the previous year their share was 10.1% (+9.9 p.p.). Only 20% consider the financial condition of their enterprises to be good, and the share of those confident in the continuation of this trend by 2026–2027 has not changed. The majority of respondents indicated its satisfactory condition in 2024 (47%), maintaining such an assessment in 2025 (40%) and for the period 2026–2027 (47%). The proportion of responses about the rather unsatisfactory condition of enterprises is significantly reduced in the future (27, 20 and 7%, respectively).

Table 2. Distribution of answers to the question “What is holding back the growth of production in your company?”, % of the number of respondents

Response option	2022	2023	2024	2025	2026 (forecast)
High percentage of commercial loans	20	15	35	47	40
Insufficient demand in the domestic market	16	53	38	40	33
High prices for raw materials, fuel, energy and materials	53	41	65	40	40
Uncertainty of economic situation	35	48	41	33	33
High level of taxation	29	40	20	27	33
Lack of skilled workers	26	27	40	27	27
Late payment for products sold	8	7	18	20	20
Competing imports	17	13	9	13	7
Lack of financial resources	19	25	18	13	20
Deterioration and lack of equipment	17	24	26	13	13
Shortage and interruptions in the supply of raw materials, fuel, energy and materials	14	7	18	7	7
Absence or imperfection of the regulatory framework	5	11	0	7	7
No restrictions	8	6	7	7	0
Other	11	12	6	7	7
Insufficient demand in the foreign market	18	19	16	0	0

Source: VolRC RAS survey data.

Transformation of value chains

Production and distribution chains continue changing in the industrial sector of the Northwest Russia. For instance, the share of respondents engaged in trade and economic cooperation with organizations in the region where the enterprise is based increased by almost 10 p.p. (93%). A significant decrease was noted among other business executives with a wider geography of trade relations. Thus, the share of those who cooperate with enterprises in other regions of the NWFD (except for the home region) decreased to 60% (-37 p.p.). The share of respondents who maintain relationships with other regions of Russia (except the Northwestern Federal District) fell by 25 p.p. last year to 60%; with other macro regions of Russia (except the Northwestern Federal District) – to 60% (-25 p.p.). The share of those cooperating with the EAEU countries decreased by 21 p.p. (up to 40%), with the countries of the former USSR (not members of the EAEU) – by 22 p.p. (up to 27%), with non-CIS countries – by 15 p.p. (up to 27%). The trend toward the transition of manufacturing sector enterprises to the

domestic market continues. Due to the problems of the infrastructure, which does not have time to transform under the sharply increased demand for transportation services, managers prefer to explore the regional markets closest to the location of their organizations.

Continued sanctions led not only to the termination of cooperation with foreign partners in the field of joint investment activities (0%), but also to the lack of interaction with them in attracting specialists (0%), selling technologies (0%) and other types of cooperation (0%, -17 p.p.; *Tab. 3*).

At the same time, we can note the results of the reorientation to the domestic market. If we take as a positive result the increase in the share of respondents interacting in one area or another with other enterprises in the Northwestern Federal District, then we can note some disappointment among respondents in joint investment activities (-58 p.p., up to 7%), purchase (-35 p.p., up to 7%) and sale of technologies (-30 p.p., up to 7%). However, only 7% indicated a lack of cooperation with regional partners within the Northwestern Federal District (-17 p.p.).

Table 3. Distribution of answers to the question “In what areas does your company cooperate with foreign and Russian organizations?”, % of the respondents

Direction	World				Russia				NWFD			
	2022	2023	2024	2025	2022	2023	2024	2025	2022	2023	2024	2025
Purchase of raw materials and semi-finished products	54	38	58	20	76	84	83	53	57	89	70	60
Sale of raw materials and semi-finished products	26	15	48	13	31	32	74	27	25	21	42	40
Sale of final products	50	46	56	40	74	84	78	60	72	93	75	80
Technology purchase	49	20	66	13	41	15	83	13	12	15	42	7
Technology sales	3	0	16	0	17	10	68	7	10	7	37	7
Joint investment activities	6	7	0	0	27	21	45	13	22	3	65	7
Attracting specialists	2	3	5	0	37	35	65	47	55	35	86	53
Other	3	17	17	0	6	20	67	7	2	19	17	13
Cooperation is not carried out	6	18	69	33	0	4	45	13	0	0	24	7

Source: VolRC RAS survey data.

A similar trend has been noted in cooperation with Russian enterprises: in all areas, the share of respondents has become significantly lower, and cooperation with foreign suppliers and consumers is maintained at a minimum.

More than half of the respondents do not plan to launch the production of import-substituting products in the future (53%). But the share of those who already produce such goods has grown to a maximum since 2022 (20%).

Cooperation with foreign countries is indicated by the fact that business executives continue noting the existence of certain barriers to cooperation with them. For instance, sanctions policy and rhetoric hinder 40% of respondents (-45 p.p.), remoteness of potential counterparties – 20% (-43 p.p.), economic inexpediency – 27% (-23 p.p.).

At the same time, the share of respondents who see no obstacles to the development of trade and economic relations with Russian (-54 p.p., 33%) and regional organizations of the NWFD

(-30 p.p., 40%) has increased significantly. A significant decrease was noted among the respondents who noted the low capacity of the Russian (-45 p.p., 20%) and regional (-52 p.p., 13%; *Tab. 4*) markets.

The reduction of many barriers that caused dissatisfaction among respondents a year ago can be attributed to effective government support measures and the actions of regional and federal authorities who tried to mitigate the forced transition to the domestic market for enterprises in the manufacturing sector. At the same time, surveys show that at the micro level, many enterprises are faced with the discrepancy between the proposed measures and individual needs.

More than half of the survey participants stated the need to reorient toward domestic suppliers and consumers in order to transform their own value chains (53%, -18 p.p.). The share of business executives going to look for new suppliers and consumers in the markets of neutral countries decreased by 31 p.p. (40%),

Table 4. Distribution of answers to the question “What, in your opinion, hinders the development of trade and economic relations between your company and foreign and Russian organizations?”, % of the respondents

Response option	World				Russia				NWFD			
	2022	2023	2024	2022	2023	2024	2022	2023	2024	2022	2024 г.	2025 г.
High competition in the market	20	7	39	0	44	19	38	13	26	18	18	13
Small market capacity	2	3	9	0	31	27	65	20	43	23	65	13
Remoteness of potential counterparties	20	8	63	20	15	9	43	20	11	8	13	20
Lack of information about ongoing tenders, contests, promising scientific and technical developments	5	15	61	0	24	14	71	0	13	11	42	0
Weak cooperation from public authorities	8	11	21	7	18	11	89	20	20	8	43	20
Economic inexpediency	22	18	50	27	8	10	44	0	11	6	18	0
Sanctions policy and rhetoric	76	65	85	40	6	8	15	7	0	8	0	7
Other	5	15	18	13	17	18	73	7	15	11	59	7
No obstacles	0	0	5	0	20	24	87	33	15	40	70	40

Source: VolRC RAS survey data.

which indicates a decreasing pace of adaptation processes in the sector. This conclusion is confirmed by the growing share of respondents who indicated that there were no violations in the supply chains (33%, +6 p.p.; Fig. 4).

The share of business executives using intermediary countries to restore contacts with former suppliers and consumers has more than doubled (-24 p.p., 20%). Half of the respondents do not expect further transformation of production and distribution chains (53%), which is 38 p.p. higher than the value of the previous survey.

The responses of the survey participants indicate the need for continued government support of the industrial sector to increase the competitiveness of products in foreign markets. For example, half indicated that this process would be facilitated by the development of strategies for the development of industries in the industrial sector (53%, +10 p.p.). Among the necessary measures, the implementation of a preferential low-interest policy leads (60%, -1

p.p.), in third place is direct financial assistance for the modernization of production (47%, -10 p.p.).

More than 80% of the respondents switched to new suppliers of equipment, spare parts, components and software after the increased sanctions pressure on the country. Only 40% of enterprises had not previously used sub-sanctioned equipment imports, 33% used sub-sanctioned spare parts, components and programs. Among those who used them, the majority preferred Russian or Chinese suppliers. Almost three quarters of business executives (73%) had not previously exported to “unfriendly” countries, while the rest had shifted to the domestic market (27%).

After stopping the import of necessary goods from abroad, 27% of business executives found that there were no alternative suppliers in Russia, and 13% did not find the required goods in friendly countries. A third of the respondents (33%) did not feel the effects of the reduction in import supplies.

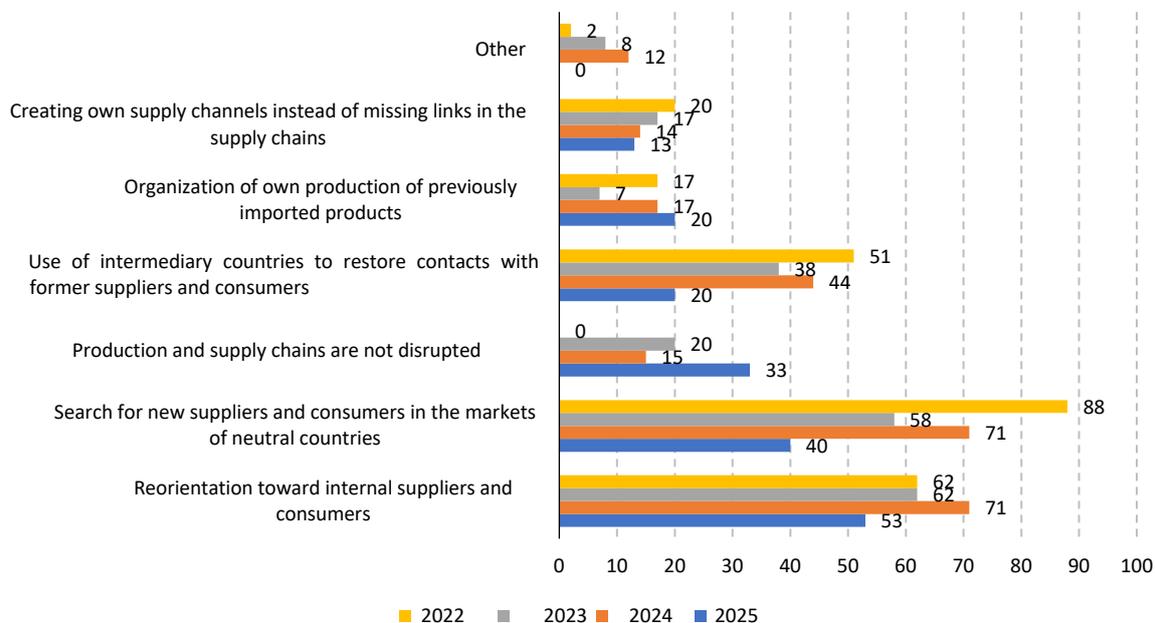


Figure 4. Distribution of responses to the question “What measures have been taken at your company to transform its production and distribution chains disrupted by sanctions?”*, % of respondents

* The question has been in the questionnaire since 2023.

Source: VoIRC RAS survey data.

Investment activity

It is necessary to increase financial resources to expand production and implement other investment projects. Over the previous year, the share of business executives who consider financing their enterprises to be optimal has increased (+13 p.p., to 40%), while the share of respondents who consider it sufficient for partial implementation of investment projects has decreased by 13 p.p. (0%, Fig. 5).

There are opposite trends in the dynamics of respondents' responses about financing that is sufficient only to maintain current production volumes and insufficient even for this purpose (27%). In the first case, the response rate has been decreasing for the third year in a row, while in the second case, it has been increasing over the past four years. We should say that the increase in the key interest rate has become a factor that has paralyzed investment activity. The policy of the Central Bank of Russia has caused the curtailment and postponement of investment programs, enterprises in the industrial sector are focusing on maintaining current activities and postponing development plans. This situation directly affects the long-term competitiveness and technological sovereignty of the region.

The fact that an increase in financial resources is required by the majority of respondents is clear from the answers about the need for modernization of production. Over the previous year, the share of business executives who noted the need for partial modernization increased by 23 p.p. (to 87%). However, only 40% of them have plans to upgrade the company's production facilities in 2025 (-42 p.p.). At the same time, there continues to be a tendency to preferentially use their own funds as a source of financing for investment activities: in 2024, 87% of managers invested in these processes, including their own capital, and only 33% indicated the use of credit funds. In 2025, 87% plan to use their own resources, 40% note the possibility of attracting credit funds. At the same time, almost half of the respondents were unsatisfied with the conditions for obtaining bank loans for long-term investment purposes (47%, -4 p.p.), and the share of dissatisfied with the conditions for obtaining a loan to finance working capital increased over the previous year to 53% (+7 p.p.).

A similar result was obtained in the monitoring of the Russian Union of Industrialists and Entrepreneurs in 2024: enterprises noted

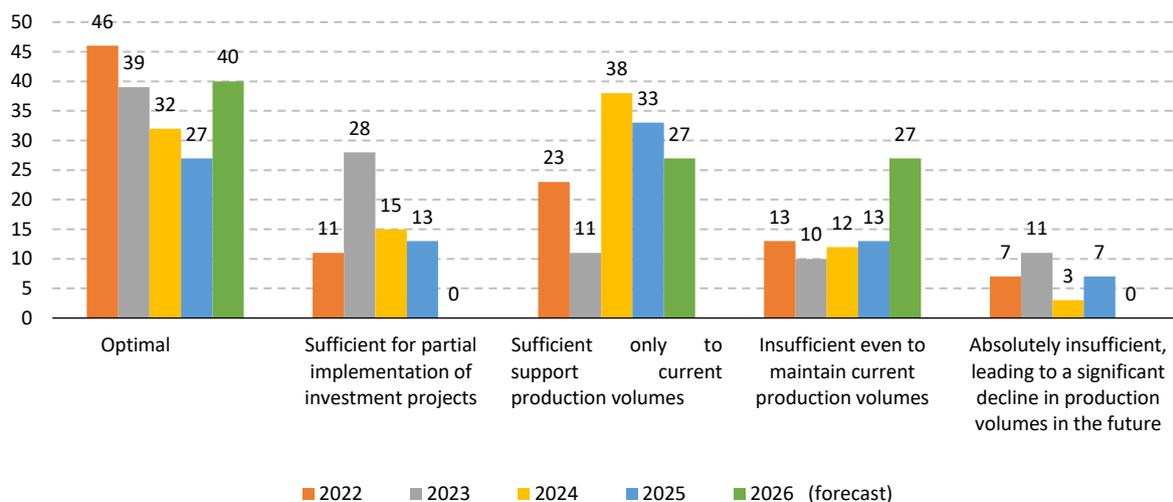


Figure 5. Distribution of answers to the question "How do you assess the level of funds allocated for the development of your company?" (sum of answers is 100%), % of respondents

Source: VolRC RAS survey data.

an aggravation of problems related to a lack of working capital and the unavailability of borrowed funds. According to 25% of the respondents, the unavailability of financing has led to significant restrictions on activities².

It is necessary to introduce innovations into the production process to produce competitive products. The respondents named the main reasons hindering investment activity in their enterprises. First of all, they note a lack of funds and a high percentage of bank loans (67%). As a result of the increase in the level of the key refinancing rate, both barriers turned out to be interrelated. Over the previous year, the increase in the share of respondents who identified these problems as the most acute was 24 and 19 p.p., respectively. Against the background

of the growth of these restrictions, several others have lost their importance, but 47% of business executives are still concerned about the high cost of equipment and construction and installation work (*Tab. 5*).

In the forecast for the coming year, respondents indicate the likelihood of an increase in the negative impact of the first two factors and a decrease in the importance of the remaining barriers against this background. An assessment by business leaders of the impact of the Bank of Russia's high key rate policy on the country's economy showed that most of them did not notice any impact (53%). At the same time, 40% noted its rather negative or unambiguously negative effect on the Russian economy (*Fig. 6*).

Table 5. Distribution of responses to the question "What, in your opinion, primarily held back investment activity at the enterprise?", % of respondents

Response option	2022	2023	2024	2025	2026 (forecast)
High interest on a bank loan	26	26	48	67	60
Lack of financial resources	55	37	43	67	67
High cost of equipment, construction and installation work	65	65	57	47	40
Restriction of access to imported equipment due to sanctions	16	35	54	27	27
Unforeseen changes in the ruble exchange rate and bank interest rates	16	45	49	27	13
High accounts payable/accounts receivable	22	8	11	13	7

Source: VolRC RAS survey data.

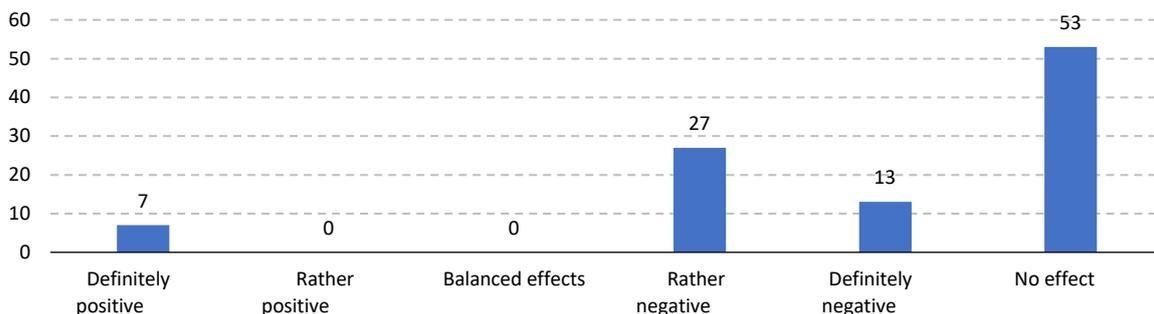


Figure 6. Distribution of responses to the question "How, in your opinion, does the high key rate policy currently implemented by the Bank of Russia affect the Russian economy?" (sum of responses is 100%), % of respondents

Source: VolRC RAS survey data.

² The state of the Russian economy and the activities of companies: The results of the monitoring of the Russian Union of Industrialists and Entrepreneurs in 2024. Available at: <https://rspp.ru/activity/analytics/sostoyanie-rossiyskoy-ekonomiki-i-deyatelnost-kompaniy-rezultaty-monitoringa-rspp-v-2024-godu>

Assessment of economic policy

The trend of approving the economic policies pursued by the federal authorities continues growing. In the 2025 survey, the share of business executives who consider the economic policy of the Russian authorities to be correct (73%) increased by 16 p.p. At the same time, the share of respondents who positively assess the activities of the regional government (47%) is still equal to the share of those who find it difficult to assess (47%).

At the same time, we can note an increase in the effectiveness of interaction between enterprises in the industrial sector of the NWFD economy and the executive branch at the federal (5.3 points; +0.1 points) and regional (6.4 points; +0.9 points) levels. The assessment of relations with executive authorities at the municipal level continues declining – over the previous four years it has decreased to 4.1 points (-1.4 points).

Last year, only 13% of respondents used state support measures at the federal level (-49 p.p.). A sharp drop was also observed among those who took advantage of support measures from the region (27%, -42 p.p.). At the same

time, only a third of business executives did not need support measures (33%), they failed get another 20% of the respondents. Among the most demanded measures of assistance, enterprises noted reimbursement of part of the costs (27%) and tax benefits (20%). The share of survey participants who received subsidies for business development has almost tripled over the year, from 38% to 13% (-25 p.p.).

The observed decline in business executives using government support measures indicates the termination of most programs aimed at leveling the acute phase of the economic crisis. Only 20% of the respondents indicated that there were no shortcomings that prevented active involvement in government support programs. The majority of respondents continue to express dissatisfaction with the discrepancy between the proposed support measures and the needs of the enterprise (40%, -18 p.p.). Another fifth of business executives indicated the appearance of other barriers (20%), in addition to the complexity of paperwork (13%), lack of information on available support measures (13%) and high time costs for documentation (7%, Fig. 7).

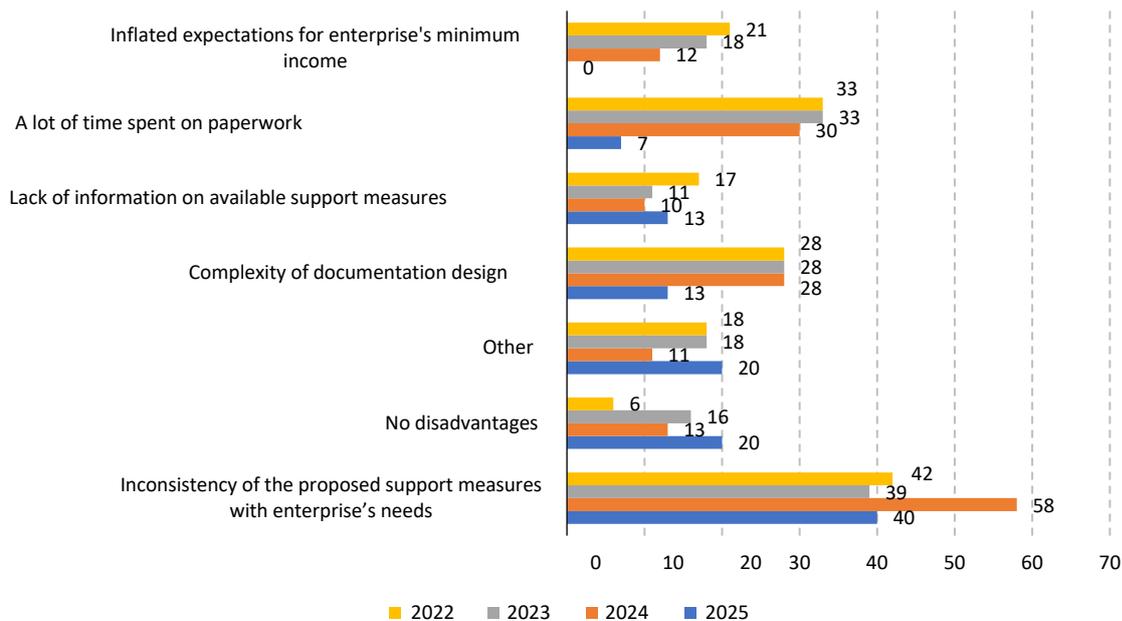


Figure 7. Distribution of responses to the question "What are the disadvantages of the existing government support that prevent you from using it actively?", % of respondents

Source: VoIRC RAS survey data.

Among the main measures for the development of the industrial sector, the survey participants most often chose the improvement of the financial and credit system (67%, +38 p.p.). They considered the need to simplify the taxation system to be the next most effective measures (40%) and the launch of large infrastructure and industrial projects at the expense of the state budget (40%; *Tab. 6*).

One third of respondents continue to worry about high prices for fuel, energy and transport services (33%), while the share of those dissatisfied with the high bureaucratic burden (20%, -36 p.p.) and poor conditions for investing in the industrial sector (13%, -47 p.p.) has significantly decreased.

Many will find a discrepancy between the opinion of the majority of respondents about the lack of impact of changes in the Central Bank's key rate on the country's economy (53%) and

the opinion of 67% of business executives about the need to improve financial and credit policy. The apparent contradiction between the data is explained by the fact that a high key rate has an ambiguous effect: it has no direct negative impact on the current activities of many enterprises that have switched to using their own funds (which explains 53% of neutral responses); However, expensive loans are a key barrier to the prospects of investment development and modernization, which reflects the request of 67% of respondents to improve the financial and credit system.

For the first time since 2022, the majority of business executives surveyed said that the role of the state in the economy is currently optimal (40%, +12 p.p.). Supporters of intensifying economic policy through the use of indirect economic regulation measures in the current survey took second place with 33% (-4 p.p.). Comparing the results obtained with the data

Table 6. Distribution of responses to the question "What measures do you think should be taken in the near future to develop the industrial sector?", % of respondents

Response option	2022	2023	2024	2025
Improve the financial and credit system in the interests of the industrial sector	30	37	29	67
Simplify the taxation system, reduce the total amount of taxes on producers	75	61	58	40
Launch large infrastructure and industrial projects at the expense of the state budget	30	26	22	40
Limit price increases for fuel, energy, and transportation services	36	58	43	33
Pursue an effective foreign trade policy in the interests of domestic producers	32	33	22	27
Reduce the level of bureaucratic burden	49	57	56	20
Create conditions for investing in the industrial sector, dramatically expand the scope of preferential loans	72	36	60	13
Provide financial support for the development of promising (for example, import-substituting) areas of the industrial sector and market infrastructure	36	32	35	13
Create conditions for the growth of effective demand	30	46	29	13
Strengthen fight against corruption	26	43	27	13
Create alternative payment systems for servicing import and export transactions	29	25	27	13
Reduce total amount of taxes on the population	17	29	10	7
Promote integration processes between enterprises	11	19	10	7
Source: VolRC RAS survey data.				

from a survey of business leaders conducted by the Institute of Economic Forecasting of the Russian Academy of Sciences (IEF RAS), it can be noted that, in the opinion of the majority of Russian business leaders, the most relevant response option is the need for indirect regulatory measures (44.3%), and only 21.4% of respondents noted the optimality of the current role of the state (Kovalin et al., 2024).

Conclusion

Let us summarize the changes in the industrial sector of the Northwest Russia over the previous year and highlight the trends and tendencies in its functioning over the previous four years.

The gradual withdrawal of enterprises from functioning in the conditions of crisis and economic uncertainty is indicated by a decrease in the share of respondents who give negative forecasts of decrease in their production performance; 40% of business executives have long-term plans to improve the indicators.

Sixty percent of the respondents continued to search for new suppliers of raw materials within the country, but the decrease in the share of those who will continue doing this in the future to 47% indicates a restructuring of logistics chains. It can also serve as an indicator of the completion of the active reorientation of most enterprises in the industrial sector to the domestic market.

An additional confirmation of the normalization of the economy is the weakening of a number of barriers that, according to business executives, hinder production growth. For instance, quarter fewer respondents are dissatisfied with high prices for raw materials, fuel and materials (-25 p.p.), 13 p.p. fewer respondents say about the shortage of skilled workers. However, working in conditions of a high key rate of the Bank of Russia led to an increase in the share of those expressing dissatisfaction with the high percentage of commercial loans (47%, +12 p.p.).

The transformation of production and distribution chains in the sector's enterprises is coming to an end. Trade and economic contacts in areas such as joint investment projects, technology sales and the recruitment of specialists with organizations from countries that have imposed sanctions have practically been discontinued (0% in 2025). At the same time, contacts remain, although they have decreased, in the field of trade in end products (40%), raw materials and semi-finished products (purchase – 20%, sale – 13%), technologies (purchase – 13%).

The decrease in the share of respondents who do not cooperate with foreign counterparties indicates a restructuring of logistics for cooperation with friendly countries (33%, -36 p.p.). The share of those who do not cooperate with Russian organizations fell to 13% (-32 p.p.) over the year, with enterprises from the Northwestern Federal District – to 7% (-17 p.p.).

The share of business executives dissatisfied with the small market capacity in Russia (20%, -45 p.p.) and the Northwestern Federal District (13%, -52 p.p.) decreased. In general, there was a significant decrease in dissatisfaction with the main barriers hindering the development of trade and economic relations with foreign and Russian organizations. The opinions of business executives have changed most dramatically about the lack of information regarding tenders and tenders in the Russian Federation (-71 p.p.) and the Northwestern Federal District (-42 p.p.), and about the weak assistance to the industrial sector from the authorities in Russia and the macro region (-69 and -23 p.p., respectively).

The stabilization of the economic situation in the country is indicated by a decrease in the share of business executives who carry out any measures to transform their production and distribution chains. Although there is a tendency of continued reorientation toward domestic suppliers and consumers (53%), and the search for new ones in

the markets of neutral countries (40%), already a third of business executives (33%) have stated that there are no disruptions in the supply chains.

The growth of up to 40% of the share of business executives who consider the amount of financing for their company to be optimal looks optimistic. On the other hand, for the third year now, the share of responses on the sufficiency of financing for the industrial sector of the NWFD economy has been falling, and there has been an increase in the share of respondents who said there were insufficient resources even to maintain current production volumes.

A request to assess the impact of a high key interest rate on the Russian economy gave the answer: 40% of respondents rated it as negative. The majority of business executives (53%) noted that such a level of the refinancing rate does not affect changes in the country's economy.

Seventy-three percent of respondents unequivocally support the actions of the government of the country, while only 47% of respondents support the regional authorities. Half of the business executives were unable to assess the policy of the regional authorities, which did not prevent the survey participants from expressing satisfaction with the effectiveness of cooperation with federal and regional executive authorities.

The sharp drop in the share of those who used state support measures at the federal and regional levels may have been due to a reduction in government programs to offset the acute phase of the crisis. One third of the respondents did not take advantage of support measures due to lack of need for such measures, another 20% did not have such an opportunity. At the same time, the main obstacles to their active application are the inconsistency of measures with the needs of the majority of enterprises in the industrial sector (40%).

Significant changes have taken place in the ranking of events that should stimulate the

development of the macro region's industrial sector in the near future. The most urgent, according to the business executives, is the improvement of the financial and credit system in accordance with the requirements of the industrial sector (67%, +38 p.p.).

Based on the survey results, it is possible to note the stabilization of the processes of transformation and adaptation of enterprises in the industrial sector of the Northwestern Federal District to sanctions and economic uncertainty. The reorientation of enterprises to the domestic market is almost complete, logistics chains have been rebuilt for the majority of respondents, and production and distribution chains do not require significant resources for further changes. The majority of experts demonstrate an optimistic view on the future work of their company, and a high key rate has no impact on the country's economy, according to half of the respondents.

Thus, we analyzed the results of the annual monitoring of the industrial sector conducted by Vologda Research Center of RAS. The survey of business executives makes it possible to supplement the official information with a subjective opinion about the real work of the sector. Participation in surveys of large corporations makes it possible to develop recommendations for the executive authorities of the constituent entities of the Northwest macro region to adjust support measures and industrial policy of the regions. The conducted research provides an opportunity to complement the study of regional and sectoral specifics of economic development, to list the barriers limiting regional growth, and to improve the necessary programs for the development of the sector. Taking into account the opinion of the business executives in the industrial sector of the macro region's economy will improve the efficiency of enterprises and have a positive impact on the region as a whole.

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INNOVATION POTENTIAL OF TERRITORIAL DEVELOPMENT

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THE RELATIONSHIP BETWEEN THE SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT INDEX AND THE ECONOMIC STRUCTURE OF RUSSIAN REGIONS



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This paper continues our research on the regional analysis of scientific and technological development. The relationship between the level of scientific and technological development and economic indicators reflecting a region's specialization has not been sufficiently analyzed in the literature, which defines the relevance of this study. The aim of the work is to identify the presence or absence of relationship between the scientific and technological development index and the established industrial specialization of a region. The importance of identifying such patterns is driven by the fact that the Strategy for Technological Development presupposes the creation of a matrix for scientific and technological development programs in the regions. The research was based on 2022 statistical data published on the websites of Rosstat and the Russian Ministry of Science and Higher Education. We applied an original aggregated index proposed earlier by us for the analysis. The study relied on methods of mathematical statistics: cluster, variance, and correlation analysis. As a result, we established a fairly stable relationship between the economic

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structure and scientific and technological development: regions with a more diversified economic structure have a higher scientific and technological development index. As expected, a strong correlation was found between the share of scientific activity in a region and its scientific and technological development, particularly for the sub-index responsible for science funding. This paper can be useful for creating the aforementioned matrices for regional state programs of scientific and technological development, taking into account the type of region and the criteria by which a region can be classified as a particular type.

Rating, region, regional development, scientific and technological development, technological sovereignty, cluster analysis.

Introduction

This article continues a series of studies dedicated to regional issues of scientific and technological development (STD) and the closely related questions of the country's technological sovereignty. The work aims to address scientific gaps concerning STD, specifically to identify the presence or absence of a relationship between the STD index and the established sectoral specialization of a region under modern conditions that require ensuring the economy's technological sovereignty.

The scientific hypothesis put forward by the authors is that the values of the aggregated STD index depend on the sectoral specialization of a region: regions with more diversified economies have higher STD indices. To this end, the work aimed to solve the following tasks: conduct a cluster analysis based on two sets of features characterizing innovative development and economic structure; compare the clusters identified by the two partitions; and perform correlation analysis to determine the presence and strength of the relationship.

Identifying such patterns is relevant because the Strategy for Technological Development, adopted by Presidential Decree 145, dated February 28, 2024, envisions the creation of a regional STD program matrix taking into account the region's specialization.

Research on technological sovereignty and regional STD has been reflected in the scientific literature. However, in our view, the relationship between the level of STD and other economic

indicators, as well as the contribution of regions to scientific and technological development, has not been sufficiently examined. This constitutes another aspect of the scientific novelty of this study.

Methods

The study employed an author's methodology for constructing an aggregated index of scientific and technological development, described in (Volkova, 2024), and a number of statistical analysis methods. At the first stage, the initial data were transformed into standardized variables using the min-max method. Then, indices of the 3rd and 2nd levels and the general index of the 1st level were calculated as simple averages of the corresponding number of features. For the initial investigation, the authors considered it entirely acceptable to use equal weights for the features, since assigning different weights requires additional research or expert assessments. Subsequently, as a result of a double cluster analysis – based on the 2nd-level indices and on the features of production structure – two cluster partitions with similar characteristics within clusters were obtained (Soshnikova et al., 1999).

To assess the significance of differences between the obtained clusters, analysis of variance (ANOVA) with post-hoc criteria was used (Kremer, 2000; Dubina, 2010).

To identify the dependence of the calculated STD indices on the features of the regions' economic structure, a correlation analysis was performed for all identified clusters.

The research was conducted on statistical data for 2022, available from open sources. On the one hand, this is the most recent data available at the time of writing the article; on the other hand, it allowed for accounting for geopolitical shocks. The authors intend to continue the research with more recent data and analyze the dynamics of STD processes in the regions.

Theory

Technological sovereignty at the macro level

It is believed that the concept of “technological sovereignty” (TS) was introduced by P. Grant. He interpreted TS as the ability and freedom to choose, create or acquire, as well as apply and exploit for commercial purposes, the technologies necessary for industrial innovation (Grant, 1983). A more specific formulation, with which the authors agree, is given in (Edler et al., 2023), where TS is defined as a means for authorities to achieve innovation policy goals in order to maintain national competitiveness and build economic potential. This interpretation reflects the essence of the phenomenon (achieving competitiveness in the global market) and identifies development directions, especially in connection with the sanctions imposed on the Russian Federation, which are largely aimed at limiting the country’s technological capabilities.

The connection between sanctions and states’ turn toward TS is also discussed in foreign sources. For instance, Indian economists note that the use of the TS concept is increasing in various countries due to the growing number of Western sanctions imposed against Iran, North Korea, Venezuela, and Russia (Bhagwat, Zaikov, 2024).

The discussion on this issue continues in the literature¹. Primarily, there is a debate

regarding the very concept of TS. For example, L.S. Nevyantseva describes different facets of the definition’s essence, particularly touching upon aspects such as the link between TS and national security, and the necessary degree of economic openness (Nevyantseva, 2024). E.V. Krasilnikova and A.A. Nikonova focused their attention on the interpretation of TS by different economic agents, such as legislation, authorities, business, and researchers (Krasilnikova, Nikonova, 2023).

Foreign experience in TS research is presented in the work (Yasinskii, 2023), which discusses the system of managing science and technology development in China, as well as in a collective work dedicated to the concept of technological autonomy in the EU².

In an article by V.E. Dementiev, it is suggested to consider the experience of foreign approaches to strengthening TS, but the need to account for the turbulence of economic development is noted (Dementiev, 2023). TS is discussed in a similar vein in an article (Krupnov, 2023).

At the state level, significant attention is also paid to TS issues. As an example, one can cite Federal Law 523-FZ dated December 28, 2024, “On Technological Policy in the Russian Federation and on Amending Certain Legislative Acts of the Russian Federation”³. The law is aimed at enhancing the competitiveness of high-tech products and the efficiency of their production through the introduction of technological innovations in the Russian Federation. One of the objectives stated in the document is “creating conditions for economic development and ensuring competition in the sphere of technological development”, and one of the tasks is “conducting monitoring of the effectiveness of technological policy and assessing the effectiveness of state incentive

¹ A detailed analysis is provided in the work (Volkova, 2024).

² Geopolitics and Economic Statecraft in the European Union (2024). Rosa Balfour and Sinan Ülgen, editors. Carnegie Endowment for International Peace. Available at <https://carnegie-production-assets.s3.amazonaws.com/static/files/Geopolitics%20and%20Economic%20Statecraft%20in%20the%20European%20Union-2.pdf>

³ Federal Law 523-FZ dated December 28, 2024, “On Technological Policy in the Russian Federation and on Amending Certain Legislative Acts of the Russian Federation”. Available at: <http://pravo.gov.ru/proxy/ips/?docbody=&firstDoc=1&astDoc=1&nd=608103518> (accessed: 23.03.2025).

measures”. However, regarding regional TS issues, the law only declares that constituent entities of the Russian Federation exercise powers to formulate technological policy within the framework of this law.

In 2024, a list of priority TS project areas was approved, including those critical for its provision, with a total cost of 977 billion rubles (as of November 2024)⁴.

The concepts of TS and STD are closely interrelated. In our view, STD is one of the means to achieve TS. All of the above pertains to the macro level – the state level. In relation to regions, the issues under investigation have a number of nuances.

Regional aspect of TS and STD

It is difficult to speak of TS in relation to a region, which “by definition” cannot be sovereign. TS is closely linked to the country’s sovereignty, and regions, even in a federal state, do not possess full independence. We agree with the opinion expressed in (Akberdina, Potaptseva, 2023) that, from a regional perspective, one should speak of the contribution of regions to the state’s TS. Thus, in this aspect, the issue of TS should be considered from the angle of technological development, which is precisely what has been done in this article.

The contribution of regions to achieving TS is given great importance at the governmental level. For instance, at a meeting of the Commission for Scientific and Technological Development of the Russian Federation in May 2024, Deputy Prime Minister D. Chernyshnikov reported that in 80 Russian regions, leaders for STD have already been appointed, as provided for by the Strategy⁵, and that 20 constituent entities have prepared state programs for STD⁶.

Some sources, for example (Tufetulov, 2007), consider general issues of the sectoral structure

of the regional economy within the framework of the concept of Kondratiev’s long technological waves. The work (Efimov, 2022) analyzes regional STD in specific entities, particularly in the south of Russia. The study (Ivanchenko, 2023) examines the main industrial regions of the Urals.

In the context of this article, the work of German economists (Kroll, Neuhäusler, 2020) is of interest. They study regional aspects of STD in China and concluded that the most developed industrial regions of China make the greatest contribution to development.

The monograph (Priorities..., 2020) analyzes aspects of innovation policy across regions, describing the potential of relatively new regional elements of innovation infrastructure, such as scientific and educational centers, which in the future will create conditions for productive partnerships between research organizations, leading universities, and major industry (Priorities..., 2020, pp. 88–89).

Measuring the level of STD

To determine the level of STD in regions, it would be useful to have some objective criterion reflecting changes; therefore, it is necessary to measure the level of TS. Questions of its measurement, both at the national and regional levels, have been discussed in the literature. For example, the work (Glazunova, 2023) investigated innovative potential and its connection to technological sovereignty.

Various approaches to assessing the level of TS and a region’s contribution to its achievement were studied by the authors in previous works (Volkova, 2024; Volkova, Romanyuk, 2024).

Some approaches to measuring the level of STD outlined in the works listed above are currently difficult to apply due to the lack of reliable statistical information, especially at the regional level. As an example, one can refer

⁴ Technological sovereignty of Russia. Available at: https://www.tadviser.ru/index.php/Статья:Технологический_суверенитет_России (accessed: 17.02.2025).

⁵ Available at: <http://www.kremlin.ru/acts/bank/50358> (accessed: 23.03.2025).

⁶ Available at: <http://government.ru> (accessed: 23.03.2025).

to the article (Yankovskaya, 2023), which states that quantitative analysis of TS is hampered by the absence of published indicators of technological sovereignty. The work (Sukharev, 2023) also notes the incompleteness of statistical information related to STD.

Nevertheless, measuring the level of STD in a region is desirable, as it allows for adjusting scientific and technological policy within it. The lack of reliable and complete regional information on this issue leads to the construction of ratings becoming a compromise between data availability and the need to account for all aspects of the process as comprehensively as possible.

The task of assessing STD has recently received particular attention in the literature due to the current geopolitical situation. For instance, the article (Myslyakova, 2022) evaluates the effectiveness of using regional scientific and technological potential, using as an example the constituent entities of the Federation that are leaders in the share of basic industrial sectors in GRP and the country's GDP as a whole. In it, regional potential is compared based on a system of indicators consolidated into an aggregated index. However, the analysis was limited to only a number of regions.

The work (Sukharev, 2019) examines models of regional technological development and postulates that their development policies should be individually differentiated.

Government bodies also attach great importance to regional innovative development. In 2022, a methodology for calculating the regional rating was published⁷.

At a meeting of the Commission for Scientific and Technological Development on September 30, 2024, Deputy Minister of Science and Higher Education of the Russian Federation (Minobrnauki) D.S. Sekirinsky emphasized that "...the STD strategy involves the development and approval of indicators that will be used to assess the effectiveness of measures and instruments of state policy in the field of scientific and technological development. Such an assessment becomes a tool for monitoring the implementation of the STD strategy..."⁸.

Various instruments are used to assess STD. For example, the work (Govorova, 2021, p. 28) proposes considering the inventive activity of universities as an important indicator of a region's technological development. Other studies discuss the need to introduce a system of indicators for monitoring the state of TS (Yankovskaya, 2023, p. 84). Most often, various indices are used, combining different aspects of the scientific and technological process into a single indicator.

The use of aggregated indicators has its advantages and disadvantages, like any other formal methods. On the one hand, they often mask differences in their components, which complicates making correct management decisions, and are poorly suited for describing qualitative processes. On the other hand, they allow for obtaining generalized information covering its different facets.

This issue also receives attention in government and expert circles. For example, the Association of Innovative Regions of Russia (AIRR)⁹ maintains a database of best practices in regional governance, including examples of the most effective activities of constituent

⁷ National Rating of Scientific and Technological Development of the Russian Federation's Constituent Entities. Available at: <https://www.minobrnauki.gov.ru/> (accessed: 27.02.2025).

⁸ Website of the RF Government. Available at: <http://government.ru/news/52844> (accessed: 27.02.2025).

⁹ The AIRR includes 19 regions: Altai, Krasnoyarsk, Perm territories; Irkutsk, Kaluga, Lipetsk, Nizhny Novgorod, Novgorod, Novosibirsk, Samara, Tyumen, Tomsk and Ulyanovsk regions, Republic of Bashkortostan, Republic of Mordovia, Republic of Sakha (Yakutia), Republic of Tatarstan (Tatarstan), Khanty-Mansi Autonomous Area – Yugra.

entities in this direction¹⁰. This organization also calculates the AIRR Scale¹¹, which allows for assessing regional efforts aimed at STD, although it must be acknowledged that it is more focused on innovative activity.

Since 2022, the Russian Ministry of Science and Higher Education (Minobrnauki) has been calculating the regional STD rating, developed in response to Presidential Directive Pr-290, paragraph 10v, dated December 24, 2021¹². The Minobrnauki website also publishes the annual rating's passport¹³. According to Russian Minister of Education and Science V. Falkov, in the 2024 rating, the number of indicators was increased from 33 to 43. These criteria are still grouped into 3 blocks, "which reflect the involvement of regional authorities in the scientific and technological development of the subject, the level of conditions created for attracting knowledge-intensive business to the region, and the level of conditions for the researchers themselves"¹⁴. The work (Dorzhiyeva et al., 2022) reviewed the methodologies existing at that time, including the governmental one, highlighted their advantages and disadvantages, and proposed an author's methodology for assessing a region's contribution to STD. The need for its development was driven by the fact that the aforementioned ratings, in addition to regular statistical data, utilized

expert assessments and special surveys¹⁵. In creating our own author's methodology, we proceeded from the need to use only regular statistical data, containing, where possible, comprehensive coverage of information on STD.

Aggregated Index of Scientific and Technological Development

The authors have been engaged with this issue since 2019, therefore the methodology has been revised several times and adjusted to the statistical data available at the moment. It should be noted that regional data on STD is more scarce than federal data, especially recently, as a number of indicators have been discontinued.

The final list of indicators used at this stage of research is presented in *Fig. 1*.

Compared to the initial dataset, some indicators in this study have been changed; for example, instead of the total number of researchers, an indicator of their number in STEM fields has been introduced. In our opinion, it more accurately reflects staffing demands in scientific and technological development. Thus, according to research by the Association of Innovative Regions of Russia, there is a trend in the economy towards growing demand for STEM specialists. According to AIRR data, over 12 months – from March 2024 compared to March 2023 – this indicator grew by 26%¹⁶.

¹⁰ An open directory of the best regional practices of the subjects of the Russian Federation – members of the Association of Innovative Regions of Russia. Available at: https://i-regions.ru/images/books/AIRR_Best_practise2.pdf (accessed: 27.02.2025).

¹¹ Regional scale of innovation development. Available at: <https://i-regions.ru/reiting/regionalnyy-indeks-razvitiya-innovatsiy-i-index> (accessed: 06.02.2025).

¹² List of instructions following the joint meeting of the State Council and the Presidential Council on Science and Education on December 24, 2021. Available at: <http://www.kremlin.ru/acts/assignments/orders/67752> (accessed: 06.02.2025).

¹³ The latest available rating (the rating of STD of Russian regions based on the results of 2023) was published on December 25, 2024..

¹⁴ Available at: https://www.minobrnauki.gov.ru/press-center/news/novosti-ministerstva/93149/?sphrase_id=8585800 (accessed: 06.02.2025).

¹⁵ For example, in the ratings compiled by the Russian Rating Agency, or the rating published on the website of the Russian Ministry of Science and Higher Education.

¹⁶ The regional index of demand for personnel for the innovative economy. Available at: <https://i-regions.ru/reiting/ezhemesyachnyy-reyting-regionov-po-dostupnosti-kadrov-dlya-innovatsionnoy-ekonomiki> (accessed: 06.02.2025).

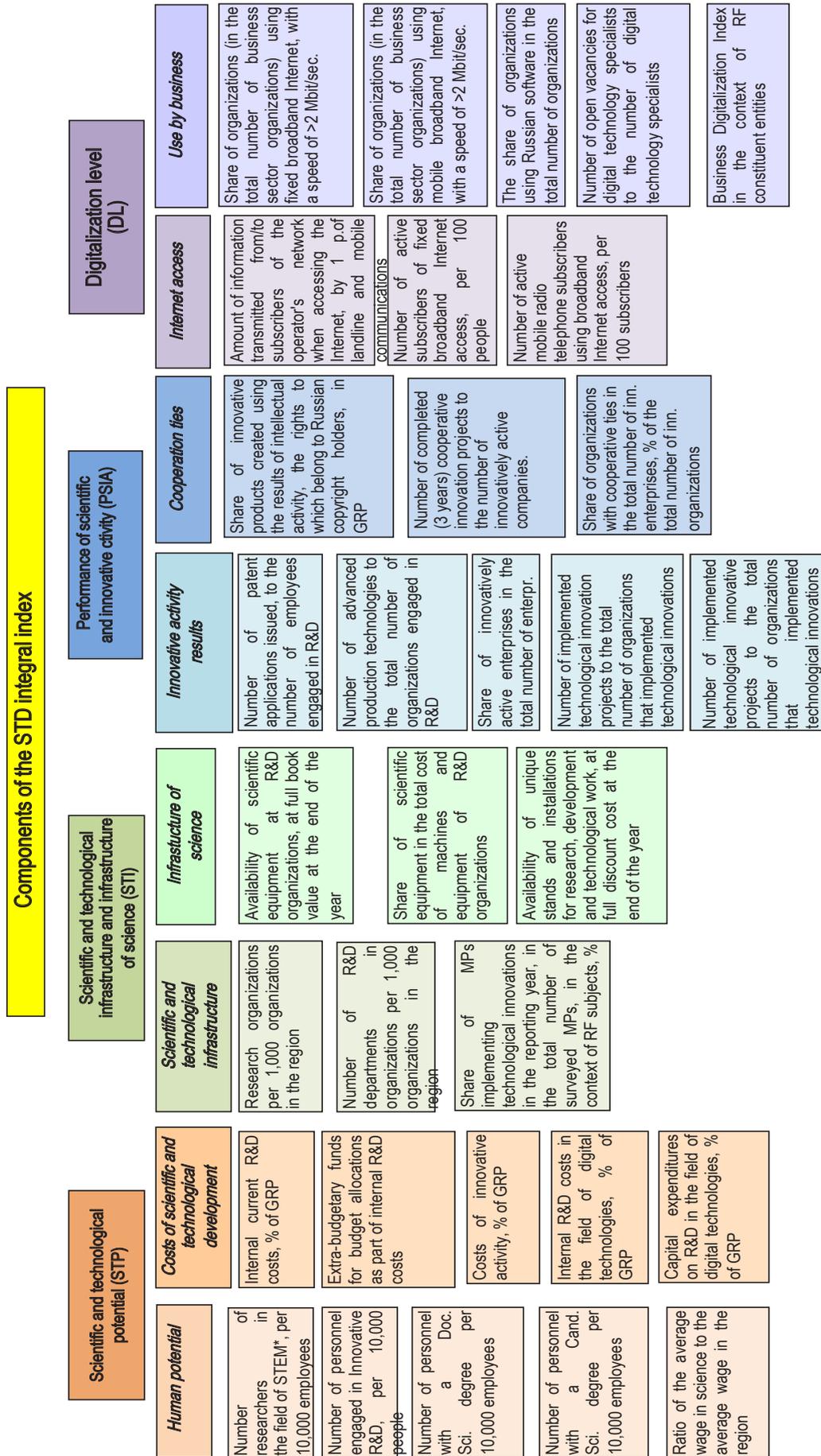


Figure 1. Aggregated index

* STEM disciplines include natural sciences: biology, physics, chemistry, as well as mathematics, logic, and statistics. Source: Compiled based on (Volkova, 2024, pp. 57–59).

A lower limit for connection speed for broadband access was also added, since according to the Rosstat methodology, broadband access implies a speed of only 256 Kbit/s, which is very low for modern applications.

Discussion of results

The work (Volkova, Romanyuk, 2024) already investigated the relationship between the scientific and technological index and the economic structure; however, it was presented only within the framework of the GRP structure, and a conclusion was made about its certain influence on the STD index: regions with a higher share of manufacturing had a higher STD index. At the same time, it was noted that the issue requires further research.

In this study, the authors added the structure of manufacturing industries for consideration. This is important because the new technological paradigm (Glazyev, 2012) is characterized precisely by subsections within the classification of manufacturing industries (Garmashova, 2019, p. 63).

Rosstat does not provide the share of manufacturing in GRP, so it was determined as follows: the share of manufacturing in total GRP (data from Rosstat in the “National Accounts” section¹⁷) was divided proportionally to the share of the corresponding industries in shipped products.

This approach assumes that the structure of intermediate consumption corresponds to the structure of shipped products. It is clear that this is not always the case, but this technique at a high level of aggregation does not introduce significant distortions and can be applied at the preliminary analysis stage; however, the results should be interpreted with caution.

The industries used for the analysis are presented in *Fig. 2* and highlighted in color.

The dataset was standardized using the min-max method, and cluster analysis was also conducted in two versions – based on STD indices and based on the GRP structure. The cluster centers resulting from the partitions are presented in *Tables 1* and *2*, and the regions are shown in *Fig. 3*.

In *Figure 3*, the clustering is based on the production structure, and the numbers correspond to the cluster numbers obtained for the partition by indices (see *Tab. 1*).

Let us briefly characterize the resulting clusters. In the first case (see *Tab. 1*), the set was divided into 5 clusters, ordered in *Table 2* by descending aggregated index. Cluster 1 includes only one element – Moscow. The second cluster includes 6 subjects¹⁸, the third – 22 regions¹⁹, the fourth cluster consists of 35 subjects²⁰. Finally, the fifth cluster combines 22 subjects with the lowest level of STD²¹.

¹⁷ Available at: https://rosstat.gov.ru/storage/mediabank/VRP_OKVED2_s_2016.xlsx (accessed: 06.03.2025).

¹⁸ Moscow Region, Saint Petersburg, Republic of Tatarstan, Nizhny Novgorod, Novosibirsk, Tomsk regions. Here and below, the regions are listed in descending order of the aggregated index.

¹⁹ Vladimir, Voronezh, Kaluga, Tula, Yaroslavl, Leningrad regions, Krasnodar Territory, Rostov Region, Republic of Bashkortostan, Perm Territory, Samara, Saratov, Ulyanovsk, Sverdlovsk, Tyumen, Chelyabinsk regions, Altai, Krasnoyarsk territories, Irkutsk, Omsk regions and Primorye Territory.

²⁰ Belgorod, Bryansk, Ivanovo, Kostroma, Kursk, Lipetsk, Orel, Ryazan, Smolensk, Tambov, Tver regions, Republic of Karelia, Komi Republic, Arkhangelsk, Vologda, Kaliningrad, Murmansk, Novgorod, Volgograd regions, Stavropol Territory, Republic of Mordovia, Udmurt Republic, Chuvash Republic, Kirov, Orenburg, Penza, Kurgan regions, Khanty-Mansi Autonomous Area – Yugra, Yamal-Nenets Autonomous Area, Kemerovo Region, Republic of Sakha (Yakutia), Kamchatka, Khabarovsk territories, Amur and Magadan regions.

²¹ Nenets Autonomous Area, Pskov Region, Republic of Adygea, Republic of Kalmykia, Republic of Crimea, Astrakhan Region, Sevastopol, Republic of Dagestan, Republic of Ingushetia, Kabardino-Balkarian Republic, Karachay-Cherkess Republic, Republic of North Ossetia–Alania, Chechen Republic, Republic of Mari El, Republic of Altai, Republic of Tyva, Republic of Khakassia, Republic of Buryatia, Trans-Baikal Territory, Sakhalin Region, Jewish Autonomous Region, Chukotka Autonomous Area.

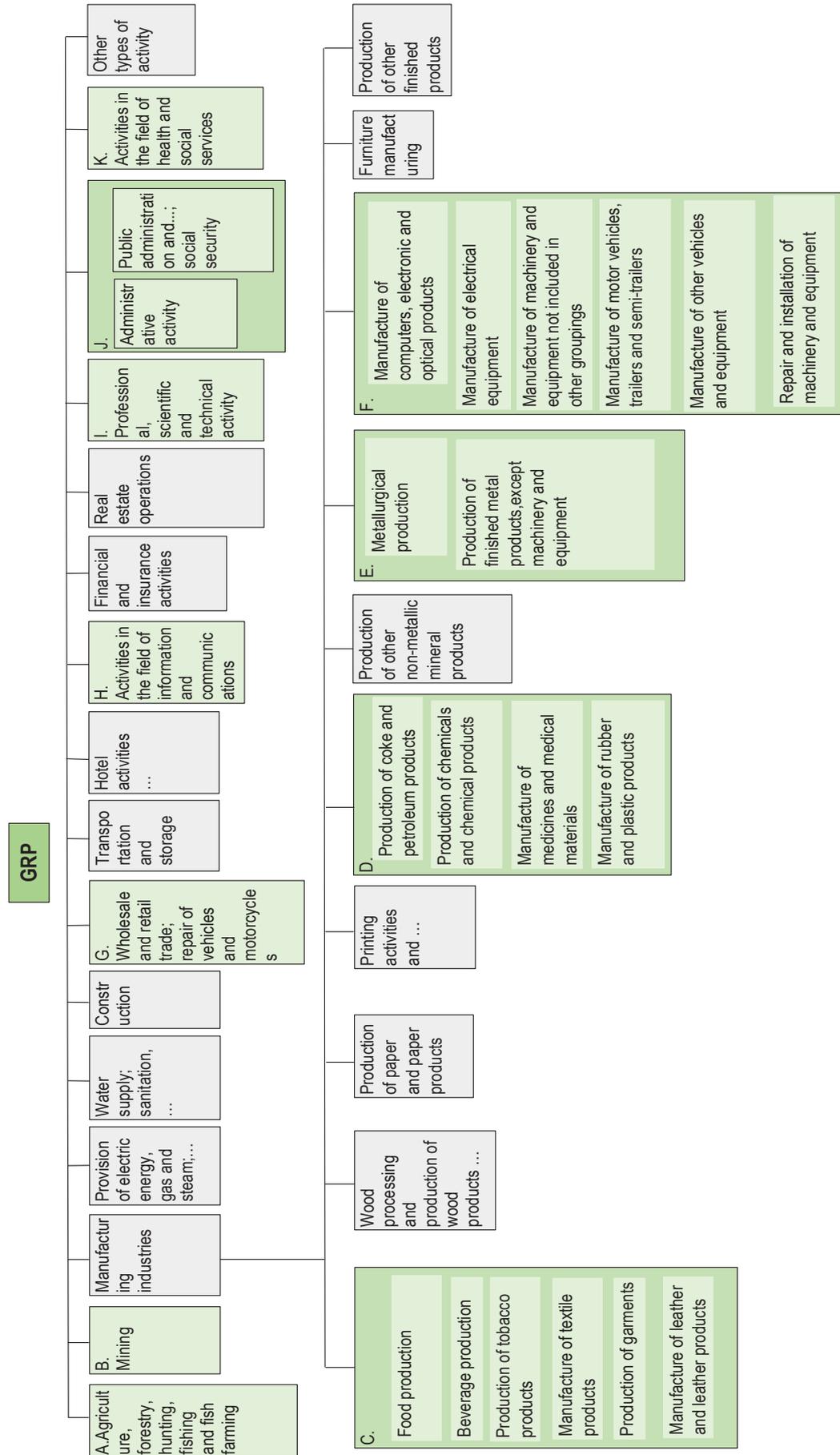
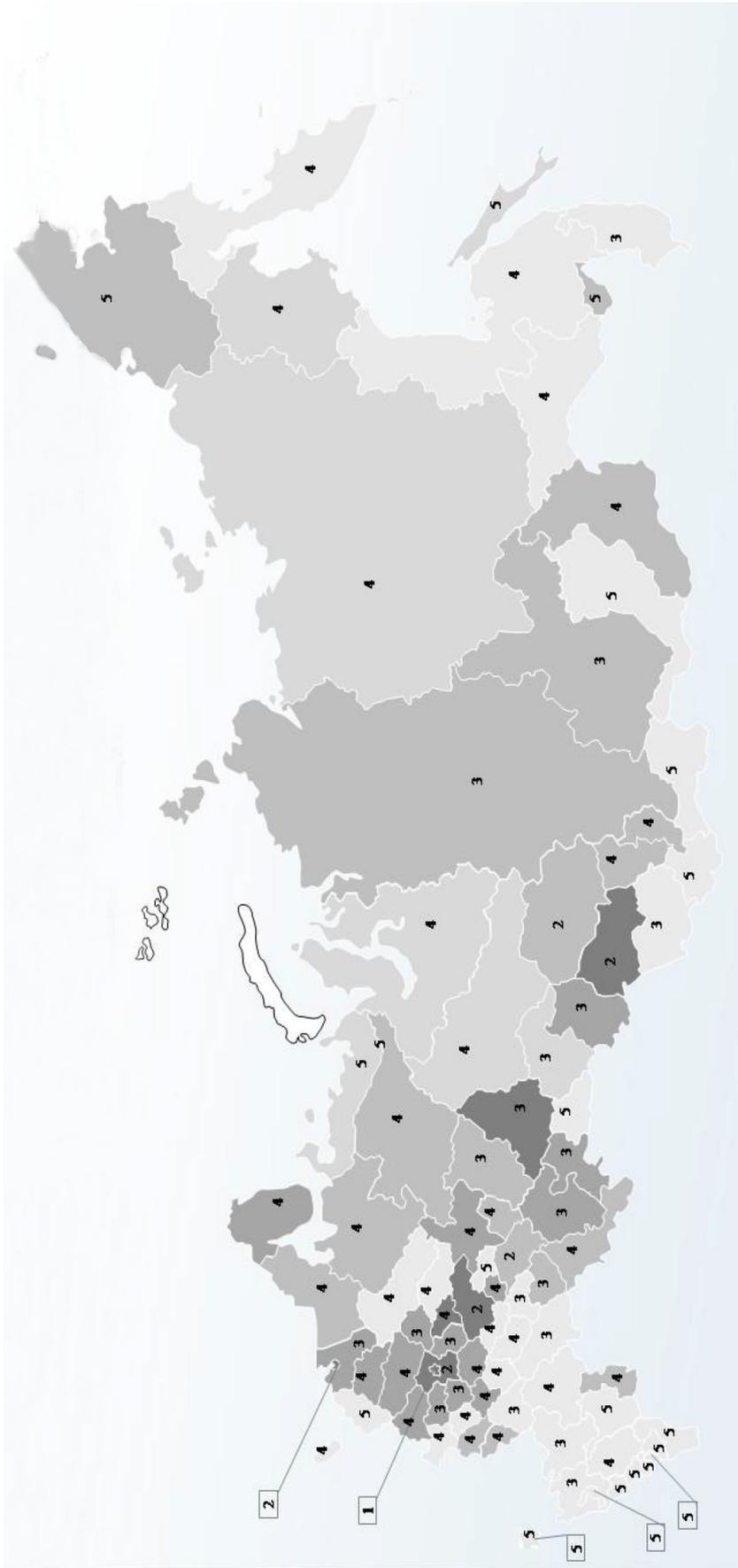


Figure 2. Types of activities included in the analysis

Source: All-Russian Classifier of Types of Economic Activity (approved by Order of Rosstandart 14-st dated January 31, 2014, as amended on April 9, 2025. Available at: https://www.consultant.ru/document/cons_doc_LAW_163320/).



- Cluster 1: Moscow, Saint Petersburg, Moscow Region, Nizhny Novgorod Region, Novosibirsk Region, Sverdlovsk Region, Ivanovo Region.
- Cluster 2: Chelyabinsk Region, Kaluga Region, Republic of Bashkortostan, Yaroslavl Region, Tula Region, Leningrad Region, Vladimir Region, Omsk Region, Lipetsk Region, Murmansk Region, Tver Region, Smolensk Region, Ryazan Region, Chuvash Republic, Vologda Region, Novgorod Region.
- Cluster 3: Republic of Tatarstan, Tomsk Region, Perm Territory, Samara Region, Krasnodar Territory, Irkutsk Region, Belgorod Region, Kursk Region, Republic of Karelia, Komi Republic, Arkhangelsk Region.
- Cluster 4: Tyumen Region, Republic of Sakha (Yakutia), YaNAA, Magadan Region, KhMAA, Sakhalin Region, Nenets AA.
- Cluster 5: Krasnodar Territory, Rostov Region, Ulyanovsk Region, Voronezh Region, Saratov Region, Primorye, Altai Stavropol territories, Republic of Mordovia, Volgograd Region, Khabarovsk Territory, Penza Region, Kaliningrad Region, Kostroma Region, Karachay-Cherkess Republic, Kamchatka Territory, Jambou Region, Bryansk Region, Orel Region, Republic of Buryatia, Kurgan Region, Republic of Crimea, Sevastopol Republic of North Ossetia–Alania, Pskov Region, Republic of Mari-El, Kabardino-Balkar Republic, Republic of Dagestan, Republic of Adygea, Republic of Kalmykia, Republic of Tyva, Republic of Ingushetia.

Figure 3. Partition of regions into clusters

Note: The map is compiled as of 2022, which was the year of the study.
Source: own calculations.

In the cluster analysis by the sectoral structure of GRP, 4 clusters were initially identified, but one of them, which included regions with a predominantly diversified economic structure, turned out to be too heterogeneous, so it was split again into 2 clusters. In Table 2, the clusters are arranged in descending order of the average aggregated index for the cluster. The letters correspond to the letters of the industries in Figure 2. In our case, the intersections of the partitions are of greatest interest, which are clearly visible in Figure 3.

Cluster 1 (see Tab. 2) has a large share of wholesale and retail trade, as it combines large cities and logistics centers. It also has the maximum value among all for the share of professional, scientific, and technical activities (hereinafter referred to as scientific), as well as the information and communication sector. The share of public administration and military security, and administrative activities in this cluster is also high.

This circumstance is not surprising, since the constituent entities of the Russian Federation included in this cluster are administrative centers of large regions²². As can be seen in Figure 3, according to the clustering presented in Table 1, these regions belong to clusters 1–2, i.e., they are regions with the highest STD index values. The Sverdlovsk Region, which falls into the third cluster by aggregated index, occupies the top position there, and its indices differ only slightly from the values of regions in the lower part of Cluster 2.

Cluster 2 has the most diversified economic structure. Its center has the highest shares among all clusters in chemical, metallurgical, and machine-building production. As seen in Figure 3, the regions of this cluster, according to the aggregated index, are “mid-tier” – represented by numbers 3 and 4 in Figure 1.

A number of regions in Cluster 2 do not occupy very high positions by aggregated index. It should be noted that all of them have a significant share of

Table 1. Cluster centers broken down by indices

Region	Aggregated index	STP	STI	PSIA	DL
Russian Federation	0.168	0.191	0.089	0.114	0.253
Cluster 1	0.796	0.749	0.788	0.779	0.877
Cluster 2	0.336	0.436	0.252	0.240	0.370
Cluster 3	0.168	0.141	0.089	0.155	0.275
Cluster 4	0.106	0.065	0.025	0.092	0.232
Cluster 5	0.066	0.037	0.025	0.043	0.155

Source: own calculations.

Table 2. Cluster centers broken down by structure

Region	Aggregated index	A	B	C	D	E	F	G	H	I	J	K
Russian Federation	0.17	4.50	14.40	3.11	5.90	3.73	2.89	14.50	3.20	4.30	7.30	3.80
Cluster 1	0.37	2.20	1.17	4.17	4.37	5.40	4.08	20.94	3.76	5.93	8.11	4.26
Cluster 2	0.13	6.51	1.55	6.55	8.93	9.56	5.69	10.69	1.72	2.39	6.88	4.54
Cluster 3	0.13	5.22	31.54	2.21	3.08	3.91	2.40	7.25	1.43	1.89	7.40	4.15
Cluster 4	0.11	1.43	67.94	0.54	1.72	0.21	0.11	2.86	0.51	0.89	4.24	2.37
Cluster 5	0.10	14.14	2.38	4.67	1.66	1.41	3.04	12.11	2.06	1.98	12.07	6.00

Source: own calculations.

²² To a lesser extent, this applies to the Ivanovo Region, but it is located on the periphery of the cluster.

trade, public administration, and administrative and economic management in their GRP.

In regions with not very high aggregated indices, such as the Smolensk, Ryazan, Kirov, Volgograd, and Novgorod regions, the share of chemical production is high, and in some of them, metallurgy and machine-building make a fairly significant contribution to GRP. Consequently, these industries and activities currently lack STD potential and are oriented towards the old technological paradigm²³. A large share of public and administrative-economic management diverts necessary resources from STD.

Cluster 3 is characterized by a high share of extractive industries, though it is lower than in Cluster 4. It also has a large share of agriculture, trade, public administration, and the administrative-economic sphere.

According to the STD index, this cluster includes regions that predominantly have low aggregated index values (numbers 4 and 5 in Fig. 3). This cluster also includes two constituent entities of the Russian Federation (Republic of Tatarstan and Tomsk Region) that have a fairly high aggregated index but a more diversified structure with a high share of oil refining (Tatarstan) and science (Tomsk Region) in GRP.

Furthermore, a number of regions show a relatively high STD index (number 3 in Fig. 3):

- Perm Territory with a high share of chemical and petrochemical production; the share of science there is higher than the cluster average (2.4 and 1.89%, respectively);

- Samara Region, where the share of machine-building production is greater than the Russian average (2.5 times – 7.22 and 2.89%, respectively); the share of science in the region is also relatively high – 3.6%;

- Krasnoyarsk Territory, which has a very high share of metallurgical production (24.8%).

Cluster 4 includes extractive regions; the share of other industries in them is insignificant.

In terms of STD level, these regions mostly belong to the third and fifth clusters.

Cluster 5 comprises regions with a high share of agriculture, food production, trade, and public administration. From the perspective of clustering by STD index, these regions are among the weakest – clusters 4 and 5. Nevertheless, the constituent entities of the Russian Federation within this cluster that have relatively high STD indices are characterized by a comparatively high share of science relative to the cluster average of 1.98%. For example, in the Voronezh Region it is 4.5%, in the Krasnodar Territory – 3.2%, in the Rostov Region – 2.7%, in the Saratov Region – 2.8%.

A preliminary analysis of Tables 1 and 2 suggests that the values of the aggregated STD index depend on the sectoral specialization of a region. A more diversified economic structure leads to a higher STD index, which aligns with the conclusions of the aforementioned study on China's economy (Kroll, Neuhäusler, 2020), stating that regions with diversified economies make the greatest contribution to innovative development.

To confirm this hypothesis, a correlation analysis was conducted; its results are presented in *Table 3*. The column names in it correspond to the designation of industries above. Initially, for the entire dataset and for each individual cluster, Spearman's rank correlation was calculated, for which the distribution of the original series is not important.

However, the results obtained for cluster 1 were unsatisfactory, so after checking the normality of the distribution for it, Pearson correlation coefficients were calculated²⁴.

Analysis of *Table 3* showed that interdependence between the aggregated STD index, its components, and the GRP structure is present for all clusters, but it varies depending on the region's specialization.

²³ The distribution of industries according to technological patterns is considered in the work (Garmashova, 2019, p. 63).

²⁴ *Table 3* shows only the values of the correlation coefficients. Significant coefficients are shown in bold.

Table 3. Results of correlation analysis

Region	A	B	C	D	E	F	G	H	I	J	K
Russian Federation											
Aggregated index	-0.24	-0.04	0.24	0.64	0.48	0.42	0.26	0.30	0.70	-0.44	-0.46
STP	-0.19	-0.09	0.23	0.46	0.35	0.36	0.32	0.33	0.74	-0.24	-0.29
STI	-0.06	-0.12	0.29	0.50	0.31	0.38	0.38	0.36	0.70	-0.21	-0.25
PSIA	-0.20	-0.14	0.23	0.70	0.53	0.47	0.29	0.32	0.55	-0.53	-0.45
DL	-0.38	0.10	0.05	0.55	0.44	0.27	0.14	0.11	0.51	-0.51	-0.59
Cluster 1 (Pearson)											
Aggregated index	-0.62	-0.31	-0.66	0.91	-0.29	-0.51	0.23	0.85	0.90	-0.16	-0.76
STP	-0.43	-0.29	-0.73	0.90	-0.31	-0.25	0.28	0.73	0.96	-0.42	-0.85
STI	-0.51	-0.18	-0.58	0.82	-0.40	-0.69	0.22	0.89	0.82	-0.06	-0.60
PSIA	-0.73	-0.36	-0.55	0.84	-0.16	-0.54	0.17	0.79	0.77	-0.01	-0.66
DL	-0.69	-0.34	-0.59	0.87	-0.23	-0.55	0.20	0.82	0.82	-0.06	-0.69
Cluster 2											
Aggregated index	-0.34	0.67	0.04	-0.09	-0.04	0.32	-0.15	0.06	0.59	-0.19	-0.18
STP	-0.07	0.51	0.13	-0.21	0.02	0.25	-0.20	0.06	0.41	-0.15	-0.28
STI	-0.28	0.58	0.10	0.05	-0.20	0.40	-0.21	-0.03	0.66	-0.13	-0.02
PSIA	-0.46	0.43	0.04	0.20	0.02	0.21	-0.18	0.15	0.55	-0.45	-0.13
DL	-0.28	0.77	-0.26	-0.28	0.26	0.05	-0.16	-0.04	0.30	0.06	-0.05
Cluster 3											
Aggregated index	0.16	-0.28	0.59	0.69	0.30	0.55	0.43	0.52	0.82	-0.55	-0.43
STP	0.12	-0.32	0.58	0.69	0.18	0.50	0.33	0.38	0.85	-0.50	-0.41
STI	0.17	-0.11	0.40	0.65	0.13	0.53	0.37	0.44	0.64	-0.53	-0.54
PSIA	0.12	-0.20	0.48	0.74	0.44	0.62	0.5	0.44	0.65	-0.73	-0.58
DL	0.05	-0.14	0.43	0.58	0.31	0.52	0.21	0.29	0.62	-0.42	-0.41
Cluster 4											
Aggregated index	-0.11	-0.32	-0.28	0.68	0.09	0.79	0.19	0.35	0.55	-0.20	-0.02
STP	0.42	-0.74	-0.13	-0.00	0.55	0.26	0.73	0.84	0.84	0.45	0.61
STI	0.11	-0.55	-0.17	0.23	0.27	0.55	0.49	0.67	0.74	0.11	0.33
PSIA	-0.40	0.00	-0.29	0.92	-0.21	0.87	-0.19	-0.03	0.20	-0.53	-0.38
DL	-0.30	-0.07	-0.31	0.83	-0.10	0.87	-0.07	0.05	0.34	-0.44	-0.30
Cluster 5											
Aggregated index	0.08	0.09	0.48	0.72	0.53	0.46	0.25	0.22	0.68	-0.51	-0.59
STP	-0.09	0.36	0.19	0.31	0.09	0.18	0.26	0.05	0.68	-0.12	-0.24
STI	0.19	0.16	0.40	0.52	0.25	0.24	0.30	0.05	0.55	-0.36	-0.43
PSIA	0.17	-0.21	0.50	0.75	0.69	0.59	0.32	0.29	0.45	-0.70	-0.56
DL	0.04	0.03	0.39	0.59	0.54	0.37	0.29	0.18	0.50	-0.52	-0.67

Thus, for the Russian Federation as a whole, almost all coefficients are significant, except for those related to extractive industries. The strongest positive relationship exists between science and the aggregated STD index and its sub-indices. This circumstance is quite predictable. It is clear that science acts as the driving force of scientific and technological development.

Among the sub-indices, the strongest positive relationship with science is shown by the scientific and technological potential, which includes indicators of science funding and the quality of human resources, which also indirectly depends on the former. Thus, the volume of science funding has a significant connection with the level of STD.

Fairly high positive and significant coefficients characterize chemical and petrochemical, as well as metallurgical productions, especially concerning the sub-index of innovation activity performance, which includes indicators characterizing completed innovation projects both in general and in cooperation with other participants. This can be explained by the presence of corporate scientific divisions in large oil and gas corporations. For example, PJSC “NK “Rosneft” has 29 corporate research and design institutes employing over 13.5 thousand people²⁵; the “LUKOIL-Engineering” division collaborates with leading universities within the framework of scientific and engineering support centers²⁶; in Gazprom, LLC “Gazprom VNIIGAZ” is a constituent element of the corporation – the leading scientific center of PJSC “Gazprom”²⁷.

Significant and sufficiently large in magnitude, but negative coefficients are observed for such activities as public administration and military security, as well

as activities in healthcare, especially regarding the performance of innovation activity and the level of digitalization. This is likely related to competition for state funds, as these activities are predominantly funded from the state budget. It can also be assumed that regions with a hypertrophied share of the public sector are, due to bureaucratization, less interested in business activation.

A rather high negative coefficient for Russia as a whole is observed between the sub-index of digitalization level and agricultural activity. This can be explained by the lower population density in rural areas and, consequently, higher costs for infrastructure development.

In Cluster 1, there are not many significant coefficients (see Tab. 3). Here, large significant coefficients are also found for science, chemical production, and information and communication activities, while a significant negative coefficient is noted for healthcare. The explanations are similar to those stated above; it can also be added that many scientific subdivisions of petrochemical enterprises are located in large cities belonging to Cluster 1.

As noted earlier, Cluster 2, from the perspective of GRP structure, is quite heterogeneous. For instance, it includes such diverse regions as the Murmansk Region, where the share of agriculture, forestry, hunting, fish farming and fishing is 11.5%, and metallurgical production is 27%, and the Novgorod Region with almost 22% chemical and petrochemical production and only 1.6% metallurgy. Perhaps for this reason, Cluster 2 shows significant correlation coefficients only for science. The cluster includes old industrial regions of Russia²⁸ with outdated fixed assets. Thus, the degree of fixed assets wear and tear on average

²⁵ Available at: <https://www.rosneft.ru/Development/knpk> (accessed: 27.04.2025).

²⁶ Available at: <https://engineering.lukoil.ru/ru/Activities/CooperationWithUniversities> (accessed: 27.04.2025).

²⁷ Available at: <https://vniigaz.gazprom.ru/about> (accessed: 27.04.2025).

²⁸ See (Sorokina, 2024).

for this cluster was higher than the Russian average. For comparison, this indicator for Russia as a whole was 48% in 2022, while for cluster 2 it was 51%, which is higher than for all other clusters (in Cluster 1 the average wear was 46%, in Cluster 3 – 49%, in Cluster 5 – 47%). Only Cluster 4, concentrating on extractive industries, had higher fixed assets wear – 54%²⁹. The mentioned work (Sorokina, 2024) also points to the insufficient innovativeness of these regions.

Cluster 3, where extractive industries and agriculture are developed, traditionally has significant positive coefficients for science, with the highest values of these coefficients for the first sub-index, which depends on science funding. A close connection is also observed with the share in GRP of such productions as chemical and petrochemical, as well as machine-building. There is a close but negative connection with such activities as public administration and healthcare; possible reasons for this phenomenon were mentioned above.

Cluster 4, oriented toward mineral extraction, shows correlation links for only a small number of variables. Thus, the aggregated index overall correlates only with the share of machine-building production, and the sub-indices of innovation activity performance and digitalization level correlate with the share of chemical production. It should be noted that neither in this cluster nor in Cluster 3, where the share of extraction is also high, is there a correlation between the level of extractive production in GRP (neither positive nor negative). The reason for this may be that in these regions only extraction is carried out, while extraction and processing technologies are researched in regions belonging to other clusters, particularly Cluster 1.

In Cluster 5, there is traditionally a close connection between the aggregated index overall and all its sub-indices and science. A negative dependence between the indices and public administration and healthcare is also traditionally observed. In this cluster, a fairly close dependence has emerged between the combined indicators of food and textile production and the STD indices, which are precisely the specializations of the territories in this cluster.

Conclusion

In conclusion, it must be said that regional analysis is limited by the block of regional data in open access. From the authors' point of view, statistics in this area require improvement, which would contribute to enhancing the quality of decision-making.

It is also necessary to state that at the meso level – the regional level – one can only speak of their contribution to the country's achievement of TS, for which STD is one of the mechanisms.

In accordance with the Strategy for Technological Development, the construction of STD program matrices in regions is envisaged, which requires taking into account the specifics of each region.

To assess the level of STD for each region, an author's aggregated index was calculated. The conducted cluster analysis based on 2022 data for two groups of features – by the GRP structure of regions and by the level of STD – allowed for identifying established clusters and analyzing their overlap.

The study showed that a fairly stable dependence between the economic structure and scientific and technological development can be traced. However, in different clusters, different economic sectors come to the fore. This makes it possible to identify key elements

²⁹ Calculated according to: Regions of Russia. Socio-economic indicators. 2023: Statistical collection. Rosstat. Moscow, 2023. P. 509.

in each type of region, the development of which could give impetus to STD.

The presence of a diversified economic structure has a beneficial effect on STD. On average, regions with a balanced economic structure have a higher STD index.

In all clusters, a dependence is observed between the share of science and the aggregated index and its sub-indices. This is especially true for the sub-index directly or indirectly responsible for science funding.

In almost all clusters, a close negative correlation is observed between the aggregated STD indices and the shares of public administration and healthcare in GRP. The reason for this may be competition for

limited financial resources, since the share of state funding for science is still very high. According to HSE data, state funding accounts for 66.6% of all domestic expenditure on research and development. Furthermore, a large share of public administration leads to bureaucratization, which reduces incentives for technological development.

Thus, an increase in non-state funding for research and development could accelerate scientific and technological development. One can agree with the opinion of colleagues cited above that the development of scientific and educational centers integrating research centers and industrial enterprises could contribute to solving emerging problems in industry.

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LIFE QUALITY AND HUMAN POTENTIAL OF TERRITORIES

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COMPONENT ANALYSIS OF REGIONAL DIFFERENCES IN NATURAL POPULATION GROWTH IN RUSSIA



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

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

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

Introduction

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

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

The objectives are:

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

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

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

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

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

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

Important for developing approaches to the comparative analysis of demographic prospects in a regional context was the monograph “Population Dynamics in the Mediterranean. Demographic Convergence?”. It presents cross-country comparisons within the Mediterranean region (Doignon et al., 2023). Based on a study of demographic parameters in 26 countries, most of which are characterized by a minor influence of migration processes, long-term prospects are defined within the context of the demographic transition. The work of A.V. Brovkova is noteworthy from the perspective of analyzing regional differences using the principal component method. It identifies (according to the author’s words) “key indicators of regional human potential reproduction in Russia at

the present stage” (Brovkova, 2018). Regional analysis of demographic dynamics, considering both natural and migration movements, was also employed in the work of V.O. Esikova (Esikova, 2023), which notes the regional heterogeneity of population movement at all stages of post-Soviet development.

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

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

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

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

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

The methodological aspect of literary review reflected studies that proposed index methods that make it possible to compare various indicators of individual cohorts of the population in demographic dynamics. To study this topic, it was useful to get acquainted with the research methods that are mainly used by geneticists. The use of the Crowe index and the assessment of the nature of population reproduction based on it were considered in the works “Reproductive characteristics and the Crowe index of the rural and urban population of Karachay-Cherkessia” (El’chinov et al., 2016), “Variability of parameters

of natural reproduction and the Crowe index in ethnic groups of Dagestan” (Kurbatova et al., 2012), “Variability of natural reproduction processes in the population of Cheboksary in 1989 and 2019” (Spitsyna, Balinova, 2023).

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

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

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

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

Research methodology

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

The index system looks like this:

$$\frac{k^1 (\sum\{(f_x^1 - m_x^1) * s_x^1\})}{k^0 (\sum\{(f_x^0 - m_x^0) * s_x^0\})} = \frac{\sum\{(f_x^1 - m_x^1) * s_x^1\}}{\sum\{(f_x^0 - m_x^0) * s_x^0\}} * \frac{\sum\{(f_x^0 - m_x^1) * s_x^1\}}{\sum\{(f_x^0 - m_x^0) * s_x^1\}} * \frac{\sum\{(f_x^0 - m_x^0) * s_x^1\}}{\sum\{(f_x^0 - m_x^0) * s_x^0\}}, \quad (1)$$

where:

$k^1 k^1$ and $k^0 k^0$ – total natural growth rates

of the compared populations;

$f_x^1 f_x^1$ and $f_x^0 f_x^0$ – age-related fertility rates of

the compared populations;

$m_x^1 m_x^1$ and $m_x^0 m_x^0$ – age-related mortality

rates (separately for women and men) of the compared populations;

$s_x^1 s_x^1$ and $s_x^0 s_x^0$ – share of the population

of each gender and age group in the total population of the compared populations.

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

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

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

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

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

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

$$\begin{aligned} &k^1 (\sum\{(f_x^1 - m_x^1) * s_x^1\}) - k^0 (\sum\{(f_x^0 - m_x^0) * s_x^0\}) = \\ &= [(\sum\{(f_x^1 - m_x^1) * s_x^1\}) - (\sum\{(f_x^0 - m_x^1) * s_x^1\})] + \\ &+ [(\sum\{(f_x^0 - m_x^1) * s_x^1\}) - (\sum\{(f_x^0 - m_x^0) * s_x^1\})] + \\ &+ [(\sum\{(f_x^0 - m_x^0) * s_x^1\}) - (\sum\{(f_x^0 - m_x^0) * s_x^0\})] \end{aligned} \quad (2).$$

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

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

Research results

The relative natural population decline in Russia increased annually in 2016–2021 and

decreased only in 2022 and 2023 compared to the previous year (Tab. 1).

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

In the republics of Kalmykia and Tatarstan, this is due to the positive influence of all three components: a favorable gender and age structure prevailed in the Republic of

Kalmykia, and in the Republic of Tatarstan, low age-related mortality rates (*Tab. 4*).

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

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

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

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

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

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

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Republic of Buryatia	2.2	1.5	-2.3	3.0
Kamchatka Territory	1.9	1.5	-2.0	2.4
Astrakhan Region	1.6	1.3	-1.2	1.5
Republic of Bashkortostan	0.5	0.1	-0.1	0.5
Krasnoyarsk Region	0.3	0.1	-1.5	1.7
Trans-Baikal Territory	0.3	1.3	-4.4	3.4
Irkutsk Region	0.2	1.4	-2.6	1.4

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

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

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Republic of Adygea	1.7	-0.6	1.0	1.3
Stavropol Territory	1.2	-1.0	0.9	1.3
Moscow Region	1.0	-0.4	0.5	0.9

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

In the Krasnodar Territory, higher age-related fertility rates (by 0.8‰ points) and lower mortality rates (by 0.2‰ points) contributed to a lower natural population decline (by 0.3‰ points) than in Russia as a whole. The gender and age structure,

on the contrary, is less favorable than the national one. In Saint Petersburg, the relative natural population decline is lower (by 1.4‰ points) than in Russia as a whole, only due to lower age-related mortality rates.

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

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

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

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

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

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

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

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

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

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

In five regions, the natural population decline in 2023 was relatively higher than in Russia as a whole, due to lower age-related fertility rates

and higher age-related mortality rates, while the gender and age structure was more favorable than in the country as a whole (*Tab. 9*).

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

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Tomsk Region	-0.2	-1.3	-0.2	1.3
Magadan Region	-0.3	-0.3	-2.8	2.8
Republic of Mari El	-0.9	-0.1	-0.9	0.1
Altai Territory	-3.1	-0.6	-2.6	0.1
Kemerovo Region	-3.1	-1.2	-2.1	0.2

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

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

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

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

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Volgograd Region	-2.5	-1.8	0.3	-1.0
Republic of Mordovia	-3.8	-2.0	0.5	-2.3

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

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

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

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

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

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

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

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

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

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

of its impact on natural population growth is possible only on the basis of comparing actual indicators with standardized ones (eliminating

the influence of the structural factor in territorial and dynamic comparisons) and more specifically using a modified index method.

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

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Kaliningrad Region	-1.0	-1.3	0.0	0.3
Leningrad Region	-2.0	-3.4	1.1	0.3

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

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

Constituent entity	Difference from the all-Russian indicator	Including due to:		
		age-related birth rate	age-related mortality rate	gender and age structure
Republic of Khakassia	-0.1	0.5	-2.2	1.6
Udmurt Republic	-0.4	0.1	-1.0	0.5
Khabarovsk Territory	-0.7	0.3	-2.2	1.2
Perm Territory	-0.8	0.8	-1.8	0.2
Murmansk Region	-0.9	0.2	-2.5	1.4
Komi Republic	-1.2	0.9	-2.3	0.2
Amur Region	-1.4	0.4	-4.1	2.3
Jewish Autonomous Region	-1.7	0.7	-3.7	1.3
Primorye Territory	-1.9	0.2	-2.6	0.5

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

Conclusion

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

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

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

The structural component also made a major positive contribution in most regions

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

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

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

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DEMOGRAPHIC POTENTIAL OF TERRITORIES: ASSESSMENT APPROACHES AND MEASUREMENT EXPERIENCE

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In the context of pronounced regional differentiation of Russia's demographic development, an urgent area of research is the working out of a scientifically based methodological approach to assessing the demographic potential of territories to ensure competent management of their development. The aim of the research is to systematize theoretical and methodological approaches to the study of the demographic potential of territories, to work out and test methods for its assessment at the regional level. The paper considers the approaches to the essence and structure of demographic potential, analyzes the indicators used in Russian and foreign scientific research to study the demographic potential of territories, and systematizes the methods of its assessment. The research shows that the use of several methods allows a comprehensive assessment of its condition and dynamics. An index methodology for assessing the demographic potential of territories is presented, and the calculation of two integral indices is proposed – quantitative and qualitative demographic potential (QuanDPI and QualDPI). At the first stage, a set of indicators was formed for the construction of indices (a priori and a posteriori), at the second stage, their calculation was performed. The principal component method is chosen as the method of convolution of private variables into integral indices. The index methodology was tested in Russia's regions for the time period from 2019 to 2023. The information base was compiled by Rosstat statistics. Based on the calculation results, the leading and outsider regions were identified for each index. The grouping of

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regions by the size of the *QuanDPI* and *QualDPI* made it possible to construct index ratio matrices. The conducted research has confirmed the close relationship between the quantitative and qualitative components of the demographic potential of the territories.

Demographic potential of territories, quantitative and qualitative components, index methodology, grouping, regions of Russia.

Introduction

Demographic potential is an integral component of human potential, therefore, its study serves as a conceptual basis for understanding the nature and drivers of human potential reproduction, as well as developing new mechanisms for its management.

The current stage of Russia's socio-economic development is characterized by a combination of predictable natural demographic challenges (demographic decline, depopulation, and population aging) with new effects for the demographic situation caused by the shock and upheavals of recent years (coronavirus pandemic, special military operation, international sanctions, and changes in the migration policy of the Russian Federation). The uneven spatial development of the country, expressed in the compression and fragmentation of the developed space, creates additional demographic threats, for example, more pronounced depopulation and aging of remote territories due to centripetal migration. These problems hinder the accumulation and disclosure of the demographic and, as a result, the human potential of the country.

The research results confirm that Russian regions differ significantly in the nature of the demographic situation and population reproduction. Thus, O.L. Rybakovsky's grouping of the constituent entities of the Russian Federation according to the relative level of reproduction and its constituent factors showed that depopulation has been observed in most of them throughout the modern history of Russia, namely the

previous 33 years, nevertheless, the regions are noticeably differentiated – from the most demographically disadvantaged to those teetering on the brink of depopulation and natural growth. Natural population growth during this period was observed in only 15 regions (Rybakovsky, 2024). In addition, studies show a significant variation in the RF constituent entities in certain indicators characterizing demographic potential: birth rate (Arkhangelskiy et al., 2023), mortality and life expectancy (Rodionova, Kopnova, 2020; Korolenko, 2020), age structure (Rybakovskii, Fadeeva, 2022), internal and external migration (Matraeva, 2024; Smirnov, 2024). As a result, a differentiated approach should be applied to the development of state demographic policy measures, taking into account the regional specifics of demographic potential.

Scientific research has not yet developed a unified theoretical approach to understanding the essence and structure of demographic potential, as well as a methodological approach to measuring it. Some researchers try to define it and associate it with related concepts, others select indicators for its assessment, and others, using this term only in the titles of their works, continue conducting routine demographic analysis (Rybakovskii, 2023). Thus, the issues of developing and improving the theory and methodology of studying the demographic potential of territories are still relevant, in particular, the development of scientifically sound methods for assessing it to monitor the demographic situation and ensure competent management of territorial development.

The aim of our research is to systematize theoretical and methodological approaches to the study of the demographic potential of territories, to develop and test methods for its assessment at the regional level. In particular, we set the following tasks: to review approaches to the interpretation of the concept of “demographic potential”, its structure and indicators used for analysis; to systematize methodological approaches to assessing the demographic potential of territories, as well as methods for measuring it; to develop own methodology for assessing the demographic potential of territories and to test it in Russia’s regions.

The study is based on two hypotheses:

- 1) a methodology for measuring the demographic potential of territories, taking into account its quantitative and qualitative characteristics, provides a more reliable and complete assessment of the situation compared to approaches based only on quantitative indicators, and allows identifying problems specific to particular regions, carrying out their multidimensional typology, which is important for determining the priorities of demographic policy;
- 2) Russian regions are markedly differentiated in terms of quantitative and qualitative indicators of demographic potential, as well as their ratio.

The scientific novelty of the research lies in the development of a new methodology for assessing the demographic potential of territories, taking into account its quantitative and qualitative components and applicable at the level of the constituent entities of the Russian Federation.

The information base consists of scientific publications on the research topic and Rosstat official statistics.

Theoretical and methodological aspects of the study

The term “demographic potential” appeared in the scientific literature at the end of the 20th

century and found application mainly in the works of researchers from Eastern Europe and Russia (Korolenko, 2021). It is actively used in their works by scientists from Poland (Sojka, 2012; Pastuszka, 2017; Gwiazdzińska-Goraj et al., 2020), Slovakia (Koišová et al., 2021), Serbia (Stojanović et al., 2017), Bulgaria (Mladenov, 2016), Georgia (Sobczyk, Archuadze, 2016). In Russia, S.A. Sukneva (Sukneva, 2010), V.V. Fauser (Fauser, 2014), O.L. Rybakovskii and O.A. Tayunova (Rybakovskii, Tayunova, 2019; Rybakovskii, 2023), N.K. Gabdrakhmanov (Gabdrakhmanov et al., 2014) etc. Demographic potential studies are conducted at different levels: cross-country and national (Sojka, 2012; Pastuszka, 2017), regional (Sukneva, 2010; Trifonova et al., 2010; Kornienko, 2014; Fauser, 2014; Kalugina et al., 2015; Shubat et al., 2019; Dobrokhleb, Sigareva, 2019; Gwiazdzińska-Goraj et al., 2020; Koišová et al., 2021) and municipal (Bessmertnyi et al., 2021; Korolenko, 2021; Gabdrakhmanov et al., 2014; Sobczyk, Archuadze, 2016; Mladenov, 2016; Stojanović et al., 2017).

To understand the essence of the category “demographic potential” and to change approaches to its interpretation, let us focus a little on the development of the demographic potential concept. First of all, the content of the term “demographic potential” has changed from its narrower interpretation as “life potential” (L. Hersh, J. Bourgeois-Pich, E. Filrose), “reproductive potential” (R. Fischer), “growth potential” (P. Vincent), “migration potential” (J. Stewart, J. Zipf), “potential of the settlement field” (O.A. Evteev, S.A. Kovalev) to its modern interpretation – common demographic resources, opportunities and reserves. Each of these categories affects particular resources for the reproduction and maintenance of the population in the territory (vital, reproductive, migration, opportunities for population growth and settlement). In addition, during the development of this scientific

field, the research subject naturally changed: from the study of individual components of demographic potential (number, fertility, mortality, migration, population structure) to its generalized indicators.

Currently, there is still no universal definition of the concept of “demographic potential” in the demographic literature. There are several basic approaches to interpreting it from the perspective of content: as a component of human potential (its basis, a condition for its formation and functioning); as the ability of the population to reproduce; as a generalized characteristic of the demographic situation; as available resources, opportunities, reserves of demographic development. The majority of definitions come down to the population of a given territory and its ability to reproduce (Korolenko, 2021). There are narrow and broad interpretations of this concept: in a narrow sense, it is understood as the potential for population reproduction, including the potential for changes in fertility and mortality, and in a broad sense, the potential for general population movement (population reproduction potential, and migration potential), including possible changes in the number and structure of the population due to fertility, mortality, emigration, and immigration (Rybakovskii, Tayunova, 2019).

As O.L. Rybakovskii and co-authors note, demographic potential is an instrumental and synthetic term, therefore it can combine both all and individual population possibilities of a particular territory. This concept is generalizing, combining the potential in various fields of demography (Rybakovskii, Tayunova, 2019; Rybakovskii, 2023). The scientist conditionally divides it into three components according to its functionality: demographic resources (funds, reserves), and/or demographic opportunities (current and prospective), and/or (additional) demographic reserves (Rybakovskii, 2023):

– *demographic resources* are what is available at a given time, i.e. number and demographic structure of a particular territory and beyond (in the case of migration) – in migration-related territories;

– *demographic opportunities* are the levels of intensity of demographic processes in a territory calculated over a period of time and their expected and anticipated demographic consequences, such as changes in demographic structures;

– *demographic reserves* are prospective possible deviations of the intensity levels of demographic processes in a territory and their expected demographic consequences from “long-term inert” trends under the influence of demographic policy measures, external and internal socio-economic, political and other factors.

At the same time, we can put a different number of components into the concept: in the minimum form – one of three, in the average version – two of three, in the extended version – all three (Rybakovskii, 2023).

Along with the category “demographic potential”, it is also used the concepts of “socio-demographic potential” (Kalugina et al., 2015; Koišova et al., 2021) and “geodemographic potential” (Gabdrakhmanov et al., 2014). The first term, in addition to the demographic component of the potential, considers the social component, which mainly characterizes the level of education, employment and well-being of the population. The term “geodemographic potential” is mainly used as a synonym for the demographic potential of territories.

Our study understands the demographic potential of the territory as a demographic resource, expressed in the characteristics of the population and the components of its dynamics, reproduction and migration, demographic structures and qualitative parameters of the population, which are able to ensure a positive demographic dynamic of the territory. At the

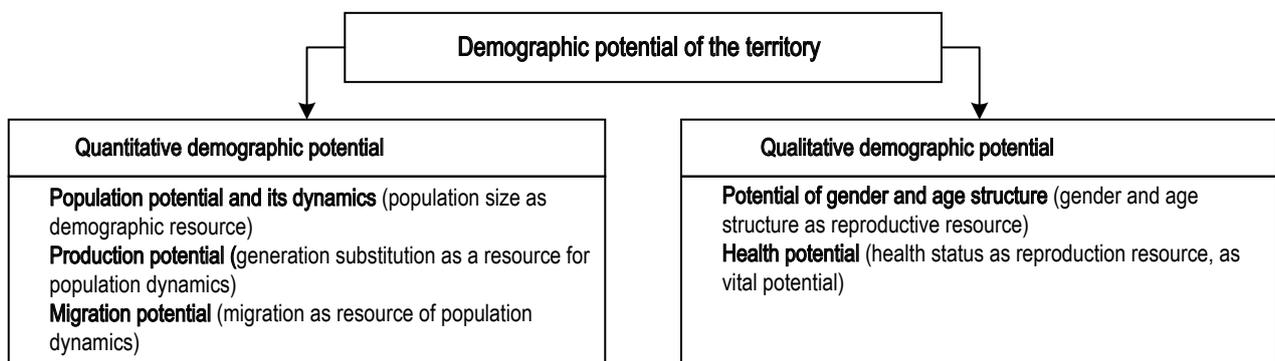
same time, the demographic potential is not limited to a quantitative demographic resource (population size and its distribution over the territory, natural and migration movement), but also reflects the population’s ability to reproduce (generational change as a result of the ratio of fertility and mortality), since its regime directly determines the nature of population dynamics. In turn, the ability to reproduce depends on the age and gender structure and the quality of its health.

Approaches to the structure of demographic potential also vary. For example, O.L. Rybakovskii identifies two main parts – reproductive and migration potentials. Each of them has two components: the first is the potential for changes in the intensity of age-related fertility and the potential for changes in the intensity of age-related mortality, while the second is the potential for changes in the intensity of permanent arrivals and the potential for changes in the intensity of permanent departures (Rybakovskii, 2023). M. Gwiazdzińska-Goraj and colleagues identify four components of quantitative demographic potential: population size, population distribution by territory (density), population structure by age, population structure by gender. They consider the natural and migration movement inseparably from the demographic potential, but as its factors (Gwiazdzińska-Goraj

et al., 2020). S.A. Sukneva equates demographic potential with reproductive potential and designates three components of its formation – population size, demographic structure and demographic behavior (Sukneva, 2010).

A number of researchers¹ (Smirennikova et al., 2018; Shubat et al., 2019) suggest separating its quantitative and qualitative characteristics when studying the demographic potential of territories. However, the approaches to their content differ. In some cases, quantitative parameters are considered as derivatives of population size and its dynamics, while qualitative parameters are considered as indicators of population structure and composition². Others attribute qualitative aspects to population health, education, ethnocultural and religious composition, and demographic attitudes (Smirennikova et al., 2018). Some scientists equate the qualitative parameters of demographic potential with the quality of the population and include the development level of total human capital, which is determined by the state of health, education, culture, and the moral and ethical sphere (Shubat et al., 2019).

Our research identified two components in the structure of demographic potential – quantitative and qualitative (*Fig.*). The quantitative component of demographic



Structure of the demographic potential of the territory

Source: own compilation.

¹ Ryazantsev S.V., Aidrus I.A., Pis'mennaya E.V. (2008). Demographic potential as a basis for the development of the higher education system: Textbook. Moscow: RUDN. 258 p.

² Ibidem. P. 5, 9.

potential (quantitative potential) reflects the quantitative human resource of a territory, the ability to reproduce and maintain its population. Accordingly, it includes the potentials of population size and its dynamics, reproduction and migration. The qualitative component (qualitative demographic potential) represents both the potential of demographic structures

(mainly gender and age) and the potential of public health (as a reproductive resource, the ability to preserve life).

Sinceresearchersidentifydifferentstructural components of demographic potential, as a result, different sets of indicators are used to analyze it (Tab. 1). In some cases, it is considered only from the perspective of population size and

Table 1. Indicators used in Russian and foreign scientific research to analyze demographic potential

Researcher	Indicators of spatial distribution of the population	Population indicator and its dynamics:							Marriage and divorce rates	Indicator of demographic and other structures:					Health indicators	Demographic behavior indicators	Other indicators
		Population size and/or its dynamics	Birth rate	Mortality rate	Natural increase /decrease	Reproduction	Migration growth/decrease	Total growth		Age structure	Gender structure	Marriage and family structure	Ethnic structure	Educational structures			
Simagin Yu.A.	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dobrokhleb V.G., Sigareva E.P.	-	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	+
Kornienko O.S.	-	+	-	-	+	-	+	-	-	-	-	-	-	-	-	-	+
Fauzer V.V.	-	+	+	+	+	+	+	+	-	+	-	-	-	-	-	-	-
Pastuszka S.	-	+	+	-	+	+	+	+	-	+	-	-	-	-	-	-	-
Gwiaździńska-Goraj M. et al.	+	+	-	-	+	-	+	-	-	+	-	-	-	-	-	-	-
Mladenov C.	+	+	+	+	+	-	+	-	-	+	-	-	-	-	-	-	-
Sobczyk A., Archuadze Z.	-	+	+	-	-	+	+	-	-	+	-	-	-	-	-	-	-
Bessmertnyi I.V. and coauthors	-	+	-	-	+	-	+	-	-	+	-	-	-	-	-	-	+
Sojka E.	-	+	+	+	+	+	+	+	-	+	-	-	-	-	+	-	-
Trifonova Z.A. and coauthors	-	+	+	-	-	-	+	-	+	+	-	-	-	-	+	-	-
Yarnykh E.A., Konstantinova A.G.	-	-	+	-	-	+	-	-	-	+	-	-	-	-	+	-	+
Korolenko A.V.	-	+	+	+	+	-	+	+	-	+	-	-	-	-	+	+	-
Stojanović J. et al.	-	+	-	-	+	-	+	-	-	+	-	-	-	+	-	-	+
Kalugina Z.I. and coauthors	-	-	-	+	-	-	+	-	-	+	-	-	-	+	+	-	-
Koišová E. et al.	-	-	+	+	-	+	-	-	-	+	-	-	-	+	-	-	+
Shubat O.M. and coauthors	-	-	+	-	-	+	-	-	-	+	-	-	-	+	+	+	+
Sukneva S.A.	-	+	+	+	+	+	+	-	-	+	+	+	-	-	+	-	-
Gabdrakhmanov N.K. et al.	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	-	+

According to: (Trifonova et al., 2010; Sukneva, 2010; Simagin, 2013; Kornienko, 2014; Fauzer, 2014; Kalugina et al., 2015; Dobrokhleb, Sigareva, 2019; Shubat et al., 2019; Bessmertnyi et al., 2021; Korolenko, 2021; Sojka, 2012; Gabdrakhmanov et al., 2014; Mladenov, 2016; Sobczyk, Archuadze, 2016; Pastuszka, 2017; Stojanović et al., 2017; Gwiaździńska-Goraj et al., 2020; Koišová et al., 2021).

spatial distribution (Simagin, 2013), but more often researchers are not limited to population size alone, analyzing its components dynamics: indicators of natural movement and migration, as well as reproduction characteristics (most often the total fertility rate). In addition to the above, indicators of demographic structures are used in other works: age, gender (or age and gender) (Fauzer, 2014; Mladenov, 2016; Sobczyk, Archuadze, 2016; Pastuszka, 2017; Stojanovich et al., 2017; Gwiazdzińska-Goraj et al., 2020), marital and family (Sukneva, 2010) and non-demographic structures: ethnic (Sukneva, 2010; Gabdrakhmanov et al., 2014), educational (Kalugina et al., 2015; Stojanovich et al., 2017; Shubat et al., 2019; Koišova et al., 2021). Marriage and divorce rates are less commonly used as criteria for assessing demographic potential (Trifonova et al., 2010; Gabdrakhmanov et al., 2014).

A number of studies of the demographic potential of territories rely on an expanded set of indicators, both quantitative: population size, rates and components of its dynamics, and qualitative: demographic and non-demographic structures, health, demographic behavior of the population (Trifonova et al., 2010; Sojka, 2012; Gabdrakhmanov et al., 2014; Yarnykh, Konstantinova, 2017; Korolenko, 2021). In addition, in some studies, in addition to the above indicators, characteristics that go beyond the components of population size and reproduction are used, such as the number of abortions (Dobrokhleb, Sigareva, 2019), the ratio of monetary incomes to the subsistence level (Kornienko, 2014), the share of the economically active population (Stojanovich et al., 2017), the number of employed people (Bessmertny et al., 2021), the quality of life index (Yarnykh, Konstantinova, 2017), the employment rate, as well as long-term unemployment and income (Gabdrakhmanov et al., 2014; Koišova et al., 2021), the

decriminalization of the region (Shubat et al., 2019), the distribution of labor resources by industry, the cost of industrial products per capita, the average monthly nominal wage of employees, the average growth rate of gross wages (Gabdrakhmanov et al., 2014). It seems that such indicators are rather superfluous and more characterize the factors concerning demographic potential or other related potentials, for example, educational.

A number of methodological approaches to assessing the demographic potential of territories have been developed (*Tab. 2*). The main ones include statistical-descriptive and criterion-statistical (indicative), while the auxiliary ones include typological and geospatial. Within the framework of the statistical and descriptive approach, the method of analyzing demographic indicators and their dynamics is most often used, while the point-rating and index methods are used within the framework of the indicative approach. The main disadvantage of the methodology for analyzing demographic indicators and their dynamics is the lack of a generalizing characteristic of demographic potential, the inability to compare territories by its level. The point-rating method partially compensates for this disadvantage by providing an opportunity to compare territories by individual parameters of demographic potential by compiling ratings summarized for each indicator. However, it also does not provide general ideas about the state of the demographic potential of the territory. In addition, its limitation is the lack of weights of the compared indicators (Rybakovskii, 2008). This problem is solved by the index method, which allows combining individual characteristics of demographic potential into one integral indicator. Data aggregation during index construction helps to present relevant information and simplify the analysis of complex and voluminous data (Pavlova et

Table 2. Methodological approaches and methods for assessing the demographic potential of territories

Approach	Method	Essence	Researcher
Main (basic) approaches and methods			
Statistical and descriptive	Analysis of demographic indicators and their dynamics	Analysis of the state and dynamics of individual indicators characterizing demographic potential	S.A. Sukneva, E. Sojka, V.V. Fauzer, J. Stojanović et al., S. Pastuszka, V.G. Dobrokhleb, E.P. Sigareva, A.V. Korolenko
Criterion-statistical (indicative)	Point-rating method (point ratings + ranking)	Ranking of demographic indicators on a 5-point scale. Calculating the average score of demographic potential	O.S. Kornienko, I.V. Bessmertnyi et al., E.V. Smirennikova et al.
	Index method	Calculation of an integral (synthetic) indicator of the demographic potential of territories, consisting of particular demographic indicators	Z.A. Trifonova et al., A. Sobczyk, Z. Archuadze, E.A. Yarnykh, A.G. Konstantinova, M. Gwiaździńska-Goraj et al., E.V. Smirennikova et al.
Auxiliary approaches and methods			
Typological	Grouping (classification)	Distribution of territories according to the value of the indicator (indicators) of demographic potential	Z.A. Trifonova et al., Yu.A. Simagin, O.S. Kornienko, N.K. Gabdrakhmanov et al., M.Gwiaździńska-Goraj et al., E.V. Smirennikova et al.
	Clusterization (cluster analysis)	Identification of clusters of regions (territories) according to indicators of demographic potential	Kalugina Z.I. et al., Koišová E. et al.
	Multidimensional classification (a combination of fuzzy clustering with expert estimates)	Identification of territorial models of the demographic potential of the territories of the RF through fuzzy clustering of the RF regions, subsequent expert assessments of clusters to determine the degree of belonging of regions to a specific cluster	O.M. Shubat et al.
Geospatial	Cartographic method (socio-demographic mapping)	Mapping territories using demographic potential indicators	C. Mladenov, J. Stojanović et al., I.V. Bessmertnyi et al.
According to: (Sukneva, 2010; Trifonova et al., 2010; Simagin, 2013; Fauzer, 2014; Kalugina et al., 2015; Yarnykh, Konstantinova, 2017; Dobrokhleb, Sigareva, 2019; Shubat et al., 2019; Korolenko, 2021; Bessmertnyi et al., 2021; Smirennikova et al., 2021; Sojka, 2012; Gabdrakhmanov et al., 2014; Sobczyk, Archuadze, 2016; Mladenov, 2016; Stojanović et al., 2017; Pastuszka, 2017; Gwiaździńska-Goraj et al., 2020; Koišová et al., 2021).			

al., 2018). At the same time, various methods can be used to construct the index – expert, a priori, multidimensional classification, factor analysis (Frenkel et al., 2015). The main limitation of index methods lies in their methodology itself: they measure exactly what their developers put into them (Pavlova et al., 2018). Their disadvantages also include the problems of determining the composition of particular criteria, correlation of variables, loss of information during convolution, and the

opacity of the development process (Pavlova et al., 2018).

Auxiliary approaches and methods are usually based on the results of the application of the basic ones and complement them. The typological approach in research practice is implemented through the methods of grouping, clustering and multidimensional classification. With their help, objects (territories) can be divided into groups according to the magnitude of individual indicators of demographic

potential or its integral indicator. The main method of applying the geospatial approach is socio-demographic mapping, which helps visualize the territorial differentiation of demographic potential and its individual components.

However, most often researchers do not limit themselves to one method, but use combinations of them, for example: point-rating and grouping (Kornienko, 2014), point-rating and cartographic (Bessmertnyi et al., 2021), index and grouping (Trifonova et al., 2010; Gwiazdzińska-Goraj et al., 2020), point-rating, index, and grouping (Smirennikova et al., 2021), which allows for a more comprehensive and systematic analysis of the state and dynamics of the demographic potential of territories.

Research methodology

The study proposes to use a combination of two methods to assess the demographic potential of territories – the index method and the grouping method. If the first one allows generalizing the demographic potential (quantitative and qualitative) of particular territories (regions), then the second one is to divide the totality of these objects into groups according to its size.

The index methodology was based on an idea of the structure of the demographic potential of territories (see Fig.). We proposed a system of two indices – quantitative (QuanDPI) and qualitative (QualDPI) demographic potential. The process of constructing integral indices was based on the methodological recommendations of S.A. Aivazyan and co-authors in the field of constructing synthetic categories of quality of life (Aivazyan et al., 2006) and included the following stages.

1. Creating a set of indicators for calculating indices:

- determination of the initial (a priori) set of indicators at the theoretical level;

- selection from the a priori set using mathematical and statistical methods of a relatively small number of particular criteria that play a crucial role in the formation of the corresponding integral indicator(s), the so-called a posteriori set.

2. Calculation of integral indices of quantitative and qualitative demographic potential:

- unification (normalization) of scales in which partial and integral indicators are measured;

- choosing a method for convolution of particular criteria and determination of weighting coefficients;

- calculation of integral indices.

In our opinion, it is unnecessary to combine the indices of quantitative and qualitative demographic potential into one integral indicator. In this case, it is more informative to rank the territories by their size, to group them according to the size of each index to compare them further.

The a priori set of indicators was determined based on the prevailing ideas in demographic science about the components of demographic dynamics and generalization of the experience of empirical studies of demographic potential (*Tab. 3*). The set was formed in accordance with the requirements of representativeness, information accessibility and reliability (Aivazyan et al., 2006). The selected indicators, in our opinion, most fully and reliably reflect the analyzed components of demographic potential. To assess the quantitative demographic potential, the main indicators of population size, its location and dynamics (number of permanent population and its rate of change, population density, birth rate, mortality, natural and total growth), population reproduction (depopulation coefficient, net reproduction coefficient, total

Table 3. A priori set of indicators characterizing the quantitative and qualitative demographic potential of territories

Component	Indicator
Quantitative DP	
Population potential and its dynamics	<ol style="list-style-type: none"> 1. Permanent population (people) 2. Population density (people per 1 km²) 3. Total population growth (people) 4. Fertility rate (per million) 5. Mortality rate (ppm) 6. Natural growth/loss ratio (ppm) 7. Population change rate (%)
Population reproduction potential	<ol style="list-style-type: none"> 1. Depopulation coefficient (ratio of deceased to those born) 2. Net reproduction rate (number of girls born to an average of 1 woman throughout their lives and who lived to the age of their mother while maintaining constant fertility and mortality rates) 3. Total fertility rate (number of children born to 1 woman of reproductive age)
Migration potential	<ol style="list-style-type: none"> 1. Migration balance ratio (migration balance per 1,000 people) 2. The coefficient of migration intensity upon arrival (arrivals per 1,000 people) 3. Migration intensity coefficient by departure (departures per 1,000 people) 4. Migration efficiency coefficient (ratio of migration gain/loss to gross migration, %)
Qualitative DP	
Gender and age structure potential	<ol style="list-style-type: none"> 1. Aging index (ratio of the population of 65+ to the population of 0–14 years) 2. Demographic load factor of the population under the working age per working-age population (number of persons under the working age per 1,000 people of working age) 3. Coefficient of demographic burden over the working age per working-age population (number of people over the working age per 1,000 people of working age) 4. Ratio of men to women (number of women per 1000 men) 5. Ratio of men and women in reproductive age (number of women per 1000 men aged 15–49) 6. Share of women of reproductive age 15–49 years (%)
Population health potential	<ul style="list-style-type: none"> Life expectancy (LE) (years) Healthy life expectancy (HLE) (years) Years of life in a state of ill-being (years) Mortality rate from CD (per 100 thousand people) Mortality rate of the population from NCD (HO) (per 100 thousand people) Mortality rate of the population from EC (per 100 thousand people)
Source: own compilation.	

fertility rate), migration (migration balance coefficients, intensity of migration arrival and departure, migration efficiency), whereas to assess the qualitative potential – key indicators of the gender and age structure (aging index, demographic load coefficients for the population younger and older than working age, ratio of the male and female population, including reproductive age, share of women of reproductive age) and public health (life expectancy, including healthy,

years of life in a state of ill health, mortality rates from diseases of the health system blood circulation, neoplasms and external causes). When assessing the qualitative demographic potential, it is important to take into account the structure of mortality due to causes of death. The choice of mortality rates from the listed classes of causes is due to the fact that, first, these are the most common classes of causes in the structure of mortality, and second, they represent larger groups of

nosologies – non-communicable (chronic) diseases and injuries.

The selection of indicators for the a posteriori (reduced) set was based on two requirements: they should directly characterize the integral property; the values of all other (excluded) particular criteria should be accurately restored according to the values of this set of indicators (Aivazyan et al., 2006). First of all, the analysis of the multicollinearity of particular criteria of an a priori set of indicators was carried out. For this purpose, a matrix of values of paired correlation coefficients was calculated, linear regressions were constructed, and the coefficients of determination (R^2) of each

of the partial criteria of the a priori set were analyzed for all other indicators. The need to reduce variables is evidenced by the presence of strong correlations between their pairs, triples, etc., as well as high values of the coefficients of determination (close to 1) (Aivazyan, 2012). Subsequently, the most informative partial criteria were selected among the indicators of the a priori set, i.e., a set of criteria was selected that corresponds to the maximum value of R^2 between the dependent variable in explanatory variables (Aivazyan, 2012). As a result of the manipulations performed, a posteriori set of indicators of the quantitative and qualitative demographic potential of the territories was formed (Tab. 4).

Table 4. A posteriori set of indicators characterizing the quantitative and qualitative demographic potential of territories

Component	Indicator	Variable	Nature of indicator
Quantitative DP index (QuanDPI)			
Population potential and its dynamics	Permanent population	x1	Direct
	Population density	x2	Direct
	Total population growth	x3	Direct
Reproduction potential	Depopulation coefficient (ratio of deceased to those born)	x4	Inverse
Migration potential	Migration efficiency coefficient	x5	Direct
Qualitative DP index (QualDPI)			
Gender and age structure potential	Demographic burden coefficient under the working age per working-age population	X1	Direct
	Ratio of men and women of reproductive age	X2	Direct*
	Share of women of reproductive age 15–49 years old	X3	Direct
Population health potential	HLE	X4	Direct
	Mortality rate from neoplasms	X5	Inverse
	Mortality rate from external causes of death	X6	Inverse
* It was assumed to be direct (rather than non-monotonic), since it demonstrates a strong correlation with reproduction indicators, in particular with the net reproduction coefficient ($r = 0.92$). Source: own compilation.			

The unification of the scales of measurement of partial and integral indicators was carried out by the method of linear scaling (minimax), which involves transformation to a dimensionless form (from 0 to 1), depending on the nature of their relationship with the integral index: in the case of a monotonously increasing dependence (the higher the value of x , the greater the demographic potential) – according to the formula of the direct indicator (1), in the case of monotonically decreasing dependence (the higher the value of x , the lower the demographic potential) – according to the formula of the inverse indicator (2).

$$\tilde{x} = \frac{x - x_{min}}{x_{max} - x_{min}}, \quad (1)$$

$$\tilde{x} = 1 - \frac{x - x_{min}}{x_{max} - x_{min}}, \quad (2)$$

where:

\tilde{x} – unified value of a private index;

x – estimated indicator;

x_{max} and x_{min} – maximum and minimum values of the indicator.

The principal component method was chosen as the method of convolution of private variables into an integral index. Each integral indicator was constructed in the form of a modified main component using the covariance matrix $\hat{\Sigma}_{\tilde{x}}(j)$ (Aivazyan, 2012). For all variables included in the groups of private criteria of the QuanDPI and QualDPI, estimates of the covariance matrix were determined and its eigenvalues were found: $((\lambda_1(j) \geq \lambda_2(j) \geq \dots \lambda_{p_j}(j)))$. The equation was solved (Aivazyan, 2012):

$$|\hat{\Sigma}_{\tilde{x}}(j) - \lambda_1 I_{p_j}| = 0, \quad (3)$$

where I_{p_j} – unit matrix of dimension p_j .

Next, the eigenvector of the largest eigenvalue of the covariance matrix was calculated ($C_1(j) = (c_{11}, c_{12}, \dots, c_{p_j})$); a system of equations was solved (Aivazyan, 2012):

$$(\hat{\Sigma}_{\tilde{x}}(j) - \lambda_1 I_{p_j})C_1(j) = 0, \quad (4)$$

where the vector $C_1(j) = (c_{11}, c_{12}, \dots, c_{p_j})$ has unit length $\sum_{q=1}^{p_j} c_{1q}^2 = 1$.

Then the first main component of the partial criteria was constructed and the integral index (QuanDPI and QualDPI) was constructed according to the formula (Aivazyan, 2012):

$$\hat{y}_i(j) = \sum_{s=1}^{p_j} \tilde{c}_{1s}(j) \times \tilde{x}_i^{(s)}(j), \quad (5)$$

where $\tilde{c}_{1s} = c_{1s} / \sum_{m=1}^{p_j} c_{1m}$ (the case when all components have the same sign).

At the same time, the share of the explained variance of the first main component, which is based on particular indicators, should be more than 55% (Aivazyan, 2012). The QuanDPI and QualDPI indices take values from 0 (the most unfavorable parameters of demographic potential) to 1 (the most favorable parameters of demographic potential).

All calculations were performed using the R language in the R-Studio program. The observation period was 5 years (2019–2023). Statistical data from Rosstat were used for calculations, in particular, data from the statistical bulletins “Population size and Migration of the Russian Federation”³, “Natural Movement of the Population of the Russian Federation”⁴, and the Unified Interdepartmental Information and Statistical System⁵.

³ Population and migration of the Russian Federation. Rosstat. Available at: <https://rosstat.gov.ru/folder/11110/document/13283>

⁴ Natural movement of the population of the Russian Federation. Rosstat. Available at: <https://rosstat.gov.ru/folder/11110/document/13269>

⁵ Unified interdepartmental information and statistical system. Available at: <https://www.fedstat.ru>

**Table 5. Weights of the private variables
QuanDPI and QualDPI**

Unif. variable	2019	2020	2021	2022	2023
QuanDPI					
\tilde{x}_1	0.14	0.01	0.04	0.13	0.13
\tilde{x}_2	0.13	0.03	0.05	0.14	0.11
\tilde{x}_3	0.21	0.27	0.25	0.21	0.23
\tilde{x}_4	0.38	0.64	0.60	0.42	0.35
\tilde{x}_5	0.13	0.05	0.06	0.10	0.17
QualDPI					
\tilde{X}_1	0.16	0.19	0.17	0.14	0.18
\tilde{X}_2	0.11	0.13	0.12	0.13	0.12
\tilde{X}_3	0.20	0.23	0.21	0.21	0.27
\tilde{X}_4	0.11	0.06	0.11	0.10	0.06
\tilde{X}_5	0.28	0.28	0.26	0.28	0.29
\tilde{X}_6	0.13	0.11	0.12	0.14	0.07

Source: own compilation with the use of R language.

Table 5 presents the calculated weights of the unified variables for each index. This technique assumes the calculation of weighting coefficients for each year of observation, which imposes certain restrictions on the analysis of the dynamics of integral indices, but does not affect the correctness of interregional comparisons within one year. However, despite the change in values during the period under review, the ranks of the main weights are generally stable over time.

After calculating the integral indices of quantitative and qualitative demographic potential for each year of observation, the regions were grouped according to their size⁶, and then a matrix of their conjugation was constructed by comparing the groups of regions according to the level of the QuanDPI and QualDPI indices.

⁶ The entire set of RF constituent entities was divided into three groups: regions with low, average and high levels of indicators. The group of regions with an average level of indicators included subjects whose values were in the "arithmetic mean ± standard deviation" range, and subjects whose values were below or above this range were included in the groups of regions with low and high levels, respectively.

Results

The calculations performed showed that the top ten leaders in terms of the index of quantitative demographic potential throughout the period under review were the metropolitan regions (Moscow and the Moscow Region, Saint Petersburg), the regions of the North Caucasus (Ingushetia, Chechnya, Dagestan), the Tyumen Region, Khanty-Mansi and Yamal-Nenets autonomous areas, and the republics of Sakha (Yakutia) and Tyva (Tab. 6). In some years, the Nenets Autonomous Area (2020, 2022, 2023), Sevastopol (2020) and the Krasnodar Territory (2023) were in the group of leaders.

The subjects of the Central Federal District (Vladimir, Tambov, Tver, Smolensk regions) and the Penza Region were among the outsider regions every year. The Pskov, Tula, Orel, Saratov and Ivanovo regions also belonged

to this category during most of the years of observation. In some years, the group of anti-leaders included the Novgorod (2019 and 2021), Ryazan (2021 and 2022), Kurgan (2023) regions and the Republic of Mordovia (2020 and 2022).

In the Vologda Region, the QualDPI increased over the period 2019–2023, as a result, the region rose from 58th to 53rd place in the ranking of Russian regions in terms of its size.

Table 6. Regions – leaders and outsiders in the QuanDPI in 2019–2023

2019		2020		2021		2022		2023	
Region	QuanDPI	Region	QuanDPI	Region	QuanDPI	Region	QuanDPI	Region	QuanDPI
Leading regions (top ten)									
Moscow	0.749	Chechen Republic	0.778	Republic of Ingushetia	0.760	Moscow	0.849	Moscow	0.801
Moscow Region	0.574	Republic of Ingushetia	0.776	Chechen Republic	0.751	Republic of Ingushetia	0.567	Moscow Region	0.675
Republic of Ingushetia	0.559	Republic of Dagestan	0.755	Republic of Dagestan	0.732	Republic of Dagestan	0.562	KhMAA	0.627
Chechen Republic	0.507	Republic of Tyva	0.686	YaNAA	0.681	Chechen Republic	0.535	Republic of Ingushetia	0.609
Saint Petersburg	0.504	YaNAA	0.684	Republic of Tyva	0.672	Moscow Region	0.527	Republic of Dagestan	0.545
Republic of Dagestan	0.502	KhMAA	0.673	KhMAA	0.664	KhMAA	0.519	Saint Petersburg	0.498
KhMAA	0.447	Republic of Sakha (Yakutia)	0.645	Republic of Sakha (Yakutia)	0.623	Saint Petersburg	0.494	Nenets AA	0.493
Tyumen Region	0.435	Sevastopol	0.622	Moscow Region	0.606	YaNAA	0.485	Krasnodar Territory	0.490
YaNAA	0.434	Nenets AA	0.599	Kabardino-Balkarian Republic	0.585	Republic of Tyva	0.466	Chechen Republic	0.489
Krasnodar Territory	0.428	Kabardino-Balkarian Republic	0.574	Nenets AA	0.566	Republic of Sakha (Yakutia)	0.444	YaNAA	0.481
Outsider regions (the last ten)									
Vladimir Region	0.134	Ivanovo Region	0.116	Novgorod Region	0.146	Penza Region	0.140	Kurgan Region	0.184
Novgorod Region	0.129	Pskov Region	0.114	Penza Region	0.142	Ryazan Region	0.128	Penza Region	0.180
Penza Region	0.116	Tver Region	0.109	Orel Region	0.139	Republic of Mordovia	0.126	Ivanovo Region	0.178
Tver Region	0.115	Saratov Region	0.107	Tver Region	0.134	Tver Region	0.122	Saratov Region	0.177
Orel Region	0.115	Republic of Mordovia	0.099	Tambov Region	0.124	Orel Region	0.116	Tver Region	0.163
Pskov Region	0.113	Penza Region	0.093	Saratov Region	0.116	Tambov Region	0.114	Pskov Region	0.148
Ivanovo Region	0.107	Tambov Region	0.088	Ryazan Region	0.097	Pskov Region	0.112	Tambov Region	0.147
Smolensk Region	0.096	Smolensk Region	0.074	Vladimir Region	0.097	Tula Region	0.108	Orel Region	0.135
Tambov Region	0.096	Vladimir Region	0.063	Tula Region	0.090	Vladimir Region	0.101	Smolensk Region	0.120
Tula Region	0.077	Tula Region	0.035	Smolensk Region	0.088	Smolensk Region	0.070	Vladimir Region	0.109
Vologda Region									
<i>58th place</i>	<i>0.197</i>	<i>47th place</i>	<i>0.301</i>	<i>52nd place</i>	<i>0.306</i>	<i>54th place</i>	<i>0.242</i>	<i>53rd place</i>	<i>0.251</i>

Source: own compilation.

The top 10 regions of Russia with the highest index of qualitative demographic potential during 2019–2023 included the republics of the North Caucasus (Chechnya, Ingushetia, Dagestan, Karachay-Cherkessia and Kabardino-Balkaria), the Republics of Sakha and Tuva, the Yamal-Nenets and Khanty-Mansi Autonomous areas (Tab. 7), most of which were also leaders in terms of the size of the QuanDPI. In 2023, the Tyumen Region was ranked among the top ten leaders in terms of the QualDPI.

The Pskov, Kurgan, Vladimir and Tula regions were consistently included in the number of outsider regions during the observation period. The Tver, Smolensk, Bryansk, Arkhangelsk, Kirov, and Ulyanovsk regions were also often among the representatives of this category of regions. At the same time, some of the listed constituent entities of the Russian Federation were in a similar group according to the QuanDPI index (Vladimir, Pskov, Smolensk, Tula, and Tver regions). In some years, the top

Table 7. Regions – leaders and outsiders in terms of QualDP in 2019–2023

2019		2020		2021		2022		2023	
Region	QualDPI	Region	QualDPI	Region	QualDPI	Region	QualDPI	Region	QualDPI
Leading regions (top ten)									
Republic of Ingushetia	0.915	Republic of Ingushetia	0.903	Republic of Ingushetia	0.920	Republic of Ingushetia	0.930	Republic of Ingushetia	0.851
Chechen Republic	0.818	Chechen Republic	0.769	Chechen Republic	0.776	Chechen Republic	0.771	Chechen Republic	0.764
Republic of Dagestan	0.737	Republic of Dagestan	0.728	Republic of Dagestan	0.756	Republic of Dagestan	0.767	Republic of Tyva	0.749
YaNAA	0.580	Republic of Tyva	0.620	Republic of Tyva	0.626	YaNAA	0.628	Republic of Dagestan	0.744
Republic of Tyva	0.578	YaNAA	0.608	YaNAA	0.615	Karachayevo-Circassian Republic	0.603	YaNAA	0.688
KhMAA	0.555	Karachayevo-Circassian Republic	0.586	Karachayevo-Circassian Republic	0.595	Kabardino-Balkarian Republic	0.597	Karachayevo-Circassian Republic	0.639
Kabardino-Balkarian Republic	0.537	KhMAA	0.568	Kabardino-Balkarian Republic	0.574	KhMAA	0.596	Kabardino-Balkarian Republic	0.626
Republic of Sakha (Yakutia)	0.535	Republic of Sakha (Yakutia)	0.564	KhMAA	0.569	Republic of Tyva	0.570	KhMAA	0.619
Karachayevo-Circassian Republic	0.532	Kabardino-Balkarian Republic	0.557	Republic of North Ossetia – Alania	0.529	Republic of Sakha (Yakutia)	0.538	Republic of Sakha (Yakutia)	0.592
Republic of North Ossetia – Alania	0.504	Republic of North Ossetia – Alania	0.507	Republic of Sakha (Yakutia)	0.526	Republic of North Ossetia – Alania	0.522	Tyumen Region	0.577
Outsider regions (the last ten)									
Jewish Autonomous Region	0.233	Sakhalin Region	0.253	Ulyanovsk Region	0.274	Ulyanovsk Region	0.263	Kostroma Region	0.271
Bryansk Region	0.233	Arkhangelsk Region	0.248	Kursk Region	0.273	Smolensk Region	0.260	Vladimir Region	0.263
Sevastopol	0.233	Smolensk Region	0.248	Arkhangelsk Region	0.272	Tver Region	0.259	Ulyanovsk Region	0.259
Smolensk Region	0.227	Vladimir Region	0.246	Vladimir Region	0.271	Tula Region	0.257	Arkhangelsk Region	0.253
Sakhalin Region	0.224	Kirov Region	0.246	Smolensk Region	0.264	Amur Region	0.257	Tver Region	0.250
Vladimir Region	0.220	Bryansk Region	0.242	Tver Region	0.259	Arkhangelsk Region	0.256	Kirov Region	0.246
Tula Region	0.216	Tver Region	0.235	Kurgan Region	0.253	Vladimir Region	0.256	Tula Region	0.245
Tver Region	0.209	Kurgan Region	0.226	Bryansk Region	0.250	Kirov Region	0.252	Kaluga Region	0.243
Kurgan Region	0.195	Tula Region	0.192	Tula Region	0.222	Kurgan Region	0.203	Kurgan Region	0.219
Pskov Region	0.145	Pskov Region	0.152	Pskov Region	0.185	Pskov Region	0.164	Pskov Region	0.207
Vologda Region									
58th place	0.292	56th place	0.320	38th place	0.361	43rd place	0.365	57th place	0.358

Source: own compilation.

ten anti-leaders were the Jewish Autonomous Region (2019) and Sevastopol (2019), the Sakhalin (2019–2020), Amur (2022), and Kostroma (2023) regions.

The Vologda Region's position in terms of the QualDPI fluctuated noticeably: if in 2019 the region ranked 56th place, by 2021, it had improved its position, rising to 38th place, but since 2022 the region began declining again, moving to 57th place by 2023. Nevertheless, the index of qualitative demographic potential in the region increased from 0.292 to 0.358.

To compare the position of the regions according to the QuanDPI and QualDPI indices, the regions were grouped according to the size of each of them, and then the index conjugation matrices were constructed. As a result, 7 variants were identified out of nine groups (possible

combinations of the ratio of the QuanDPI and QualDPI) (Tables 8, 9). The group of regions with an average level of indices of quantitative and qualitative demographic potential turned out to be the most numerous (59 regions each in 2019 and 2023). In 2019 and 2023, 7 and 6 regions, respectively, were included in the number of subjects with high QuanDPI and QualDPI values, mainly the Chechen Republic, the republics of Ingushetia, Dagestan, Sakha (Yakutia), the Khanty-Mansi and Yamal-Nenets Autonomous areas. There were 3 regions in the group of subjects with low levels of both indices in both 2019 and 2023 (Tver and Pskov regions, Tula Region in 2019 and Vladimir Region in 2023).

Other Russian regions have demonstrated some mismatch in the levels of demographic potential indices: high QuanDPI and average

Table 8. Matrix of Russian regions by the ratio of QuanDPI and QualDPI, 2019

		Quantitative DP index (QuanDPI)		
		High (above 0.391)	Average (from 0.143 to 0.391)	Low (below 0.143)
Qualitative DP index (QualDPI)	High (above 0.477)	(7) Republic of Ingushetia, Chechen Republic, Republics of Dagestan, Tuva, Sakha (Yakutia), Khanty-Mansi Autonomous Area, Yamal-Nenets Autonomous Area	(3) Kabardino-Balkarian, Karachayevo-Circassian republics, Republic of North Ossetia – Alania	–
	Average (from 0.220 to 0.477)	(5) Moscow, Saint Petersburg, Moscow, Tyumen regions, Krasnodar Territory	(59) Republics of Altai, Tatarstan, Buryatia, Adygea, Kalmykia, Bashkortostan, Crimea, Mari El, Khakassia, Udmurtia; Chuvash, Komi republics, republics of Karelia, Mordovia; Nenets Autonomous Area, Chukotka Autonomous Area, Altai, Krasnoyarsk, Kamchatka, Trans-Baikal, Stavropol, Perm, Primorye, Khabarovsk territories; Novosibirsk, Kaliningrad, Tomsk, Sverdlovsk, Leningrad, Sakhalin, Irkutsk, Samara, Rostov, Chelyabinsk, Orenburg, Astrakhan, Belgorod, Magadan, Amur, Murmansk, Voronezh, Nizhny Novgorod, Omsk, Vologda, Arkhangelsk, Lipetsk, Yaroslavl, Kemerovo, Kostroma, Volgograd, Ulyanovsk, Kaluga, Kursk, Kirov, Ryazan, Saratov, Bryansk regions; Jewish Autonomous Region, Sevastopol	(7) Vladimir, Novgorod, Penza, Orel, Ivanovo, Smolensk, Tambov regions
	Low (below 0.220)	–	(1) Kurgan Region	(3) Tver, Pskov, Tula regions

Source: own compilation.

QualDPI (5 regions in 2019 and 6 regions in 2023), average QuanDPI and high QualDPI (3 regions each in 2019 and 2023), low QuanDPI and average QualDPI (7 regions in 2019 and 6 regions in 2023), average QuanDPI and low QualDPI (1 region in 2019 and 2 regions in 2023). Nevertheless, regions with polar index levels (high QuanDPI and low QualDPI and vice versa) have not been identified, which may indicate a pronounced mutual conditionality of quantitative and qualitative demographic potential. Indeed, correlation analysis shows that there is a strong direct relationship between the QuanDPI and the QualDPI: the correlation coefficients were: in 2019 – 0.72, in 2020 and 2021 – 0.8, in 2022 – 0.74, in 2023 – 0.70.

Conclusion

Thus, despite the variety of approaches to determining the essence of demographic potential, highlighting its components and indicators for analysis, it is possible to identify their similar features:

- demographic potential is most often considered as the available demographic resource of a territory;
- quantitative and qualitative characteristics should be distinguished when studying it; the main indicators for analyzing demographic potential are indicators of population size and its dynamics, reproduction, migration, gender and age structure, and some other qualitative indicators, such as population health.

Table 9. Matrix of Russian regions by the ratio of QuanDPI and QualDPI, 2023

		Quantitative DP index (QuanDPI)		
		High (above 0.442)	Average (from 0.183 to 0.442)	Low (below 0.183)
Qualitative DP index (QualDPI)	High (above 0.541)	(6) Republics of Ingushetia, Dagestan, Chechen Republic, Republic of Sakha (Yakutia), Yamal-Nenets Autonomous Area, Khanty-Mansi AA	(3) Kabardino-Balkarian Republic, Republics of Tyva, Karachayevo-Circassian Republic	–
	Average (from 0.282 to 0.541)	(6) Moscow, Saint Petersburg, Nenets Autonomous Area, Krasnodar Territory, Moscow, Tyumen regions	(59) Republics of Kalmykia, Tatarstan, Adygea, Altai, Buryatia, Bashkortostan, North Ossetia – Alania, Khakassia, Mari El, Crimea, Udmurtia, Komi, Chuvash republics, republics of Karelia, Mordovia, Chukotka Autonomous Area, Khabarovsk, Perm, Kamchatka, Stavropol, Krasnoyarsk, Primorye, Trans-Baikal, Altai territories, Leningrad, Novosibirsk, Kaliningrad, Chelyabinsk, Astrakhan, Rostov, Sverdlovsk, Murmansk, Sakhalin, Kaluga, Magadan, Irkutsk, Samara, Amur, Orenburg, Vologda, Tomsk, Voronezh, Yaroslavl, Kursk, Omsk, Ulyanovsk, Volgograd, Kirov, Arkhangelsk, Nizhny Novgorod, Kostroma, Kemerovo, Novgorod, Lipetsk, Bryansk, Belgorod, Ryazan regions, Jewish autonomous Region, Sevastopol	(6) Penza, Ivanovo, Saratov, Tambov, Orel, Smolensk regions
	Low (below 0.282)	–	(2) Tula, Kurgan regions	(3) Tver, Pskov, Vladimir regions

Source: own compilation.

Several methodological approaches have been formed to measure the demographic potential of territories – basic (statistical-descriptive, criterion-statistical) and auxiliary (typological and geospatial). Each of them uses its own methods, but several methods can be used to comprehensively assess its condition and dynamics.

Our study proposes to use a combination of two methods – the index method and the grouping method. The developed methodology for calculating integral indices of quantitative and qualitative demographic potential has several advantages: it takes into account the structure of demographic potential; it is based on available statistical information; calculation procedures are carried out using proven econometric methods that eliminate problems of multicollinearity and duplication of data; it is convenient to use and interpret the results. Its combination with the grouping method makes it possible not only to assess the differences between territories in terms of the size of the indices, but also to compare them in terms of the level and ratio of the indices.

The testing of the index methodology in the RF constituent entities allowed drawing a number of conclusions. During 2019–2023, the filling of the groups of leaders and outsiders in terms of the size of the QuanDPI and QualDPI was relatively stable. Among the leaders in the index of quantitative demographic potential, Moscow and Saint Petersburg, the Moscow Region, the Chechen Republic, the Republics of Dagestan and Ingushetia, Sakha and Tuva, the Tyumen Region, the Khanty-Mansi and Yamal-Nenets Autonomous areas, while the Vladimir, Tambov, Tver, Smolensk, Penza, Pskov, Tula, Orel, Saratov and Ivanovo regions are among the outsiders. It is noteworthy that the composition of the ten regions with the maximum and minimum values of the index of qualitative demographic potential largely repeats that of the QuanDPI: the top leaders traditionally include the Chechen Republic, the republics

of Ingushetia, Dagestan, Sakha and Tuva, the Karachayevo-Circassian and Kabardino-Balkarian republics, the Yamal-Nenets and Khanty-Mansi autonomous areas, while the outsiders – the Pskov, Kurgan, Vladimir, Tula, Tver, Smolensk, Bryansk, Arkhangelsk, Kirov and Ulyanovsk regions. A comparison of the groups of regions by the value of the QuanDPI and QualDPI allowed concluding that the indices are clearly consistent with each other: the majority of constituent entities of the Russian Federation (59 regions in 2019 and 2023, respectively) have average values, while some regions are characterized by high values (7 and 6 regions in 2019 and 2023, respectively) and, conversely, low (3 regions in 2019 and 2023, respectively) values. In other regions, there is some misalignment of the indices, however, no combination of opposite levels of the QuanDPI and QualDPI (high and low) was found in any constituent entity of the Russian Federation. Their consistency is also evidenced by the high correlation coefficients between the indices, which may indicate a close relationship between the quantitative and qualitative components of demographic potential, both due to their interdependence (the number of people determines its quality or, conversely, quality determines quantity) and the commonality of their determinants (time factor, level of socio-economic development of the region, quality of life, demographic policy, etc.).

The conducted research contributes to the development of the methodology for assessing demographic potential at the regional level in Russia. The developed methodology serves as a tool for identifying problems of preserving demographic potential, and the results of its testing serve as a scientifically sound basis for policy in the field of territorial development management. The index methodology can form the basis for monitoring the demographic situation in Russian regions and assessing the effectiveness of demographic policy in them.

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ASSESSING THE RELATIONSHIP BETWEEN ECONOMIC GROWTH IN RUSSIAN REGIONS AND ENVIRONMENTAL POLLUTION



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In the context of the turbulence of the global economy and geopolitics, the task of ensuring accelerated economic growth of the regions by increasing the efficiency of using internal potential: natural resources, human resources, scientific and technological, etc. is strategically important for the Russian Federation. However, the solution to this problem, as noted by scientists and public administration practitioners, must necessarily take into account the environmental aspects of territorial development, current and future anthropogenic impact on the environment. Underestimation of these aspects can lead to irreversible consequences in the field of climate change, degradation of natural resources, deterioration of public health and reduction of the total economic potential of territories. The aim of the study is to assess the impact of environmental pollution on the economic growth of Russian regions. To achieve it, we used general scientific methods (generalization, analysis, synthesis) and methods of spatial econometrics (construction of multiple

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regression models with spatial lags, calculation of local spatial autocorrelation indices). As a result, we found that, in general, in Russia's regions, an increase in the gross regional product is accompanied, on the one hand, by an increase in emissions of pollutants into the atmosphere from stationary sources and the number of passenger vehicles, and, on the other, by a decrease in discharges of contaminated wastewater into surface water bodies. The paper substantiates the clustering of regions in the country's space according to the level of per capita GRP and the most significant indicator of environmental pollution affecting it – emissions of pollutants into the atmospheric air. The paper proposes the directions of reducing emissions of such substances into the atmosphere. The results of the work contribute to the substantiation of the relationship between environmental factors and the economic growth of Russian regions and can be used by researchers in conducting research on similar topics, government authorities in the development of strategic documents and specific projects for the development of territories.

Region, economic growth, gross regional product, environmental pollution, ecology, spatial econometrics, emissions of pollutants into the atmosphere.

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Introduction

The modern global agenda, based on the sustainable development concept¹, dictates the need to promote the economic and social spheres, taking into account the environmental component. This is clearly recognized not only by the scientific community (Zamyatina, 2021; Baraboshkina, Kudryavtseva, 2023; Bobylev et al., 2025, etc.), but also by representatives of state authorities and top officials of the country. For instance, according to Presidential Decree 309, dated 05/07/2024, one of the seven national development goals of the Russian Federation for the period up to 2030 and for the future up to 2036 is environmental well-being. In addition, environmental aspects related to reducing anthropogenic impact on nature are reflected in the vast majority of strategic planning documents at the federal level, including “non-core” ones, i.e. not directly related to solving environmental

problems. For example, in the National Security Strategy of the Russian Federation, approved by Presidential Decree 400, dated 05/07/2024, environmental safety and rational use of natural resources are declared as a strategic national priority, the implementation of which, among other things, will contribute to the protection of the national interests of the country. In the Spatial Development Strategy of the Russian Federation for the period up to 2030 with a forecast up to 2036, approved by Government Resolution 4146-r, dated 12/28/2024, the main tasks of spatial development include the formation of territories of ecological well-being through the implementation of measures to preserve and restore the natural environment, ensuring the quality of the environment necessary for a comfortable and safe human life, as well as the sustainable development of the economy.

¹ According to the definition of the International Commission on Environment and Development of the United Nations, sustainable development is a development that meets the needs of the present, but does not jeopardize the ability of future generations to meet their own needs. Source: Bobylev S.N. (Ed.). (2025). *Fundamentals of Sustainable Development Economics*. Moscow: Faculty of Economics, Lomonosov Moscow State University. 312 p. Available at: <https://books.econ.msu.ru/economics-of-sustainable-development/sect01/chap02/2.1>

However, despite the above, issues concerning the directions and scales of the relationship between environmental pollution indicators and economic growth of territories at various levels of the hierarchy remain controversial and poorly understood.

The aim of our study is to assess the impact of environmental pollution on the economic growth of Russian regions.

Achieving the goal involves solving two interrelated tasks:

- to propose a methodological approach to assessing the impact of environmental pollution on regional economic growth;
- to test the proposed approach and, based on it, assess the impact of environmental pollution on economic growth.

As part of these tasks, we are planning to test the research hypothesis that environmental pollution in the region affects economic growth not only in the region itself, but also in other Russia's regions.

Theoretical aspects of the research

The issues of identifying and assessing the relationship between economic growth and environmental pollution are controversial in the global scientific community. An analysis of the scientific literature allows dividing research on this issue into two large groups:

1) works devoted to the analysis of the impact of the level of economic growth on the ecological situation of territories at different levels of the hierarchy (countries, macro-regions and regions, local territories – urban municipalities, rural settlements, etc.);

2) works devoted to the analysis of the impact of environmental pollution indicators on the economic growth of territories at different levels of the hierarchy.

The studies of the first group are the most numerous. One of them is the work (Kilinc-Ata, Likhachev, 2022), which examines the relationship between carbon emissions and

economic development factors such as economic growth, energy consumption, population, trade openness and financial development for the period 1990–2020 in relation to the Russian Federation. The key research method was the construction of a distributed lag autoregression model. Based on the results of its application, the authors concluded that to achieve zero carbon emissions by 2060, as part of the implementation of the climate policy of the Russian Federation, it is necessary to actively develop and apply environmentally friendly energy technologies, including on the basis of state support.

No less interesting is the work (Druzhinin et al., 2020), which reveals the reasons for the transformation of the relationship between economic and environmental indicators, examines the impact of changes in environmental legislation and other external shocks on environmental and economic processes in the Russian Federation and the European Union using the example of the air environment through the use of a variety of methods, including econometric modeling.

The work of V. Ivanova is devoted to the empirical assessment of the dependence of the level of environmental pollution on the level of GRP per capita in Russian regions, taking into account the features of their mutual spatial location through the use of tools of spatial econometrics, in particular, the calculation of the spatial autocorrelation of Moran (Ivanova, 2019).

The environmental consequences of the development of large industrial cities in resource-rich regions of Russia are discussed in the article (Pyzhev et al., 2021). Using the example of Krasnoyarsk, the authors show that during the implementation of resource megaprojects in the 20th century, the city became an important economic center of the Siberian macro-region. But the downside of this success has been environmental problems, primarily air pollution, which has become one of the main elements of the regional public agenda in recent years.

Some aspects of the influence of economic factors on environmental development and environmental pollution are described in the works of researchers from Omsk State Agrarian University (Golova, Gapon, 2022; Golova, Baranova, 2022), Samara National Research University and Perm State National Research University (Rostov, Cherepanova, 2020), as well as other scientific and educational organizations in the country. Foreign works on similar subjects include (Economou, Halkos, 2023; Kulasinghe, Wijerathna, 2023; Chen, Tang, 2024).

Special attention should be paid to works that analyze the impact of various social, economic, and technological factors on the environment using special models such as IPAT, ImPACT, and STIRPAT. The IPAT model, developed back in 1971, is based on a multiplicative identity, according to which the environmental impact is equal to the product of population per capita and the intensity of emissions, depending on the technology used. Subsequently, other models were developed based on it, in particular the ImPACT model, which takes into account energy and carbon intensity factors. However, like IPAT, it could not be verified in terms of fulfilling statistical hypotheses. To remove this limitation, the STIRPAT model has been developed, which conceptually corresponds to IPAT, but is based on the use of regression analysis methodology. A detailed description of the IPAT, ImPACT, and STIRPAT models is described in the articles (Grigoryev et al., 2020; Mariev et al., 2021; York et al., 2003).

Among the works of the second group, a study (Porfir'ev et al., 2025) stands out which proposed a method for quantitative economic assessment of the consequences associated with permafrost degradation, floods, for economic facilities in the field of fuel and energy complex, agriculture and

forestry. In the article (Kurbatskiy, Shakleina, 2022), based on spatial econometric models based on materials from the regions of Russia and the United States for the period 2004–2018. The existence of a spatial correlation in the level of pollutant emissions in the studied territories has been proved, and the hypothesis that the dependence of emissions on economic growth in Russian regions has the form of an inverted U-shaped curve has been confirmed. Among foreign works on the impact of environmental indicators on the economic growth of territories, one can single out, for example, an article (Acheampong, Opoku, 2023), in which materials from 140 countries for the period 1980–2021 revealed the retarding effect of environmental degradation on economic growth.

However, there are few works in which the above approaches are organically combined. Among them is a study by the staff of the Karelian Research Centre of the RAS (Druzhinin, Shkiperova, 2014), in which two problems were studied using statistical analysis and economic and mathematical modeling methods: the economic development impact on the environment and the impact of climate change on the development of certain economic sectors. As a result, it has been revealed that a significant part of Russian regions, in terms of the main indicators of environmental stress, is far from the maximum position on the Kuznets ecological curve², and potential economic growth in them may be accompanied by increased environmental degradation. This type of work abroad includes a study (Yan et al., 2022), which analyzes the nonlinear mechanism of the relationship between environmental pollution and economic growth in China using econometric modeling (construction of the MS-VAR autoregressive model).

² According to the Kuznets curve, with an increase in GDP (or GRP, when considering not the national, but the regional level) per capita, the volume of pollution per capita first increases and then decreases. That is, the connection has a U-shape.

Thus, we can conclude that the problem of the mutual influence of economic growth indicators and environmental pollution is in the focus of attention of Russian and foreign scientists. At the same time, the issues of the influence of economic factors on the state of the environment are more studied than the influence of environmental factors on economic growth. This creates a field for additional research. In addition, it is important to note that in the framework of such work, the

most proven and proven method is econometric modeling.

Materials and methods

The information base of the study consists of Rosstat data on the volume of gross regional product as a result of economic growth, as well as on individual indicators of environmental pollution and economic development of 83 constituent entities of the Russian Federation⁵ for the period 2014–2022. *Table 1* describes the variables used in the study.

Table 1. Indicators used in the study

no	Indicator name, unit of measurement	Designation
Endogenous variable		
1	Gross regional product (GRP), rubles per capita	GRP
Exogenous variables of interest		
2	Emissions of pollutants into the atmospheric air from stationary sources, tons per capita	air_person
3	Discharge of polluted wastewater into surface water bodies, m3 per capita	water_person
4	Number of passenger cars owned by citizens, units per capita	pascar_person
5	Number of organizations using electronic data exchange, % of the total number of surveyed organizations	business
Exogenous control variables		
6	Length of paved public roads, km per 1,000 people	road_person
7	Availability of fixed assets at the end of the year at full book value for the full range of organizations, thousand rubles per capita	fixAs_person
8	Level of innovation activity of organizations, % of the total number of surveyed organizations	innov

Note. When selecting exogenous variables, the presence of complete (without omissions) series of Rosstat statistical data in the territorial (by region) and temporal (by years from 2014 to 2022) sections was taken into account, which allows forming a balanced panel for regression analysis. Taking this aspect into account, from the limited set of environmental pollution indicators observed by Rosstat, the following were selected as variables of interest: 1) emissions of pollutants into the atmospheric air coming from stationary sources and discharges of polluted wastewater into surface water bodies as key indicators directly characterizing environmental damage and environmental pollution from the economic activities of the population; 2) number of passenger cars owned by citizens is one of the key indicators characterizing environmental damage from human activity (in the Russian Federation, the predominant number of cars have a gasoline engine, which during operation emits carbon dioxide and carbon monoxide, nitrogen and carbon oxides, etc. substances that contribute to the formation of smog, enhance the greenhouse effect, etc.); 3) number of organizations that have used electronic data exchange as one of the indicators, the growth of which, unlike those mentioned above, characterizes the reduction of environmental harm from economic activity (electronic exchange reduces the need for organizations for paper, printing and postal services, etc.). The choice of control variables designed to prevent a shift in coefficients for variables of interest is based on theoretical foundations and the results of previously conducted domestic research. Thus, in the Cobb–Douglas production function, which is used in When analyzing the regional economy, the indicator of the value of fixed assets is used as the “capital” factor (Suvorov et al., 2020). The influence of indicators of road transport infrastructure on GRP is justified, for example, in (Patrakova, 2025), and the level of innovation activity in (Shalaeva, 2022). The indicators of per capita GRP and fixed assets were included in the model in a logarithmic form, since they are monetary (expressed in monetary units). The reasons for the changes in the indicators used in modeling were not taken into account in this study (modification of the statistical accounting methodology in the period 2014–2022, changes in the range of observed or reporting enterprises, the introduction of new environmentally friendly technologies in certain regions of the country, etc.); they are the topic of future research. According to: Rosstat data (collection “Regions of Russia. Socio-economic indicators” and its appendices. Available at: <https://rosstat.gov.ru/folder/210/document/13204>).

⁵ Due to the lack of statistical data, information on the Donetsk People’s Republic, Lugansk People’s Republic, Zaporozhye and Kherson regions was not taken into account in the calculations.

The methodological approach to identifying and assessing the relationship between environmental pollution and economic growth in Russian regions is based on the construction of multiple regression models with spatial lags⁴.

At the first stage, the basic descriptive statistics of the indicators selected for the study are analyzed. Multicollinearity between exogenous variables is checked, and variables with a strong relationship are excluded from further analysis, i.e. the correlation coefficient exceeds 0.7.

At the second stage, a multiple regression model is built on panel data. Taking into account the information given in Table 1, it has the following form:

$$\begin{aligned} \ln GRP_{it} = & \beta_0 + \beta_1 \times air_{person_{it}} + \\ & + \beta_2 \times water_{person_{it}} + \beta_3 \times pascar_{person_{it}} + \\ & + \beta_4 \times business_{it} + \beta_5 \times road_{person_{it}} + \beta_6 \times infixAs_{person_{it}} + \beta_7 \times innov_{it} + \varepsilon_{it}, \end{aligned} \quad (1)$$

where:

GRP_{it} – GRP of i -th region in year t , rubles per capita;

$air_{person_{it}}$ – emissions of pollutants into the atmospheric air from stationary sources in i -th region in year t , tons per capita;

$water_{person_{it}}$ – discharge of polluted wastewater into surface water bodies in i -th region in year t , cubic meters per capita;

$pascar_{person_{it}}$ – number of passenger cars owned by citizens of i -th region in year t , units per capita;

$business_{it}$ – number of organizations using electronic data exchange in i -th region in year t , % of the total number of surveyed organizations;

$road_{person_{it}}$ – length of paved public roads in i -th region in year t , kilometers per 1,000 people of the population;

$fixAs_{person_{it}}$ – availability of fixed assets at the end of the year at full book value for the full range of organizations in i -th region in year t , thousand rubles per capita;

$innov_{it}$ – level of innovation activity of organizations in i -th region in year t , % of the total number of surveyed organizations;

ε_{it} – accidental mistake;

β – regression coefficients.

It is important that the indicators selected for the analysis, namely the fact that none of them were unchanged during 2014–2022, allow building panel data models with both fixed and random effects (conditionally, if the first assumes that individual differences between regions are constants, then in the second they are random variables). At the same time, the choice of the best model among the constructed ones is based on a comparison of the Akaike and Schwartz information criteria.

Results and discussion

Descriptive statistics show that most of the variables selected for modeling have an uneven distribution, since the coefficient of variation in them exceeds 0.33 or 33% (Tab. 2). However, due to the importance of the indicators for the study, as well as the need

⁴ In the most general sense, the spatial lag reflects the influence of the values of variables in neighboring spatial units (in this study, the RF regions) on the value of variables in the spatial unit under consideration. The simulation can take into account lag with a dependent variable (in this case, the model is called SAR), with unobservable variables/errors (SEM), with dependent variables and error (SAC), with dependent and independent variables simultaneously (SDM). The model, which includes all types of spatial interaction, has the abbreviation GSP.

to include in the model all regions of Russia for which statistics are available, it was decided continue working with the existing data set⁵.

As part of the study of the selected indicators for multicollinearity, we found that all exogenous variables are characterized by weak and moderate correlation dependence (since the correlation coefficient is less than 0.7; *Tab. 3*), which allows them to be used for modeling.

It is worth noting that the highest degree of correlation among the analyzed seven indicators (correlation coefficient 0.6) was found between emissions of pollutants into the atmosphere from stationary sources and the availability of fixed assets. With a certain

degree of conditionality, this suggests that the key sources of atmospheric pollution in Russian regions are fixed assets, represented mainly by industrial enterprises, factories, and plants with an insufficiently high level of implementation of environmental-saving technologies.

Thus, all variables as a whole can be used to build a regression model of the impact of environmental pollution indicators on the gross regional product.

Within the framework of this study, 8 model specifications for panel data with fixed and random effects were constructed. *Table 4* presents their statistics and evaluation results. At the same time, a comparison of the Akaike and Schwartz information criteria made it

Table 2. Descriptive statistics of variables

Variable	Average value	Minimum	Maximum	Variation
GRP	671316.25	78009.30	11786365.00	1.60
air_person	0.16	0.00	2.40	1.84
water_person	83.05	0.24	542.81	0.85
pascar_person	0.32	0.04	0.61	0.23
business	58.89	24.5	91.1	0.15
road_person	9.38	0.51	28.69	0.47
fixAs_person	2101.18	23.79	36122.43	1.77
innov	9.93	0.18	33.76	0.54

Source: own compilation.

Table 3. Correlation matrix of exogenous variables

Variable	road_person	air_person	water_person	business	pascar_person	innov	ln FixAs_person
road_person	1	-0.082	-0.134	0.022	0.123	-0.113	-0.086
air_person		1	0.090	-0.129	0.057	-0.135	0.556
water_person			1	0.134	0.146	-0.051	0.140
business				1	0.105	0.215	-0.040
pascar_person					1	0.142	0.370
innov						1	0.029
ln FixAs_person							1

Source: own compilation.

⁵ Otherwise, the possibility of excluding from the analysis those regions that produce “emissions” in certain indicators, such as the Nenets and Yamal-Nenets autonomous areas, whose per capita GRP is several times higher than the national average, would be considered.

possible to identify SAC as the best model with fixed effects, in which these criteria are minimal.

The data regarding the SAC model allows drawing the following conclusions.

1. The rho⁶ spatial autocorrelation coefficient is statistically significant and positive, i.e. in the studied regions of the Russian Federation, the per capita GRP of each

particular region is influenced not only by its “nearest neighbors”, but also by more remote regions⁷ (Demidova, Timofeeva, 2021).

2. The lambda⁸ coefficient is also statistically significant, which confirms the need to take spatial effects into account (Dubovik, Dmitriev, 2025).

Table 5 shows more detailed descriptive statistics of the SAC model.

Table 4. Results of evaluation of panel data models with random and fixed effects

Indicator	Specification of models							
	With random effects				With fixed effects			
	SAR	SEM	SDM	GSP	SEM	SAR	SAC	SDM
Spatial autocorrelation coefficients								
Spatial								
rho	0.747***		0.687***			0.751***	0.879***	0.693***
lambda		0.919***		0.920***	1.022***		-0.651***	
phi				1.316***				
Variance								
lgt_theta	-2.532***		-2.508***					
sigma2_e	0.006***	0.006***	0.006***		0.005***	0.005***	0.004***	0.005***
ln_phi		3.841***						
sigma_mu				0.354***				
sigma_e				0.076***				
Akaike (AIC) and Schwartz (BIC) Information Criteria								
AIC	-1196	-995,4	-1224	-1022	-1451	-1745	-1834	-1770
BIC	-1145	-944,4	-1140	-965,9	-1410	-1703	-1787	-1695
Note: *** p-value < 0,01; ** p-value < 0,05; * p-value < 0,1. Dependent variable – I_GRP.								
Source: own compilation.								

Table 5. Regression estimates and spatial effects of the SAC model

Variable	Regression coefficient (β)	Direct effect (LR_Direct)	Indirect effect (LR_Indirect)	Total effect (LR_Total)
air_person	0.191***	0.282 ***	1.318***	1.600***
water_person	-0.000***	-0.001***	-0.003***	-0.003***
pascar_person	0.359***	0.537***	2.488***	3.025***
business	-0.000	-0.000	-0.001	-0.001
road_person	0.005	0.007	0.030	0.036
I_FixAs_person	0.051***	0.074***	0.342***	0.416***
Innov	0.000	0.000	0.001	0.001
Note: *** p-value < 0,01; ** p-value < 0,05; * p-value < 0,1.				
Source: own compilation.				

⁶ The coefficient before the spatial lag of the endogenous variable.

⁷ Demidova O.A. (2023). NAG Seminar “Assessment of the impact of macro shocks on socio-economic processes in Russian regions”. Higher School of Economics. Available at: <https://economics.hse.ru/mirror/pubs/share/824652359.pdf>

⁸ Coefficient of spatial error autocorrelation.

An analysis of the data content in Table 5 allows drawing the following key conclusions regarding the impact of environmental pollution indicators on the gross regional product.

1. Emissions of pollutants into the atmospheric air from stationary sources are statistically significant within the framework of the model. With their increase, there is an increase in the per capita GRP of the region of these stationary sources. At the same time, they have a significant impact on the GRP of neighboring regions, and the effect is 4.67 times greater (0.282 versus 1.318).

The increase in GRP associated with an increase in emissions into the atmosphere from stationary sources is explained by an increase in the number of enterprises, most of which in the Russian Federation are manufacturing and extractive industries, or by an increase in utilization or capacity building of existing enterprises (an indirect sign of both the first and second options is an increase in pollutant emissions).

2. The rate of discharge of polluted wastewater into surface water bodies also turned out to be statistically significant. However, with its increase in the conditional *i*th region, there is a decrease in the per capita GRP of both this region and other regions of Russia. At the same time, the effect on other regions is 3.00 times higher than the effect on the first region (-0.001 versus -0.003).

The negative effect in this case is most likely due to a decrease in production volumes in agriculture, fishing and fish farming and other sectors of the economy as a result of such actions, as well as a deterioration in the quality of life, which is an important link in the GRP formation.

3. The number of passenger vehicles owned by citizens is also a significant factor for the region and increases its per capita GRP, while at the same time significantly affecting the

GRP of neighboring regions (the effect is 4.63 times greater: 0.537 versus 2.488). At the same time, it is worth noting that it is the presence of motor vehicles that has the greatest positive impact on the GRP of each individual region of the country, and on the GRP of all other surrounding regions, as evidenced by the values of direct and indirect effects.

The increase in GRP as a result of an increase in the number of personal vehicles is due to the fact that the production of machinery requires the development of a large number of related industries (spare parts and components, the production of fuels and lubricants and the extraction of resources for their creation, etc.), services (insurance, etc.).

Thus, with an increase in emissions of pollutants into the atmosphere and the number of passenger vehicles in the conditional *i*th region of Russia, there is a positive GRP trend not only in this region, but also in other regions; with an increase in discharges into water, on the contrary, a negative GRP trend. The direct and statistically significant link between the increase in emissions of pollutants into the atmosphere from stationary sources and GRP, which indicates a low level of greening of production in the country, a high share of extractive and manufacturing industries in its economy, should attract the greatest attention of scientists, public administration practitioners, and the public. As noted by the Candidate of Sciences (Economics) A.R. Batchaev, industrial enterprises engaged in the production of chemical and metallurgical products, coke and petroleum products, rubber and plastic products, electricity, and enterprises producing oil and gas cause the greatest damage to nature⁹. This is confirmed by official statistical data: for example, on average in 2020–2022, oil and natural gas production accounted for 14.5% of total emissions of pollutants into the atmosphere substances (*Tab. 6*).

⁹ Industry vs ecology? HSE. Available at: <https://spb.hse.ru/news/113729456.html>

Table 6. Emissions of air pollutants from stationary sources by economic activity type in Russia

Economic activity type	2020		2021		2022		On average in 2020–2022	
	thousand tons	% of the total volume	thousand tons	% of the total volume	thousand tons	% of the total volume	thousand tons	% of the total volume
Agriculture, forestry, hunting, fishing and fish farming	421.8	2.5	448.1	2.6	400.9	2.3	423.6	2.5
Mining	6754.8	39.8	6968.1	40.5	7235.0	42.1	6986.0	40.8
including coal mining	1379.1	8.1	1511.6	8.8	1434.6	8.4	1441.8	8.4
oil and natural gas production	2343.1	13.8	2599.3	15.1	2477.0	14.4	2473.1	14.5
mining of metal ores	2385.7	14.1	2129.2	12.4	2300.8	13.4	2271.9	13.3
extraction of other minerals	164.9	1.0	156.1	0.9	180.0	1.0	167.0	1.0
provision of services in the field of mining	482.1	2.8	572.0	3.3	842.6	4.9	632.2	3.7
Manufacturing industries	3900.5	23.0	3679.5	21.4	3606.7	21.0	3728.9	21.8
including food production	259.4	1.5	147.5	0.9	189.4	1.1	198.8	1.2
wood processing and manufacture of wood and cork products, except furniture, manufacture of straw products and materials for weaving	128.2	0.8	139.0	0.8	144.0	0.8	137.1	0.8
production of paper and paper products	75.8	0.4	71.4	0.4	72.0	0.4	73.1	0.4
production of coke and petroleum products	666.4	3.9	667.2	3.9	650.6	3.8	661.4	3.9
production of chemicals and chemical products	432.9	2.6	448.1	2.6	417.6	2.4	432.9	2.5
production of other non-metallic mineral products	425.9	2.5	469.2	2.7	538.4	3.1	477.8	2.8
metallurgical production	1499.6	8.8	1399.9	8.1	1282.2	7.5	1393.9	8.1
production of finished metal products, except machinery and equipment	37.8	0.2	40.1	0.2	37.2	0.2	38.4	0.2
manufacture of computers, electronic and optical products	40.1	0.2	32.2	0.2	32.2	0.2	34.8	0.2
manufacture of motor vehicles, trailers and semi-trailers	22.0	0.1	22.3	0.1	16.9	0.1	20.4	0.1
manufacture of other vehicles and equipment	34.5	0.2	43.4	0.3	52.4	0.3	43.4	0.3
Provision of electric energy, gas and steam; air conditioning	2890.9	17.1	3061.3	17.8	3114.1	18.1	3022.1	17.7
Water supply; sanitation, waste collection and disposal, pollution control activities	728.4	4.3	749.6	4.4	848.1	4.9	775.4	4.5
including water intake, purification and distribution	36.7	0.2	46.9	0.3	51.4	0.3	45.0	0.3
wastewater collection and treatment	66.7	0.4	77.2	0.4	90.3	0.5	78.1	0.5
collection, processing and disposal of waste; processing of secondary raw materials	623.1	3.7	623.7	3.6	703.2	4.1	650.0	3.8
provision of pollution control and other waste management services	1.8	0.0	1.9	0.0	3.2	0.0	2.3	0.0
Transportation and storage	1604.7	9.5	1675.6	9.7	1365.3	7.9	1548.5	9.1

According to: Rosstat data (appendix to the collection "Environmental Protection in Russia. 2024". Available at: <https://rosstat.gov.ru/folder/210/document/13209>).

However, at the same time, enterprises of these types of economic activities create the bulk of GRP. This is confirmed, in particular, by the results of calculating the spatial autocorrelation index¹⁰. *Figures 1, 2* show cartograms of the distribution of 83 regions of Russia by cluster of the Moran scattering diagram in terms of per capita GRP and atmospheric emissions from stationary sources for 2022. It is clearly seen that the cartograms largely coincide. This is especially true for the extractive regions of the North and Siberia, and the Far East, in whose economic structure a significant share is occupied by the extractive and manufacturing industries, which have a significant negative impact on the environment.

The above determines the relevance and importance of reducing emissions of pollutants into the atmosphere from stationary sources while maintaining the pace of economic development. To solve this problem, it seems advisable to implement the following measures and directions with the cooperation of government authorities at the federal, regional and local levels, business, the scientific and educational community, the public and other interested parties.

1. Critical analysis, generalization and replication of advanced Russian and foreign experience in greening the industrial sector, especially in the manufacturing and extractive industries.



Figure 1. Cartogram of Russian regions by Moran's index clusters in terms of per capita GRP in 2022.

Note. Here and in Fig. 2, the fill colors have the following designations:

	Cluster HH (regions have relatively high values of the analyzed indicator and are surrounded by the same regions)
	Cluster HL (regions have relatively high values of the analyzed indicator, but are surrounded by regions with relatively low values)
	LH cluster (regions have relatively low values of the analyzed indicator, but are surrounded by regions with relatively high values)
	LL cluster (regions have relatively low values of the analyzed indicator and are surrounded by the same regions)

Source: own compilation.

¹⁰ The spatial autocorrelation index is calculated using a matrix of inverse distances across highways.



Figure 2. Cartogram of Russian regions by Moran's index clusters in terms of emissions of pollutants into the atmosphere from stationary sources in 2022

Source: own compilation.

Here we can highlight the experience of Nornickel in implementing the sulfur program starting in 2023, aimed at achieving sulfur capture rates at the level of world best practices at the Norilsk and Kola production sites and the complete elimination of emissions from the Kola Mining and Metallurgical Company¹¹. The essence of the program is to create a new production site for the production of sulfuric acid from gases with a high sulfur dioxide content coming from the smelter of the Nadezhdinsky Plant. According to the conclusion of Rosprirodnadzor, all points of the Action Plan for achieving emission quotas by Nornickel have been fulfilled, and the effectiveness of gas purification has been confirmed (more than 99%). At the same time, the total amount of reduction in pollutant

emissions in 2024 exceeded the established target values (fact – 386.5 thousand tons, plan – 377.6 thousand tons)¹².

It is also useful the experience of EVRAZ West-Siberian Metal Plant in building a structurally unique sulfur and gas purification complex, which will potentially reduce sulfur dioxide emissions into the atmosphere by 70%¹³, at an agglomeration plant in Novokuznetsk.

No less interesting is the experience of RUSAL's development and implementation of the Ecological Soderberg technology, which made it possible to almost completely eliminate fluoride and benzopyrene emissions during aluminum production at the Krasnoyarsk Aluminum Plant¹⁴. The technology is an improved version of the traditional Soderbergh technology.

¹¹ The sulfur program. Available at: <https://nornickel.ru/sustainability/projects/sulphur/>

¹² Nornickel has confirmed the effectiveness of the Sulfur Program in Norilsk. Available at: <https://nornickel.ru/news-and-media/press-releases-and-news/nornikel-podtverdil-effektivnost-raboty-sernoy-programmy-v-norilске>

¹³ Eiffel Tower in Siberia: a unique earthquake-resistant structure is being built for a factory in Novokuznetsk. Available at: <https://наука.рф/news/eyfeleva-bashnya-v-sibiri-unikalnyu-seysmostoykuyu-konstruktsiyu-stroyat-dlya-fabriki-v-novokuznets>; In Kuzbass, the Eiffel Tower was completed at EVRAZ ZSMK. Available at: <https://evrazsteel.ru/publication/news/eyfelevu-bashnyu-na-evraz-zsmk-dostroili>

¹⁴ Ecological Soderberg is a unique development of RUSAL. Available at: <https://mnr-air.ru/tpost/637vxtoxn1-ekologicheskii-soderberg-unikalnaya-razr>

However, special attention should be paid to the best available technologies, the incentives for the introduction of which have significantly weakened after the introduction of laxative environmental solutions for businesses in response to the Covid-19 pandemic and increased external sanctions pressure (Burmatova, 2023).

2. Expanding the list of cities participating in the federal Clean Air project¹⁵, aimed at phasing down emissions of dangerous pollutants into the atmosphere through the implementation of comprehensive emission reduction plans; updating summary calculations of air pollution in the participating cities of the project; state support for the modernization of enterprises and laboratories of the Centers for Laboratory Analysis and Technical Measurements of Rosprirodnadzor, modernization and installation monitoring posts of the Russian Hydrometeorological Service; development of the laboratory control system of Rosprirodnadzor; implementation of environmental forecasting, modeling, analytics and artificial intelligence.

Initially, starting in 2018, the project was implemented in 12 cities that are industrial centers: Bratsk, where 30% of the country's aluminum is produced, Lipetsk and Magnitogorsk, specializing in ferrous metallurgy, Novokuznetsk, a metallurgical and coal mining center, etc. In 2023, 29 more cities joined them, mainly from the regions of Siberia and the Far East (Barnaul, Kemerovo, Minusinsk, Yuzhno-Sakhalinsk, etc.), bringing the total number of participating cities to 41. Two more cities, Salavat and Sterlitamak,

have begun implementing measures to reduce emissions under four-party agreements between government and business representatives. However, together these 43 cities make up only 3.8% of the total number in the country, which seems to be extremely insufficient.

In this regard, it seems relevant to expand the list of project participants by including not only industrial centers, but also cities that are important transport and logistics hubs, the cores of large and major urban agglomerations, as well as cities, urban-type towns and villages that are significant centers of agricultural production, etc.

3. Expanding the range of activities implemented within the framework of the federal Clean Air project. For instance, with regard to stationary sources, the possibility of providing grant support (on the terms of co-financing by interested enterprises) to researchers, scientists, designers, engineers for research, development and technological work aimed at reducing emissions into the atmosphere, as well as activities to introduce modern systems for automatic control of pollutants emissions of Russian production facilities.

With regard to non-stationary sources in million-plus cities, the cores of large and major urban agglomerations, the development of infrastructure for electric vehicles seems promising, which can potentially reduce the amount of pollutants emitted from personal vehicles, as well as the creation of a system of state financial or organizational support for owners of such vehicles. The construction of new and modernization, restoration of existing

¹⁵ In 2018–2024, it was a part of the national Ecology project, and since 2025, it was a part of the national Environmental Well-being project (the Federal Clean Air Project. Available at: <https://mnr-air.ru/about>; Ministry of Natural Resources and Ecology of the Russian Federation. Available at: https://www.mnr.gov.ru/activity/environmental_well-being/federalnyy-proekt-chistyy-vozdukh).

trolleybus networks in cities, and expansion of the fleet of electric buses are relevant. The implementation of these measures should be carried out using methods and tools that do not duplicate the methods and tools of other government programs and projects (for example, the program “Development of the transport system”), or have a different geography.

Conclusion

The study assessed the relationship between GRP indicators and environmental pollution based on materials from 83 regions of Russia for the period 2014–2022. For this purpose, we propose a methodological approach, which is based on the tools of spatial econometrics,

in particular, regression modeling based on panel data. Its application made it possible to identify the relationship between the level of per capita GRP (the resulting indicator of economic growth) of each region of Russia and environmental pollution indicators not only in it, but also in other regions, which indicates the need for state regulation of the environmental sphere mainly at the national rather than regional level.

The research results can be used by representatives of public authorities in improving the policy of territorial (spatial) development, and by researchers in overcoming the problems of the relationship between economic growth and the state of the environment.

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MONITORING OF CHANGES: MAIN TRENDS

THE ECONOMY OF NORTHWEST RUSSIA IN SEPTEMBER 2025: INDUSTRIAL STAGNATION AND INCREASED SOCIAL SPENDING

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Vologda Research Center of the Russian Academy of Sciences (VoIRC 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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According to data from Rosstat, the Russian economy demonstrated a GDP growth of 1.1% in Q2 2025 (compared to 4.1% a year earlier; *Fig. 1*). The Russian Ministry of Economic Development estimated Russia's GDP growth in January–September 2025 at 1.0%¹, with the same figure forecast for the entire year.

✔ The dynamics of the Business Confidence Index reflect worsening business expectations: in October 2025, the index for the mining and manufacturing industries dropped to -2.2 and -1.1, respectively (a year earlier, their values were positive at 0.9 and 6.7, respectively; *Fig. 2*). Business assessments of the expected change in output for these industries over the next 3 months also showed a decline.

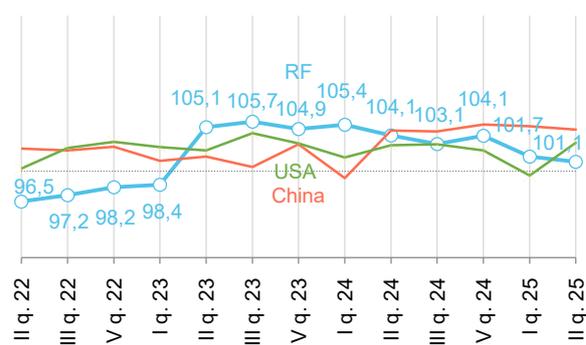


Figure 1. Gross domestic product (GDP) production dynamics, % to the corresponding quarter of the previous year

For citation: Sidorov M.A., Lukin E.V. (2025). The economy of Northwest Russia in September 2025: Industrial stagnation and increased social spending. *Problems of Territory's Development*, 29(6), 210–223. DOI: 10.15838/ptd.2025.6.140.12

¹ Unless otherwise specified, the period January–September 2025 is compared to January–September 2024 throughout the text.

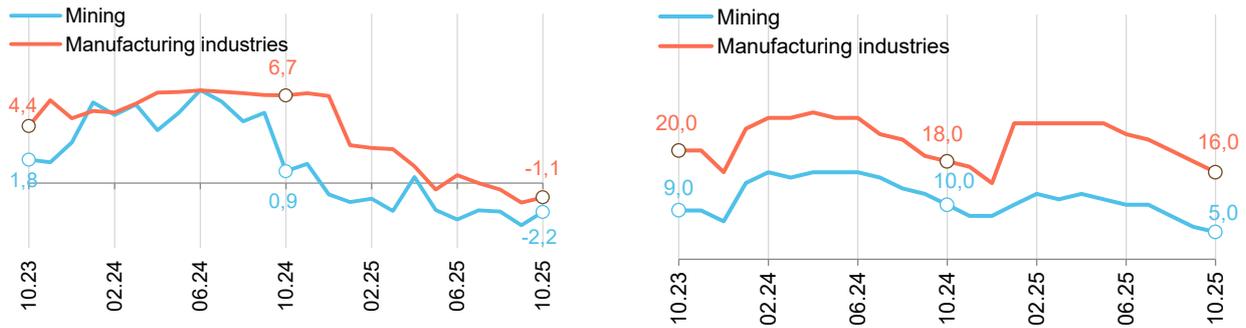


Figure 2. Business Confidence Index (left) and assessment of the expected change in demand for organizations' products over the next 3 months (right), %

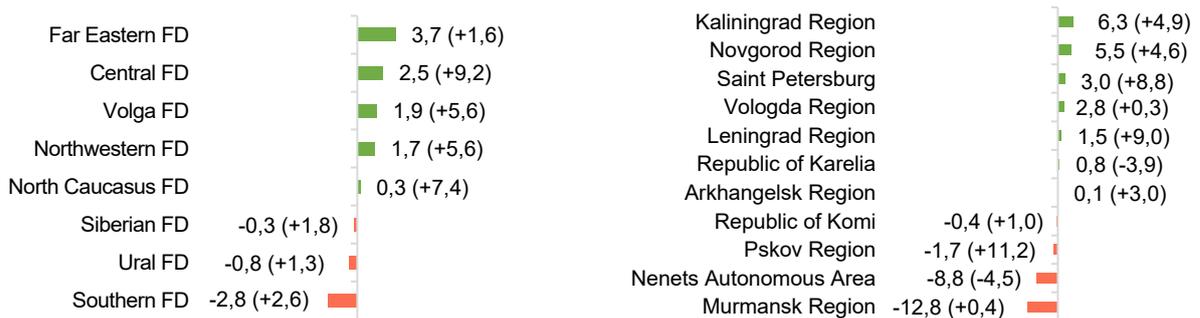


Figure 3. Growth in output of goods and services for basic types of economic activity* in January–September 2025 by federal district and NWF D Regions, % to January–September 2024

*Basic types of economic activity include crop and animal production, 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 for motor vehicles and motorcycles); retail trade (except for motor vehicles and motorcycles); transportation.

Note: The figure in parentheses indicates the change in the indicator in January–September 2024, % to January–September 2023.

1. Gross output production

The output of goods and services for basic types of economic activity across the NWF D as a whole increased by 1.7% (Fig. 3). Most regions in the district showed positive dynamics in the output of goods and services. The leaders in the growth rate of this indicator were the Kaliningrad and Novgorod regions (up by 6.3% and 5.5%, respectively). At the same time, a sharp decline in the output of goods and services was noted in the Murmansk Region and the Nenets Autonomous Area (down by 12.8% and 8.8%, respectively).

📈 **Industrial production** in Russia and the NWF D showed output growth of 0.7% and 0.2%, respectively (Tab. 1). However, assessments by Rosstat and the Center for Macroeconomic Analysis and Short-Term Forecasting (CMASF) differ: the statistical agency shows that the national industrial production index increased

by 0.7% over the 9 months of 2025, while CMASF analysts believe the industry is in a borderline state between stagnation and decline, with growth since the beginning of the year amounting to only 0.3%².

📌 **Mining operations** across Russia and in the NWF D accelerated their output decline, which amounted to 2.1% and 4.4%, respectively, following a 0.4% decline a year earlier. The change in the industry's output in the NWF D was the worst result among all federal districts. The decline in mining affected enterprises in most regions of the district, most significantly in Saint Petersburg, the Arkhangelsk, and Pskov regions (down by 29.3%, 16.1%, and

² On the dynamics of industrial production in September and the third quarter of 2025. Available at: http://www.forecast.ru/_ARCHIVE/Analitics/PROM/2025/PR-OTR_2025-10-23.pdf (accessed: 18.11.2025).

**Table 1. Industrial production dynamics,
% to the corresponding period
of the previous year**

Territory	9 months of 2023	9 months of 2024	9 months of 2025	p*
Industry as a whole				
Russian Federation	104.0	105.1	100.7	-
Northwestern FD	104.9	107.6	100.2	3
Novgorod Region	101.4	104.5	108.8	5
Kaliningrad Region	93.5	101.8	105.2	16
Saint Petersburg	114.1	116.0	105.1	18
Vologda Region	105.4	101.2	102.9	27
Arkhangelsk Region	97.7	108.6	97.3	60
Pskov Region	109.8	112.0	97.1	63
Leningrad Region	109.2	109.2	96.9	66
Komi Republic	98.7	102.0	96.8	67
Nenets Autonomous Area	93.3	96.7	95.4	71
Republic of Karelia	98.5	99.3	95.2	72
Murmansk Region	95.7	102.5	89.3	82
Mining				
Russian Federation	98.8	99.6	97.9	-
Northwestern FD	96.6	99.6	95.6	8
Republic of Karelia	101.0	96.5	102.1	24
Murmansk Region	106.0	92.1	101.4	25
Vologda Region	88.3	99.1	100.4	28
Leningrad Region	108.1	97.7	97.6	45
Komi Republic	98.1	102.8	95.7	52
Nenets Autonomous Area	93.2	96.4	95.4	55
Novgorod Region	91.1	82.1	90.0	68
Kaliningrad Region	94.0	101.9	89.7	69
Pskov Region	95.8	108.4	84.6	79
Arkhangelsk Region	90.1	102.8	83.9	80
Saint Petersburg	79.2	160.6	70.7	84
Manufacturing industries				
Russian Federation	108.5	108.9	102.9	-
Northwestern FD	108.7	110.3	101.9	3
Novgorod Region	101.7	104.5	109.5	9
Kaliningrad Region	94.1	100.7	107.4	11
Saint Petersburg	117.0	117.5	106.4	13
Vologda Region	105.3	101.4	103.5	25
Komi Republic	101.0	99.4	101.7	29
Pskov Region	107.3	111.2	100.7	34
Nenets Autonomous Area	106.0	134.2	100.6	37
Arkhangelsk Region	98.8	110.8	100.1	41
Leningrad Region	112.6	108.6	96.1	61
Republic of Karelia	96.7	100.1	89.9	76
Murmansk Region	91.1	107.0	82.6	83

* Here and hereafter, the rank of the respective region among the subjects of the Federation (for the NWFD – among federal districts) by the dynamics of the indicator in January–September 2025 is shown (unless otherwise specified). Statistical information for the Donetsk People's Republic (DPR), Lugansk People's Republic (LPR), Zaporozhye, and Kherson regions is not considered.

15.4%, respectively). The indicator increased in the Republic of Karelia, the Murmansk, and Vologda regions (up by 2.1%, 1.4%, and 0.4%, respectively).

📈 **Manufacturing** in Russia and the NWFD continued to increase output (by 2.9% and 1.9%, respectively, following growth of 8.9% and 9.5% a year earlier). The dynamics of this indicator were positive in most regions of the district, with the Novgorod and Kaliningrad regions, as well as Saint Petersburg, showing production growth of 9.5%, 7.4%, and 6.4%, respectively.

📉 At the same time, output in this sector declined in the Murmansk Region, the Republic of Karelia, and the Leningrad Region by 17.4%, 10.1%, and 3.9%, respectively.

The sectoral dynamics of manufacturing output in the NWFD demonstrated slowing growth.

📈 Industries within the intermediate demand manufacturing sector of the NWFD increased their output. For instance, production of pharmaceuticals and materials grew by 3%, while output of rolled metal and chemical products rose by 2.4% and 2%, respectively (Fig. 4). At the same time, the indicator for the wood processing industry decreased by 1.6%.

The government has postponed the deadline for payment of the excise tax on liquid steel and the mineral extraction tax (MET) on iron ore for ferrous metallurgy enterprises. The decision concerns taxes with payment deadlines falling between September and November. The deadlines for these payments have been extended until December 1, 2025, inclusive. This measure will allow metallurgical enterprises to free up working capital, which in turn will provide additional support for their operations and investment activity³.

³ RF Government Resolution 1683 dated 29.10.2025 on supporting the ferrous metallurgy industry.

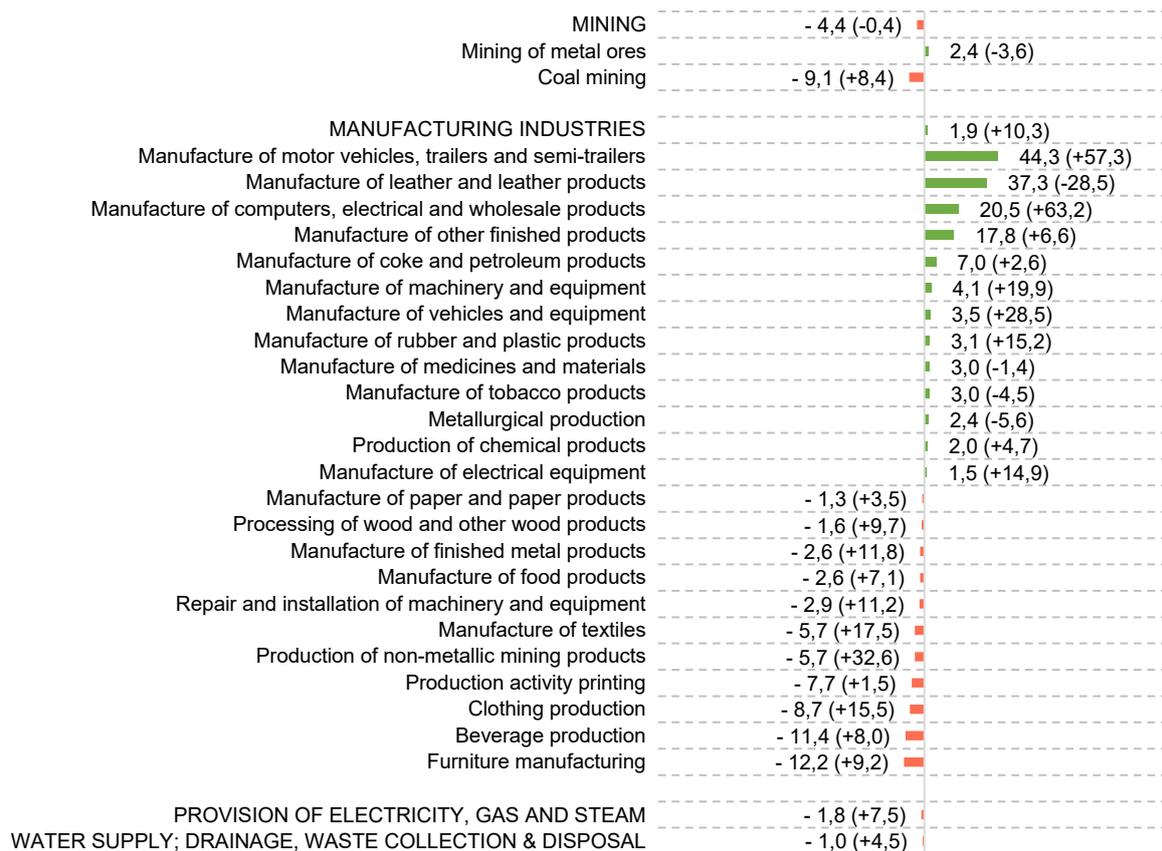


Figure 4. Growth in industrial production volumes in the NWF in January–September 2025, % to January–September 2024

Note: The figure in parentheses indicates the change in the indicator in January–September 2024, % to January–September 2023.

➤ A number of industries within the **final demand manufacturing sector** of the NWF also showed production growth. In particular, output of leather and leather products increased significantly – by 37.3% (after a 28.5% decline in the previous year). Output of other finished products grew by 17.8%, and rubber and plastic products by 3.1%. At the same time, production of beverages and clothing decreased by 11.4% and 8.7%, respectively, and textiles by 5.7%.

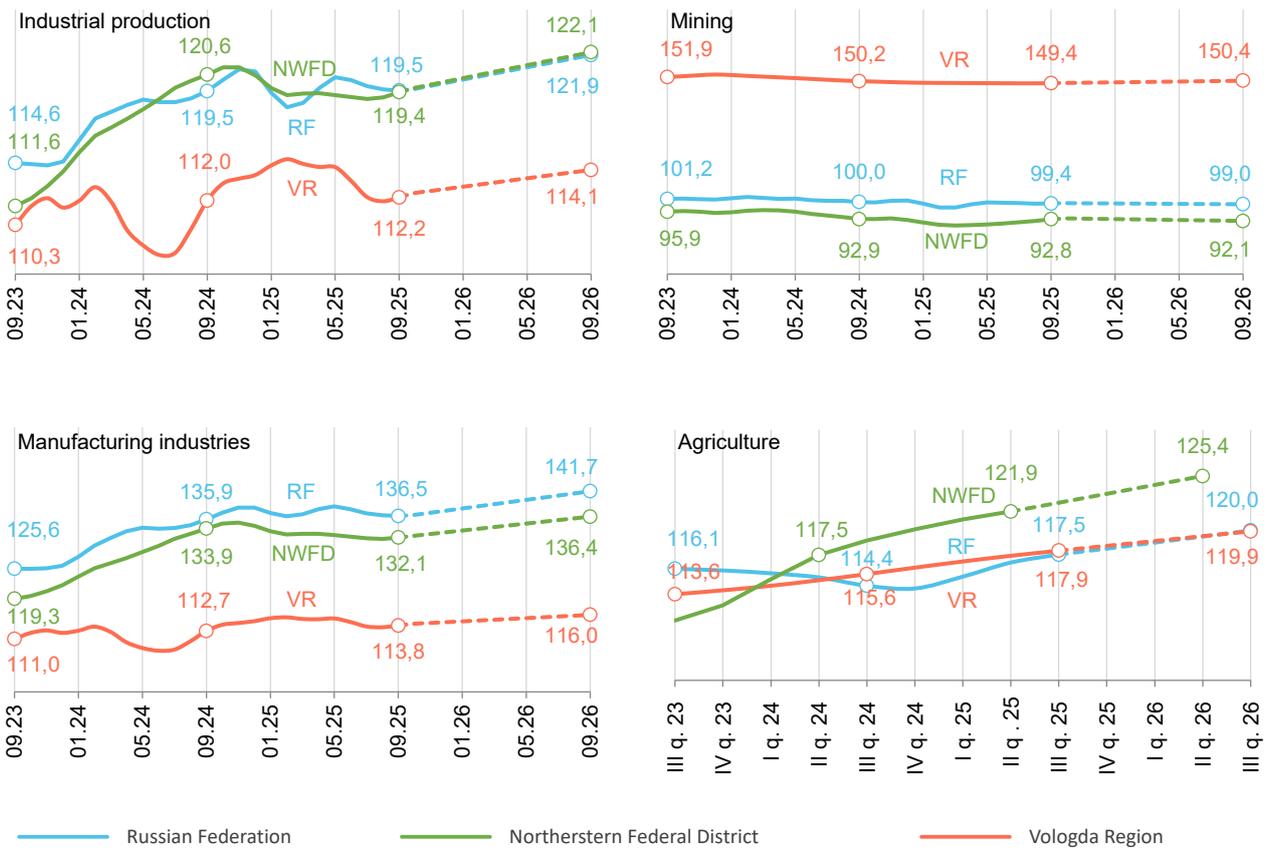
➤ Industries within the **investment demand manufacturing sector** of the NWF showed mixed output dynamics. A positive development was the high growth rate of output for computers, electronic and optical products, as well as motor vehicles, trailers, and semi-trailers (up by 20.5% and 44.3%, respectively, following growth of over 50%

a year earlier). Furthermore, production of machinery and equipment, as well as transport equipment, increased by 4.1% and 3.5%, respectively. However, a decline was noted in the production of other non-metallic mineral products by 5.7%.

The company "PP Abrasivnye Materialy" (PP Abrasive Materials) has commissioned a new production and warehouse complex in Vsevolozhsky District of Leningrad Region. The total investment in this project amounted to 2 billion rubles. The new complex includes 16 production sites manufacturing the most popular abrasive tools on the Russian market⁴.

⁴ A new office and production facility opened in the Leningrad Region. Available at: https://abramat.ru/news/otkrytie_krupnogo_proizvodstva_abrazivnykh_materialov_v_leningradskoy_oblasti/ (accessed: 18.11.2025).

Trends in industrial and agricultural production development in 2023–2026, % to the 2018 level



▲ Russian **agriculture** in January–September 2025 increased output by 2% (Tab. 2). Among NWFD regions, the value of this indicator grew in the Novgorod and Vologda regions, as well as the Republic of Karelia (by 2.1%, 1.9%, and 0.1%, respectively).

Labor market indicators showed slower improvement.

▲ The unemployment rate in Russia and the NWFD in July–September 2025 decreased to 2.1% and 2.0%, respectively (Tab. 3). A reduction in the indicator was recorded in most regions of the district. Exceptions were the Arkhangelsk Region, where the indicator increased from 2.6% to 2.8%, as well as Saint Petersburg, the Leningrad, and Murmansk regions, where the unemployment rate remained at last year's level.

Table 2. Agricultural production dynamics, % to the corresponding period of the previous year

Territory	9 months of 2023	9 months of 2024	9 months of 2025	P
Russian Federation	102.5	97.9	102.0	-
Northwestern FD	101.7	105.7	-	-
Novgorod Region	102.3	99.0	102.1	-
Vologda Region	102.5	100.0	101.9	-
Republic of Karelia	101.0	96.6	100.1	-
Komi Republic	99.5	94.7	-	-
Nenets Autonomous Area	102.0	105.3	-	-
Arkhangelsk Region	101.6	97.4	-	-
Kaliningrad Region	102.2	107.4	-	-
Leningrad Region	101.9	101.2	-	-
Murmansk Region	104.2	95.5	-	-
Pskov Region	100.4	130.2	-	-

Table 3. Labor market dynamics, % to the corresponding period of the previous year

Territory	July – September 2023	July – September 2024	July – September 2025	P*
Unemployment rate, % of the number of the employed				
Russian Federation	3.3	2.4	2.1	-
Northwestern FD	2.8	2.1	2.0	5
Novgorod Region	2.8	1.5	0.9	4
Saint Petersburg	1.6	1.5	1.5	19
Vologda Region	3.2	2.0	1.7	27
Kaliningrad Region	3.1	2.4	1.9	44
Pskov Region	3.2	2.3	2.0	49
Komi Republic	5.2	3.4	2.4	60
Murmansk Region	3.8	2.6	2.6	63
Arkhangelsk Region	5.6	2.6	2.8	67
Leningrad Region	2.8	2.8	2.8	68
Republic of Karelia	5.5	4.0	2.9	70
Nenets Autonomous Area	6.5	5.1	4.1	78
Territory	9 months of 2023	9 months of 2024	9 months of 2025	P
Employers' demand for workforce				
Russian Federation	116.4	118.6	98.7	-
Northwestern FD	117.0	115.3	-	-
Leningrad Region	120.2	128.1	119.9	-
Saint Petersburg	121.7	112.9	106.5	-
Novgorod Region	121.9	129.9	105.4	-
Vologda Region	114.3	126.7	104.9	-
Kaliningrad Region	111.7	114.8	101.9	-
Nenets Autonomous Area	117.9	106.8	98.8	-
Murmansk Region	102.7	102.7	96.8	-
Komi Republic	109.9	110.9	94.8	-
Arkhangelsk Region	114.3	113.7	91.9	-
Republic of Karelia	112.0	112.0	-	-
Pskov Region	108.6	119.4	-	-

* According to the indicator "Unemployment rate", the rank of the corresponding region among the subjects of the Federation (for the NWFD – among the federal districts) is given according to the dynamics of the indicator in July–September 2025.

❏ The volume of employer demand for workers registered with the country's employment services decreased by 1.3%. A deterioration in this indicator was also noted in a number of NWFD regions. For instance, the Arkhangelsk Region saw a decline of 8.1%, and the Komi Republic – 5.2%.

⬆ At the same time, an increase in the number of registered vacancies was recorded in several regions of the district, particularly in the Leningrad Region, Saint Petersburg, and the Novgorod Region, where it amounted to 19.9%, 6.5%, and 5.4%, respectively.

2. Income generation

The changes were characterized by growth in household and state incomes against a backdrop of declining business profits.

Real disposable incomes of the Russian population increased by 8.1% (Tab. 4), while pensions grew by 2.1%. The wages of Russians in January–August 2025 increased by 4.4%.

Table 4. Dynamics of the population's income generation, % to the corresponding period of the previous year

Territory	9 months of 2023	9 months of 2024	9 months of 2025	P
Real monetary incomes of the population				
Russian Federation	105.0	108.1	108.1	-
Northwestern FD	104.6	109.1	-	-
Republic of Karelia	104.3	107.2	-	-
Komi Republic	107.5	108.7	-	-
Nenets Autonomous Area	101.3	103.8	-	-
Arkhangelsk Region	101.7	105.7	-	-
Vologda Region	101.1	103.8	-	-
Kaliningrad Region	104.1	108.8	-	-
Leningrad Region	107.2	110.9	-	-
Murmansk Region	103.1	105.2	-	-
Novgorod Region	103.3	108.8	-	-
Pskov Region	104.4	109.6	-	-
Saint Petersburg	105.3	110.6	-	-

⬆ **Real incomes of the consolidated budget and the territorial state extra-budgetary fund** of the Russian Federation increased by 0.8% (Tab. 5). However, tax revenues from business income in Russia and the NWFD decreased by 9.7% and 10.8%, respectively. The dynamics of revenues from excise goods also worsened: in Russia – by 7%, in the NWFD – by 4.3%. The volume of personal income tax (PIT) revenues across the country grew by 5.5%, and in the macro-region by 2.4%.

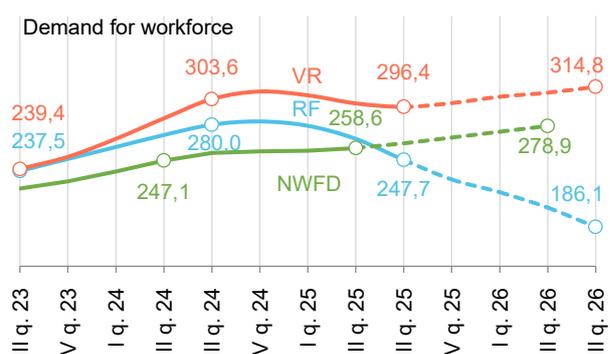
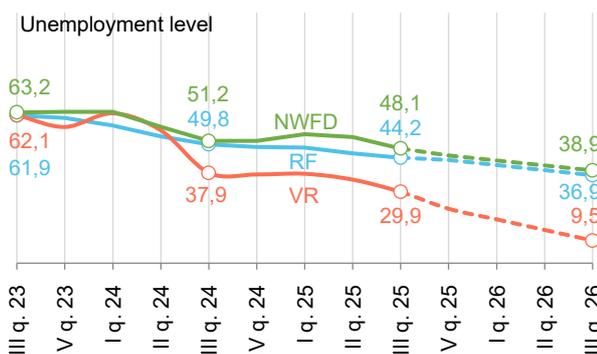
Table 5. Dynamics of business and state income generation, % to the corresponding period of the previous year

Territory	9 months of 2023	9 months of 2024	9 months of 2025
Revenues of the consolidated budget and the budget of the territorial state extra-budgetary fund			
Russian Federation	53,4	101,9	100,8
Northwestern FD	97,0	102,1	98,4
Kaliningrad Region	96,2	113,9	101,2
Saint Petersburg	91,3	107,3	100,3
Leningrad Region	120,5	101,1	100,2
Murmansk Region	107,4	88,8	99,2
Novgorod Region	105,4	85,8	98,8
Republic of Karelia	101,3	94,0	96,9
Arkhangelsk Region	94,0	97,5	95,5
Pskov Region	114,9	92,5	95,0
Komi Republic	90,2	97,4	92,7
Vologda Region	98,6	93,1	90,1
Nenets Autonomous Area	73,2	125,5	86,9
Territory	8 months of 2023	8 months of 2024	8 months of 2025
Net financial result of organizations' activities			
Russian Federation	97,2	86,5	80,0
Northwestern FD	52,3	96,4	81,0
Saint Petersburg	39,0	71,2	132,1
Leningrad Region	104,1	119,4	82,1
Arkhangelsk Region	63,3	114,2	80,7
Pskov Region	139,1	113,7	79,2
Komi Republic	64,3	84,5	68,5
Kaliningrad Region	122,8	305,9	57,4
Republic of Karelia	41,8	161,3	38,4
Murmansk Region	93,5	18,9	26,8
Vologda Region	54,9	99,5	21,3
Nenets Autonomous Area	16,9	119,7	17,8
Novgorod Region	61,1	-	-

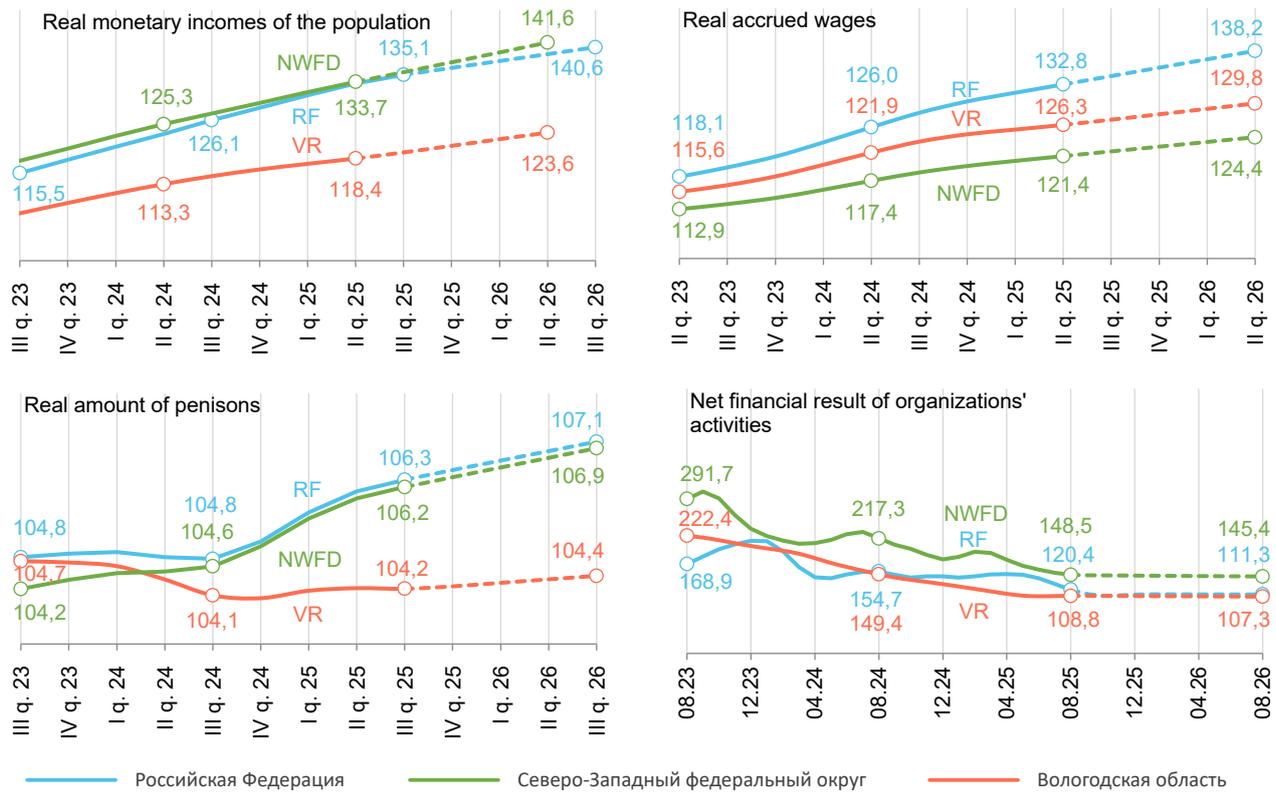
✓ In the NWFD, total budget revenues decreased by 1.6%. The decline affected almost all regions of the district, with the exception of the Kaliningrad Region, Saint Petersburg, and the Leningrad Region, where the indicator grew by 1.2%, 0.3%, and 0.2%, respectively. Budget revenues declined most significantly in the "resource-based" regions – the Nenets Autonomous Area and the Komi Republic (by 13.1% and 8.3%, respectively), as well as in the Vologda Region (by 9.9%), which specializes in metal product manufacturing.

✓ The net financial result of Russian organizations continued to decline, a trend now observed for the third consecutive year. In January–August 2025, the decline amounted to 20% in comparable prices, compared to 13.5% and 2.8% in the same periods of 2024 and 2023, respectively. A significant deterioration in the financial position of enterprises is also observed in the NWFD. An exception to the general trend was the growth of business incomes in Saint Petersburg by 32.1%. In all other regions of the district, business incomes declined. In particular, in the Novgorod Region, the net financial result of organizations was negative; in the Nenets Autonomous Area, the indicator amounted to only 17.8% of last year's level; and in the Vologda and Murmansk regions – 21.3% and 26.8%, respectively.

Trends in labor market development in 2023–2026, % to the 2018 level



Trends in the population's income generation in the Economy in 2023–2026, % to the 2018 level



3. End use

Consumer demand continued to grow at a pace exceeding overall economic dynamics.

➡ Retail trade turnover in Russia and the NWFD increased by 2.1% and 1.3%, respectively (Tab. 6). Nationwide, the expansion of non-food retail trade amounted to 2.1%, and food retail trade to 2.3%. In the NWFD, the turnover of non-food trade decreased by 0.3%, largely explained by a 4.5% decline in the indicator in Saint Petersburg, against an increase of 3.8–9.8% in more than half of the district's regions. Across the NWFD, the turnover of food trade grew by 3.7%, driven by an increase in the indicator in most regions by 0.4–6.3%. the Vologda Region became the leader in the macro-region in terms of growth in non-food retail turnover (6.3%), while simultaneously demonstrating the largest decline in food

trade turnover (3.6%) among other regions of the district.

➡ The volume of paid services provided to the population of the country and the NWFD increased by 2.4% and 3.1%, respectively. The drivers of the indicator's dynamics in the macro-region were Saint Petersburg, where the volume of paid services grew by 4.6%, as well as the Leningrad and Kaliningrad regions, where the indicator increased by 4.5% and 3.9%, respectively.

➡ At the same time, in a number of northern regions of the district, the volume of paid services to the population decreased, most significantly in the Komi Republic (by 1.7%, which was one of the worst results in the country).

Analysts from the Institute of Economic Forecasting of the Russian Academy of Sciences (IEF RAS) note that the prospects for continued consumption growth depend on the labor market situation. In October 2025, there was a

Table 6. Dynamics of consumer market development, % to the corresponding period of the previous year

Territory	9 months of 2023	9 months of 2024	9 months of 2025	P
Retail trade turnover				
Russian Federation	106.6	108.6	102.1	-
Northwestern FD	111.0	107.3	101.3	7
Republic of Karelia	110.5	103.3	106.5	10
Leningrad Region	112.1	107.3	104.9	18
Komi Republic	107.1	107.8	104.0	24
Kaliningrad Region	105.2	112.6	103.9	26
Novgorod Region	102.2	106.4	103.2	35
Vologda Region	102.9	104.8	102.4	46
Pskov Region	100.4	109.5	101.6	53
Arkhangelsk Region	102.8	100.4	100.0	77
Nenets Autonomous Area	102.6	103.2	99.8	80
Saint Petersburg	116.0	108.5	99.3	81
Murmansk Region	100.7	102.7	98.8	83
Volume of paid services provided to the public				
Russian Federation	106.6	104.5	102.4	-
Northwestern FD	110.4	103.0	103.1	5
Saint Petersburg	116.0	101.2	104.6	17
Leningrad Region	110.3	110.5	104.5	20
Kaliningrad Region	106.4	109.3	103.9	23
Pskov Region	101.7	102.2	101.7	45
Nenets Autonomous Area	90.6	104.0	101.4	51
Republic of Karelia	105.1	103.9	101.3	53
Novgorod Region	100.3	100.5	100.5	62
Murmansk Region	101.6	100.4	99.8	71
Vologda Region	100.7	102.9	99.3	75
Arkhangelsk Region	104.4	107.1	98.5	78
Komi Republic	98.1	101.4	98.3	80
Consumer price index (compared to December of the previous year)				
Russian Federation	104.6	106.6	104.3	-
Northwestern FD	104.3	105.9	104.8	7
Arkhangelsk Region	106.0	105.6	103.5	10
Komi Republic	104.3	106.3	104.2	28
Nenets Autonomous Area	101.2	103.5	104.2	28
Saint Petersburg	104.0	105.8	104.3	31
Novgorod Region	104.1	105.7	105.1	61
Vologda Region	104.8	106.3	105.2	64
Republic of Karelia	105.8	105.5	105.7	75
Leningrad Region	104.0	105.9	105.7	75
Murmansk Region	103.6	105.4	105.8	78
Pskov Region	103.6	105.8	105.8	78
Kaliningrad Region	104.8	107.1	105.9	79
Producer price index for manufactured goods (compared to December of the previous year)				
Russian Federation	120.7	107.0	98.4	-
Northwestern FD	110.8	106.6	102.1	6
Nenets Autonomous Area	174.9	97.5	75.7	1
Komi Republic	129.8	107.7	92.0	8
Vologda Region	114.1	104.6	98.0	20
Republic of Karelia	119.0	111.3	100.0	27
Kaliningrad Region	105.4	104.1	101.6	32
Leningrad Region	109.0	110.0	102.7	45
Arkhangelsk Region	98.7	109.2	104.5	55
Murmansk Region	111.7	102.9	105.4	60
Novgorod Region	104.0	104.2	106.9	63
Pskov Region	107.6	107.9	109.6	74
Saint Petersburg	104.9	106.0	114.0	83

significant increase in the hh.index (HeadHunter Index) to 7.3 p. (compared to 6.4 p. in September 2025 and 3.9 p. in October 2024), indicating a moderate (but gradually increasing) level of competition for jobs. Combined with the exhaustion of one-off factors (increased activity in car sales ahead of higher recycling fees, the expected VAT increase), this may lead to a slowdown in consumer demand growth⁵.

✔ Consumer price inflation in Russia and the NWFD stood at 4.3% and 4.8%, respectively. Prices for food products both nationwide and in the federal district increased by 3%. Prices for non-food goods across the country and in the macro-region rose to a lesser extent – by 1.8% and 2.6%, respectively. Utility tariffs (housing and communal services) in Russia and the NWFD, due to a widespread tariff increase from July 1, rose by 11.6% and 11.7%, respectively. Consumer prices for services in the country and the macro-region increased by more than 9%.

✔ Nationwide, producer prices for industrial goods decreased by 1.6%, while in the NWFD they increased by only 2.1%. A sharp decline in prices for industrial products was recorded in the Nenets Autonomous Area (down by 24.3%, which was the best result in the country). Industrial products also became cheaper in the Komi Republic and the Vologda Region (down by 8% and 2%, respectively).

✔ In the other NWFD regions, producer prices for industrial goods increased, with the most significant price hikes observed for industrial products in Saint Petersburg and the Pskov Region (up by 14% and 9.6%, respectively). An exception was the Republic of Karelia, where the indicator remained unchanged.

✔ In the **construction sector** of Russia and the NWFD, the volume of work performed increased by 3.1% and 4.5%, respectively (Tab. 7). Among NWFD regions, high growth was demonstrated by the Leningrad Region, as well as the republics of Komi and Karelia (up by 37.3%, 22.9%, and 14.8%, respectively).

⁵ Short-term analysis of GDP dynamics: November 2025. Available at: <https://ecfor.ru/publication/kratkosrochnyj-analiz-dinamiki-vvp-noyabr-2025/> (accessed: 19.11.2025).

**Table 7. Construction dynamics,
% to the corresponding period of the previous year**

Territory	9 months of 2023	9 months of 2024	9 months of 2025	P
Scope of work on the type of economic activity "Construction"				
Russian Federation	111.3	101.5	103.1	-
Northwestern FD	105.7	99.9	104.5	3
Leningrad Region	103.4	124.2	137.3	4
Komi Republic	116.4	99.4	122.9	13
Republic of Karelia	120.0	60.5	114.8	20
Saint Petersburg	111.2	97.1	103.6	34
Vologda Region	104.1	106.4	102.7	36
Novgorod Region	116.1	110.4	93.8	56
Arkhangelsk Region	124.7	58.9	92.5	59
Pskov Region	81.6	101.2	82.8	71
Kaliningrad Region	119.1	118.1	76.9	78
Nenets Autonomous Area	73.6	82.0	67.0	80
Murmansk Region	73.7	88.9	57.0	82
Housing commissioning				
Russian Federation	100.7	101.8	94.4	-
Northwestern FD	98.6	96.1	95.2	5
Murmansk Region	23.9	153.2	146.5	2
Republic of Karelia	100.5	86.2	125.6	6
Vologda Region	114.2	100.1	114.8	12
Novgorod Region	98.5	97.2	107.6	18
Nenets Autonomous Area	54.1	139.2	105.1	21
Komi Republic	97.0	104.8	99.7	33
Arkhangelsk Region	114.8	96.9	98.5	35
Leningrad Region	97.4	112.3	96.3	41
Kaliningrad Region	91.7	94.9	93.8	45
Saint Petersburg	104.3	75.0	83.2	69
Pskov Region	90.4	105.9	76.0	77
Volume of mortgage loans issued				
Russian Federation	161.8	66.6	61.1	-
Northwestern FD	139.7	70.3	63.0	3
Nenets Autonomous Area	134.4	67.5	78.7	3
Leningrad Region	146.3	63.1	70.5	11
Kaliningrad Region	182.5	79.3	64.6	27
Komi Republic	153.5	57.1	63.5	32
Arkhangelsk Region	148.7	87.2	63.3	33
Murmansk Region	146.0	67.9	63.4	35
Pskov Region	160.7	68.2	62.9	36
Saint Petersburg	126.8	72.4	62.2	40
Novgorod Region	154.7	66.5	60.1	50
Republic of Karelia	172.2	60.1	57.4	64
Vologda Region	163.9	63.9	54.8	72

At the same time, half of the regions in the district showed negative dynamics for this indicator. In particular, declines were recorded in the Murmansk Region, the Nenets Autonomous Area, and the Kaliningrad Region (down by 43%, 33%, and 23.1%, respectively).

Residential housing commissioning across Russia and in the NWFD slowed down by 5.6% and 4.8%, respectively. At the same time, regions within the district demonstrated diverging changes in this indicator. For instance, the Pskov Region saw a decline in housing commissioning by almost a quarter, and Saint Petersburg by 16.8%. In other NWFD regions, the indicator level increased, with the high values in the Murmansk Region and the Republic of Karelia partly explained by low levels in previous periods. Significant growth was observed in the Vologda and Novgorod regions (up by 14.8% and 7.6%, respectively).

The volume of mortgage loans issued decreased substantially both nationwide and in the NWFD – by 38.9% and 37%, respectively. This trend affected all regions of the district, manifesting as a decline in mortgage lending ranging from 22.3% to 45.2%. It should be noted that this was preceded by a decline in the indicator in the previous year as well. According to data from the Bank of Russia, in August and September 2025, 82% and 77% of mortgages, respectively, were issued under government support programs. In annual comparison, the number of mortgage housing loans issued decreased by 6.9%, but their total volume increased by 8.5%⁶.

⁶ Bank of Russia: Review of the mortgage housing lending market. Available at: https://cbr.ru/statistics/bank_sector/mortgage/Indicator_mortgage/0925/ (accessed: 18.11.2025).

⬆️ **Real expenditures of the consolidated budget and the territorial state extra-budgetary fund** across Russia and in the NWFD increased by 7% and 2.8%, respectively (Tab. 8). Some regions of the district demonstrated growth in budget expenditures, including the Leningrad Region – by 10.5%, and the Nenets Autonomous Area and Saint Petersburg – by 4.7% and 4.2%, respectively. At the same time, the indicator decreased in a number of regions within the macro-region, most notably in the Novgorod and Murmansk regions (down by 5.9% and 4.5%, respectively). Notably, national budget expenditures on social policy increased by 12.4% (a year earlier, spending under this category had decreased by 2.7%). An increase in this indicator was also noted in the NWFD, though it was preceded by growth a year earlier (up by 8.2% and 3.4%, respectively). Healthcare expenditures nationwide increased by 5.1%, while in the NWFD they decreased by 1.7%.

Table 8. Dynamics of state expenditures, % to the corresponding period of the previous year

Territory	9 months of 2023	9 months of 2024	9 months of 2025
Expenditures of the consolidated budget and the budget of the territorial state extra-budgetary fund			
Russian Federation	54.5	103.1	107.0
Northwestern FD	109.7	106.9	102.8
Leningrad Region	102.5	114.1	110.5
Nenets Autonomous Area	96.3	95.0	104.7
Saint Petersburg	119.6	109.3	104.2
Kaliningrad Region	102.7	100.4	103.6
Komi Republic	99.1	104.1	102.8
Arkhangelsk Region	105.2	99.8	101.3
Pskov Region	107.2	92.2	98.2
Republic of Karelia	100.7	89.5	98.0
Vologda Region	107.0	112.4	97.0
Murmansk Region	94.2	115.1	95.5
Novgorod Region	117.2	98.7	94.1

⬇️ According to data from the Federal Customs Service, Russia's total export value decreased by 4.6%, while **import** value fell by 1%. Exports to Europe declined by 15.7%, to Asia by 1.9%, and to Africa by 13.4%. It is worth noting that Europe remains one of Russia's main trading partners, including being the largest buyer of pipeline and liquefied natural gas⁷. Imports from Europe and Asia decreased by 5% and 0.9%, respectively, while imports from Africa increased by 32.2%. Exports of food products decreased by 11.1%, while imports of this commodity group grew by 14.6%. The value of mineral products exports also fell by 14.7% (their share amounted to 55.7%), and imports of mineral products decreased by 14.5%. Exports of machinery and equipment increased by 26.2%, while imports of this category of goods decreased by 7%, with their share constituting just under half of total imports. The decline in foreign trade turnover of mineral products against the backdrop of a strengthening currency and a trend toward declining world prices has become a factor exerting a negative influence on economic dynamics.

⬇️ **World market prices** for oil in January–September 2025 decreased by 15.1%, for rolled metal by 13.6%, and for phosphorus-containing fertilizers by 8.4% (Tab. 9).

⬆️ At the same time, natural gas became more expensive by 24.8%.

Table 9. Dynamics of world commodity prices, % to the corresponding period of the previous year

Commodity	9 months of 2023	9 months of 2024	9 months of 2025
Oil	79.5	100.5	84.9
Gas	31.3	77.8	124.8
Rolled metal (Met.)	76.0	94.5	86.4
Phosphate fertilizers (PF)	71.9	122.0	91.6

⁷ The European Union remains the largest buyer of Russian LNG amid sanctions. Available at: <https://www.rbc.ru/economics/27/10/2025/68fee98c9a7947553dbf568b> (accessed: 19.11.2025).

World prices for metal products show mixed changes: an increase in prices for flat rolled products (by 3.2–6.4%) and for rebar steel (by 0.8%) was noted, while structural profiles and

long products became cheaper by 0.3%. On the domestic market, prices were declining: for flat rolled metal – by 17.5–11.1%, and for long products – by 19.1–13.2% (*Tab. 10, 11*).

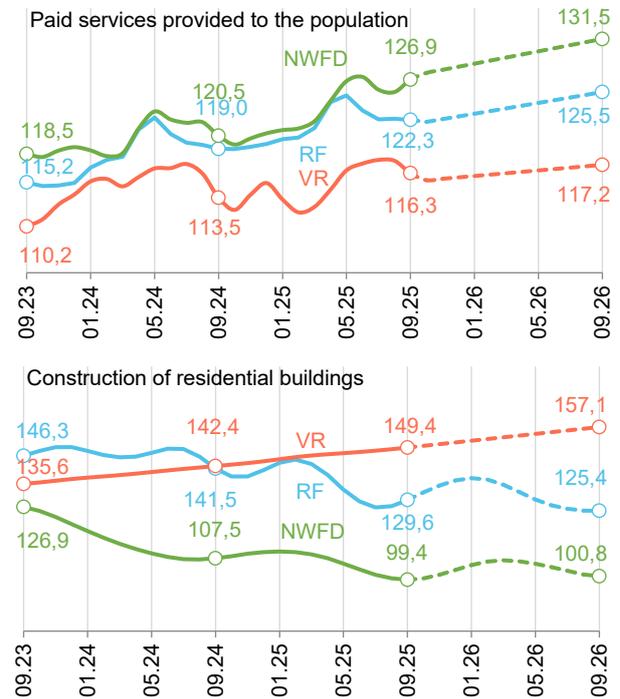
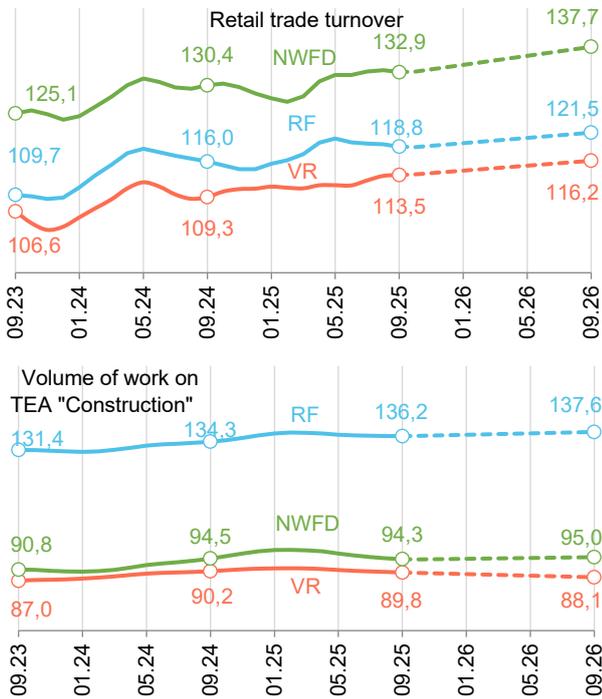
Table 10. Prices of steel products on the world market (EU countries) per ton (as of the beginning of October of the corresponding year)

Type of metal product	Unit of measurement	2023	2024	2025	2025, % to	
					2024	2023
"Flat" rolled metal						
Cold-rolled sheet	USD	730	713	735	103.2	100.7
Galvanized sheet	USD	820	783	833	106.4	101.5
Hot-rolled sheet	USD	653	608	630	103.7	96.6
"Long" rolled metal						
Reinforcing steel	USD	743	655	660	100.8	88.9
Structural sections	USD	915	715	713	99.7	77.9
Rolled products	USD	860	715	713	99.7	82.8

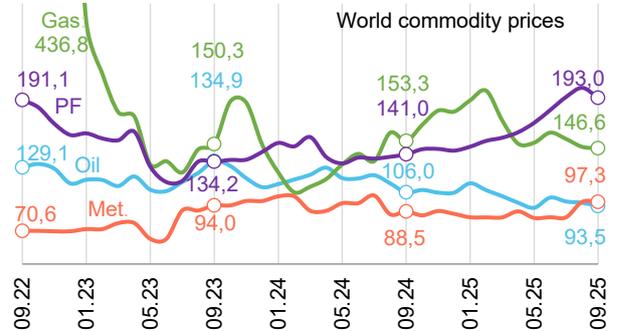
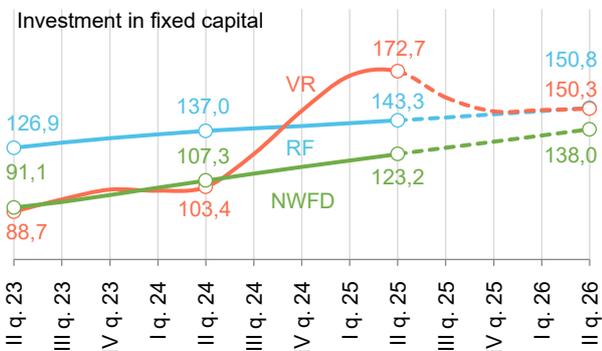
Table 11. Prices of metal products on the Russian market per ton (as of the beginning of November of the corresponding year)

Type of metal product	Unit of measurement	2023	2024	2025	2025, % to	
						2023
"Flat" rolled metal						
Cold-rolled sheet	Rub.	80167	86503	75900	87.7	94.7
Galvanized sheet	Rub.	104280	115250	95100	82.5	91.2
Hot-rolled sheet	Rub.	70586	64500	57350	88.9	81.2
"Long" rolled metal						
Rebar	Rub.	74244	59054	49750	84.2	67.0
Beam and Channel	Rub.	85023	82756	70181	84.8	82.5
Round	Rub.	72480	57500	46500	80.9	64.2
Angle	Rub.	73214	62700	54400	86.8	74.3

Trends in the development of the consumer market and construction in 2023–2026, % compared to the level of 2018



Trends in the development of investment activity and foreign trade in 2022–2026, % compared to the level of 2018



- Russian Federation
- Northwestern Federal District
- Vologda Region

- Oil
- Gas
- Rolled metal
- Phosphorous fertilizers

In summary, from January to September 2025, the economy of the NWF developed under conditions of slowing national growth and increasing internal imbalances. Despite maintaining positive GDP dynamics and an increase in real household incomes, key challenges included the stagnation of industrial production, a sustained decline in business confidence and corporate financial results, as well as a reduction in budget revenues, especially in resource-based regions. The growth of consumer demand turned out to be moderate against the backdrop of declining mortgage lending volumes and a high key rate, while foreign trade faced declining exports due to falling world prices for key commodities. In these circumstances, increasing regional differentiation and a worsening labor shortage underscore the need for an accelerated structural restructuring of the economy and improved effectiveness of state support measures to transition to sustainable growth. Examples of already implemented measures include

the expansion of support for industrial projects⁸, support for agricultural producers⁹, small and medium enterprises¹⁰, and regional infrastructure projects¹¹. An interesting proposal is also to conduct an audit of existing budget incentives and industrial support measures, thereby freeing up additional resources to increase productive budget expenditures¹².

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

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⁸ RF Government Resolution 3160-r dated 07.11.2025 on allocating 200 million rubles to support industrial enterprises in the Vologda Region; RF Government Resolution 3191-r dated 08.11.2025 on allocating 250 million rubles to support industrial enterprises in the Kaliningrad Region.

⁹ RF Government Resolution 1722 dated 01.11.2025 on expanding support parameters for agricultural producers under the state agricultural development program; RF Government Resolution 3138-r dated 06.11.2025 on allocating over 6.3 billion rubles to subsidize the program of preferential lending for agricultural producers; RF Government Resolution 1730 dated 01.11.2025 on introducing a temporary ban on the export of technical sulfur, a critical raw material for mineral fertilizer production; RF Government Resolution 3080-r dated 31.10.2025 on allocating over 34.6 billion rubles to subsidize preferential loans for agricultural producers.

¹⁰ RF Government Resolution 2537-r dated 16.09.2025 on allocating 1.5 billion rubles for the operation of regional export support centers.

¹¹ RF Government Resolution 3264-r dated 14.11.2025 on allocating about 1.4 billion rubles for the development of road infrastructure in a number of regions; RF Government Resolution 2940-r dated 21.10.2025 on allocating funding for the renewal of ambulance fleets in the Tambov Region; RF Government Resolution 2713-r dated 30.09.2025 on allocating funding for the renewal of ambulance fleets in the Republic of Komi; RF Government Resolution 2900-r dated 17.10.2025 on allocating an additional 4.5 billion rubles for the program of preferential lending for investment projects in tourism.

¹² Shirov A.A. (2025). The Russian economy in a cooling period. Is a thaw coming soon? Stimul, 3, 61–66. Available at: <https://ecfor.ru/wp-content/uploads/2025/10/mechanizmy-formirovaniya-ekonomicheskoy-dinamiki-posle-nachala-svo.pdf> (accessed: 19.11.2025).

MONITORING OF THE SOCIAL WELL-BEING OF THE VOLOGDA REGION POPULATION IN OCTOBER 2025

DOI: 10.15838/ptd.2025.6.140.13 • UDC 316.658(470.12) • LBC 60.527(2Rus-4Vol)

In September–October 2025, the Federal State Budgetary Institution of Science "Vologda Research Center of the Russian Academy of Sciences" (VolRC RAS) conducted another round of public opinion monitoring regarding the socio-economic and political situation in the country and the region. The study results are presented in the following material.

The VolRC RAS public opinion monitoring has been conducted since 1996 at two-month intervals. The survey covers 1,500 respondents aged 18 and over in the cities of Vologda and Cherepovets, as well as in Babayevsky, Velikoustyugsky, Vozhegodsky, Gryazovetsky, Tarnogsky, Kirillovsky, Nikolsky municipal okrugs, and Sheksninsky Municipal District. The sample's representativeness is ensured by maintaining the following proportions: between urban and rural populations; between residents of different types of settlements (rural settlements, small and medium towns); and the gender-age structure of the adult population of the region. The survey method is face-to-face questionnaire interviews at respondents' residences. The sampling error does not exceed 3%.

The study analyzes the dynamics of assessments across 14 socio-demographic categories, segmented by:

- gender (male, female);
- age (under 30, 30 to 55, over 55);
- education level (secondary or incomplete secondary, vocational secondary, higher);
- self-assessed income level (the 20% least well-off, the 60% average, the 20% most well-off);
- area of residence (Vologda, Cherepovets, districts of the region).

An index method is used to process the sociological information and analyze the data. To calculate the indices, the percentage of negative responses is subtracted from the percentage of positive responses; then, 100 is added to the result to avoid negative values. Thus, entirely negative responses would yield a total index of 0, entirely positive – 200, and a balance of the two – an index of 100, which essentially serves as the neutral mark.

🟡 In August–October 2025, as over the past 12 months, the indicators of social well-being of the population in the Vologda Region showed no significant change. The share of positive assessments of social sentiment was 70–71%; negative – 24–26% (*Tab. 1*).

🟢 At the same time, there was a slight increase in the proportion of positive characteristics of the "reserve of patience": the share of those who believe that "things are not so bad and one can live; life is hard, but bearable" increased by 4 percentage points (p.p.) (from 80% to 84%).

For citation: Morev M.V., Leonidova E.E. (2025). Monitoring of social well-being of the Vologda Region population in October 2025. *Problems of Territory's Development*, 29(6), 224–231. DOI: 10.15838/ptd.2025.6.140.13

Table 1. Dynamics of selected social well-being indicators for the population of the Vologda Region*, % of respondents

Indicator	Response option	2012	2015	2018	2019	2020	2021	2022	2023	2024	Oct. 2024	Dec. 2024	Feb. 2025	Apr. 2025	June 2025	Aug. 2025	Oct. 2025	Dynamics (+/-), Oct. 2025 to	
																		Aug. 25	Oct. 24
Mood	Excellent mood; normal state	67,3	68,7	71,2	69,9	61,0	66,7	67,3	65,6	69,0	70,1	72,3	69,4	71,2	71,9	72,9	70,9	-2	+1
	Feeling tension, irritation; fear, melancholy	27,0	25,9	23,1	24,5	30,4	27,3	28,1	29,2	27,2	25,9	24,8	26,6	23,8	25,3	24,1	23,5	-1	-2
	Index of Social Sentiment	140,3	142,8	148,2	145,5	130,6	139,4	139,3	136,4	141,8	144,2	147,5	142,8	147,4	146,6	148,8	147,4	-1	+3
Patience reserve	Things are not so bad and one can live; life is hard, but bearable	76,6	78,4	77,1	77,0	72,3	75,8	76,9	76,5	77,9	79,6	81,1	79,6	79,6	80,4	79,9	83,5	+4	+4
	Our dire situation is no longer bearable	15,8	14,5	16,3	17,2	19,9	17,7	16,1	14,6	13,9	14,1	12,1	14,5	14,0	11,9	12,9	12,1	-1	-2
	Index of Patience Reserve	160,8	163,9	160,8	158,8	152,5	158,1	160,8	162,0	164,0	165,5	169,0	165,1	165,6	168,5	167,0	171,4	+4	+6

* According to the research methodology, the sampling error does not exceed 3%. Therefore, here and henceforth, changes with a difference of 3 p.p. or less are considered insignificant; in the tables, they are highlighted in blue.

📈 In the dynamics of self-assessed monetary incomes over the last two months, minor positive changes are noted among representatives of the 20% least well-off population (an increase of 2 thousand rubles, from 14 to 16 thousand rubles) and the 60% average-income category (also an increase of 2 thousand rubles, from 27 to 29 thousand rubles; *Tab. 2*).

📈 Over the 12 months, the income level (based on self-assessments) increased across all income groups, especially among representatives of the 20% most well-off residents of the region (an increase of 7 thousand rubles, from 43 to 50 thousand rubles).

🟡 Assessments of the economic situation in the country and the Region in October 2025 remained at the level of two months prior:

- the share of positive judgments is 16–17%;
- 40–42% of the Region's residents hold neutral views;

- the proportion of negative assessments is 26–32% (*Tab. 3*).

As in August 2025, the share of people positively assessing their family's financial situation stands at 15%, neutral at 49%, and negative at 25%.

📈 Among the changes over the past 12 months, a slight decrease in the share of neutral assessments of personal financial standing should be noted (by 4 p.p., from 53% to 49%) alongside an increase in the proportion of positive judgments (by 3 p.p., from 12% to 15%).

In the dynamics of assessments regarding the political situation in the country and the region over the last two months (as well as in the annual retrospective), no significant changes occurred either. The share of people who consider the political situation in the country "calm, favorable" is 24%, and in the region – 52–53% (*Tab. 4*).

Table 2. Income per family member and ratio of income per family member to the subsistence minimum (by income group)

Income group	2012	2015	2018	2019	2020	2021	2022	2023	2024	Oct. 2024	Dec. 2024	Feb. 2025	Apr. 2025	June 2025	Aug. 2025	Oct. 2025	Dynamics (+/-), Oct. 2025 to	
																	Aug. 25	Oct. 24
Income per family member, RUB																		
20% least well-off	4330	5430	6602	7792	7546	8529	10008	11746	13211	13450	14128	13609	14382	13726	14118	16549	+2431	+3099
60% average	9293	11708	13251	14113	14031	15741	17503	20310	22885	23481	25140	25473	27120	26831	27079	29274	+2195	+5793
20% most well-off	19907	23624	27433	28267	28207	30338	37250	40186	43286	43120	43270	48009	50076	53688	52992	49932	-3060	+6812
Average for the region	10425	12837	14757	15686	15570	17220	19953	22578	25038	25413	26566	27607	29161	29579	29669	30863	+1194	+5450
Subsistence minimum, RUB*	6563	9639	10658	11042	11509	11767	13633	14519	15608	15608	15608	17910	17910	17910	17910	17910	0	+2302
Ratio of income per family member to the subsistence minimum by income group, times																		
20% least well-off	0,7	0,6	0,6	0,7	0,7	0,7	0,7	0,8	0,8	0,9	0,9	0,8	0,8	0,8	0,8	0,9	+0,1	0
60% average	1,4	1,2	1,2	1,3	1,2	1,4	1,3	1,4	1,5	1,5	1,6	1,4	1,5	1,5	1,5	1,6	+0,1	+0,1
20% most well-off	3,0	2,5	2,6	2,6	2,5	2,6	2,7	2,8	2,8	2,8	2,8	2,7	2,8	3,0	3,0	2,8	-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	1,6	1,7	1,5	1,6	1,7	1,7	1,7	0	+0,1

*Source: Resolutions of the Government of the Vologda Region "On Establishing the Subsistence Minimum per Capita and for Main Socio-Demographic Groups in the Vologda Region". Official Portal of the Government of the Vologda Region. Available at: <https://vologda-Region.ru>.

Table 3. Dynamics of assessments of economic and financial standing, % of respondents

Income group	2012	2015	2018	2019	2020	2021	2022	2023	2024	Oct. 2024	Dec. 2024	Feb. 2025	Apr. 2025	June 2025	Aug. 2025	Oct. 2025	Dynamics (+/-), Oct. 2025 to	
																	Aug. 25	Oct. 24
Economic situation in Russia																		
Good	10,7	6,2	14,4	14,6	11,7	11,5	11,7	12,1	13,9	16,8	14,7	13,0	14,3	14,2	15,1	16,1	+1	-1
Average	51,2	46,6	43,9	44,6	42,9	42,7	42,3	43,2	45,7	44,7	45,5	46,7	44,9	44,3	43,3	41,5	-2	-3
Poor	25,5	35,5	27,2	26,1	31,1	30,8	32,9	30,2	26,2	26,7	26,8	29,0	29,4	28,5	27,5	26,4	-1	0
Index	85,2	70,7	87,2	88,6	80,6	80,8	78,7	81,9	87,7	90,1	87,9	84,0	84,9	85,7	87,6	89,7	+2	0
Economic situation in the region																		
Good	9,9	5,2	11,8	11,5	10,8	10,9	11,1	13,8	15,0	14,8	15,8	15,2	16,2	15,9	16,5	17,7	+1	+3
Average	49,4	39,9	39,2	41,3	38,3	40,4	40,1	42,7	43,8	42,2	42,3	45,3	41,5	40,8	43,5	40,1	-3	-2
Poor	29,4	43,0	36,9	34,9	36,9	35,9	36,5	32,6	30,3	31,2	30,8	29,5	33,2	31,7	30,9	32,0	+1	+1
Index	80,5	62,2	74,9	76,6	73,9	75,0	74,6	81,2	84,7	83,6	85,0	85,7	83,0	84,2	85,6	85,7	0	+2
Financial situation of the family																		
Good	10,1	7,9	11,8	10,2	9,2	8,4	8,8	10,1	12,4	12,0	13,7	13,8	14,0	14,7	13,8	15,3	+2	+3
Average	54,2	49,5	48,7	50,1	46,2	48,6	47,9	51,0	51,6	52,7	49,9	47,0	46,5	47,7	50,7	48,9	-2	-4
Poor	27,4	31,2	30,2	29,7	33,0	32,4	32,2	27,9	26,4	24,7	26,1	29,1	26,4	27,5	25,2	25,3	0	+1
Index	82,7	76,7	81,6	80,4	76,2	76,0	76,4	82,2	86,0	87,3	87,6	84,7	87,6	87,2	88,6	90,0	+1	+3

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

Income group	2012	2015	2018	2019	2020	2021	2022	2023	2024	Oct. 2024	Dec. 2024	Feb. 2025	Apr. 2025	June 2025	Aug. 2025	Oct. 2025	Dynamics (+/-), Oct. 2025 to	
																	Aug. 25	Oct. 24
<i>In Russia</i>																		
Favorable, calm	39,8	25,5	40,4	45,0	41,0	37,2	27,5	23,3	24,7	23,7	24,9	22,3	24,7	24,3	25,6	24,0	-2	0
Tense, critical, explosive	43,2	58,7	45,6	41,6	43,2	47,2	56,9	62,3	59,7	59,9	61,3	63,0	61,1	62,1	61,3	60,2	-1	0
<i>Index</i>	<i>96,6</i>	<i>66,8</i>	<i>94,8</i>	<i>103,5</i>	<i>97,8</i>	<i>89,9</i>	<i>70,6</i>	<i>61,0</i>	<i>65,0</i>	<i>63,8</i>	<i>63,6</i>	<i>59,3</i>	<i>63,6</i>	<i>62,2</i>	<i>64,3</i>	<i>63,8</i>	<i>-1</i>	<i>0</i>
<i>In the region</i>																		
Favorable, calm	51,8	46,0	54,9	58,0	53,9	53,7	47,9	49,8	52,5	53,3	53,5	51,3	52,9	54,3	51,1	52,3	+1	-1
Tense, critical, explosive	31,8	39,1	33,3	31,5	32,9	34,3	40,4	41,0	39,1	38,9	39,0	40,4	38,3	37,1	38,9	39,2	0	0
<i>Index</i>	<i>120,0</i>	<i>106,9</i>	<i>121,6</i>	<i>126,4</i>	<i>121,0</i>	<i>119,8</i>	<i>107,5</i>	<i>108,8</i>	<i>113,4</i>	<i>114,4</i>	<i>114,5</i>	<i>110,9</i>	<i>114,6</i>	<i>117,2</i>	<i>112,2</i>	<i>113,1</i>	<i>+1</i>	<i>-1</i>

Summary

The study results show that against the backdrop of the ongoing complex international political situation and continuing economic sanctions, public opinion assessments on the main monitoring indicators remain stable, both in the short-term and long-term retrospective.

Over the past 12 months, there has been a slight improvement in citizens' self-assessments of their financial standing and, more importantly, in indicators of the population's psychological well-being (specifically, the social "reserve of patience").

However, it should be noted that for many residents of the region, the situation in the country remains quite alarming:

60% characterize the political situation in Russia as "tense, critical, explosive"; 26–28% of the surveyed citizens express negative assessments regarding the economic situation.

Thus, overall, one can speak of the preservation of a stable, steady emotional background, especially concerning the assessment of the state of affairs in the region and at the level of personal daily life. Anxious feelings about the situation in the country are quite understandable, objective in nature, and largely depend on developments in the international political arena.

The results of the subsequent rounds of the VoIRC RAS monitoring will indicate the direction of further dynamics in public opinion on key aspects of citizens' daily lives.

MONITORING OF SOCIAL SENTIMENT



Figure 1. Index of Social Sentiment, points

From August to October 2025, the social sentiment of the residents of the Vologda Region remained unchanged. The Index of Social Sentiment stands at 147–149 points.

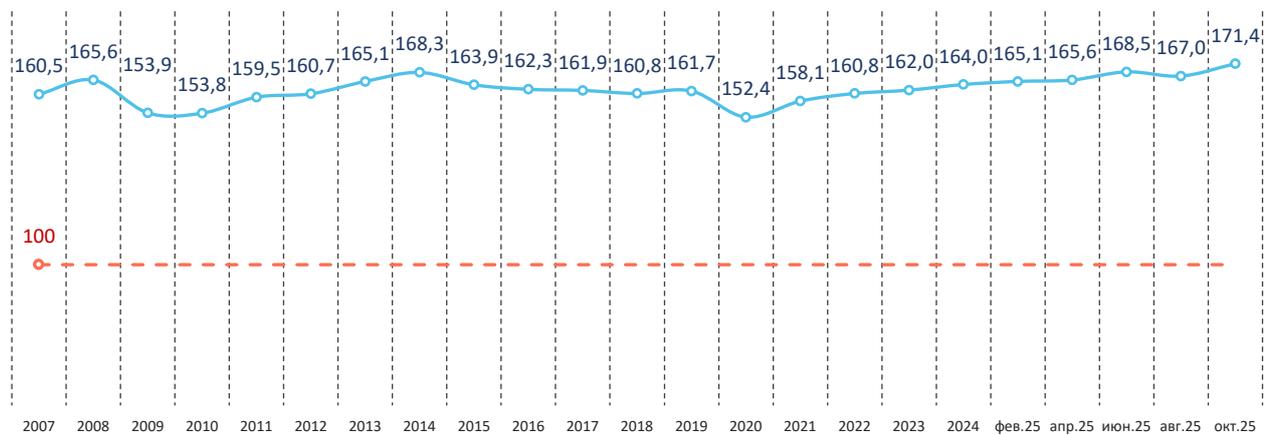


Figure 2. Index of Patience Reserve, points

In October 2025, the Index of Patience Reserve for the region's residents reached 171 points, which is the highest value for the presented period. Compared to August of this year, it increased by 4 points (from 167 to 171 points).

Here and henceforth: To calculate the indices, the percentage of negative responses is subtracted from the percentage of positive responses; then, 100 is added to the result to avoid negative values. Thus, entirely negative responses would yield a total index of 0, entirely positive – 200, and a balance of the two – an index of 100, which essentially serves as the neutral mark (---).

Data are presented from 2007 – the final year of V.V. Putin's second presidential term.

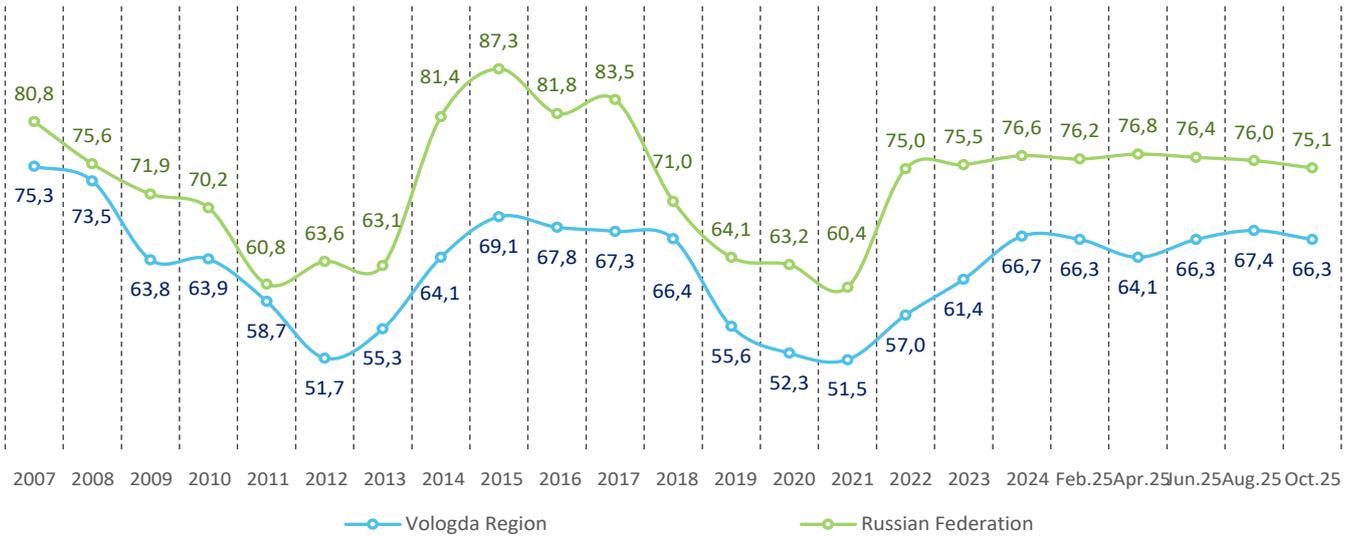


Figure 3. Approval of the activities of the President of the Russian Federation, % of respondents

From August to October 2025, the approval rating for the activities of the President of the Russian Federation remained unchanged both in the Vologda Region and in Russia as a whole, standing at 66–67% and 75–76%, respectively.

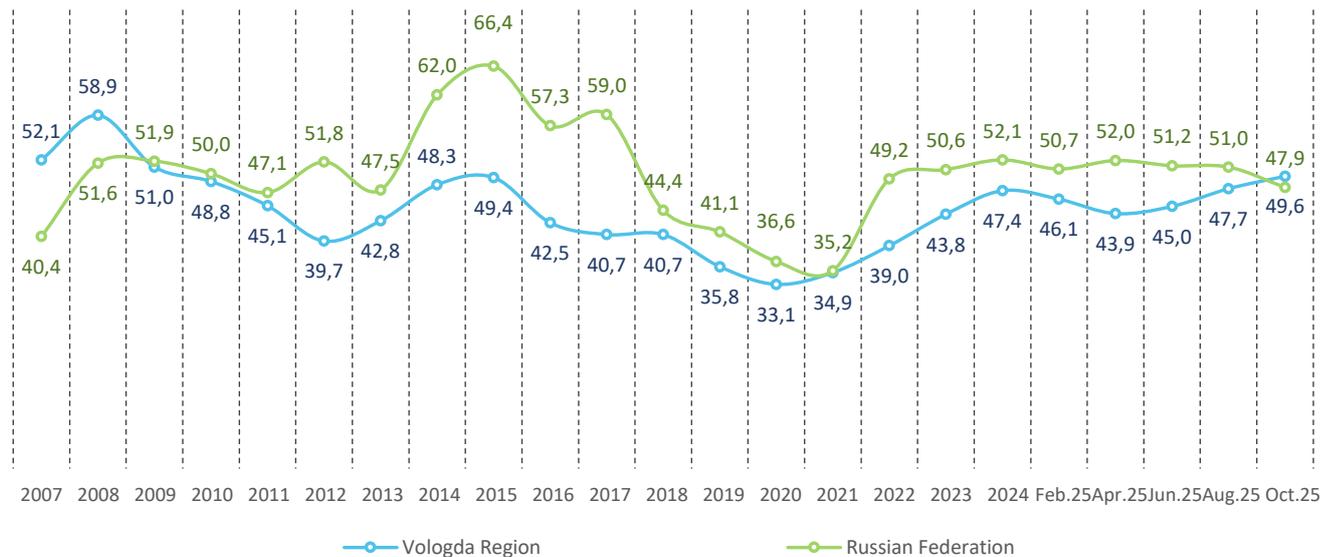


Figure 4. Approval of the activities of the Government of the Russian Federation, % of respondents

From August to October 2025, the share of positive assessments of the work of the Government of the Russian Federation by the region's residents showed no significant change (48–50%). For the country as a whole, this indicator decreased by 3 p.p. (from 51% to 48%).

Here and henceforth: Vologda Region – data from VolRC RAS; Russian Federation – data from VCIOM (<https://wciom.ru>).

VCIOM data – approval of the activities of the President of the RF and the Government of the RF: average of 2 surveys dated 05.10.2025 and 12.10.2025.



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

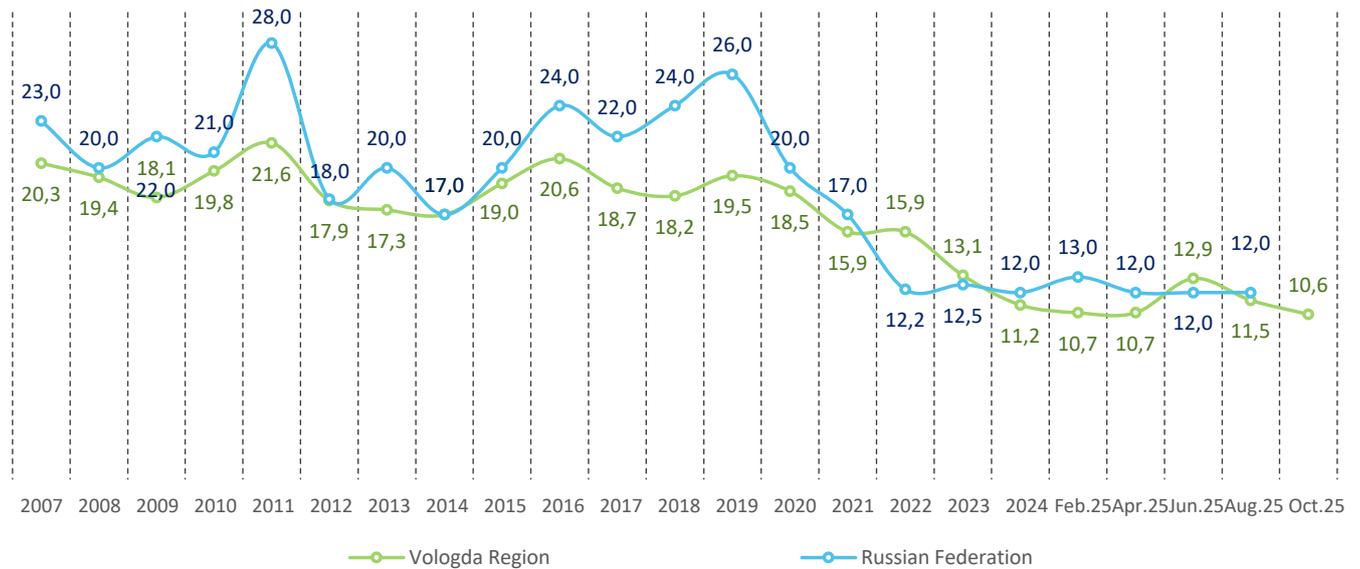


Figure 6. Willingness to participate in protests
(share of respondents ready to take part in mass protest actions),
% of respondents

In October 2025, assessments of the degree of social tension in the Region remained at the level of August values. The share of those who consider protest actions likely is 13–14%, while those willing to participate in them is 11–12%.

Monitoring of social sentiment



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

From August to October 2025, the proportion of positive and negative assessments of the economic situation in the Region remained unchanged (17–18% and 31–32%, respectively). At the same time, the share of neutral assessments decreased by 4 p.p. (from 44% to 40%).

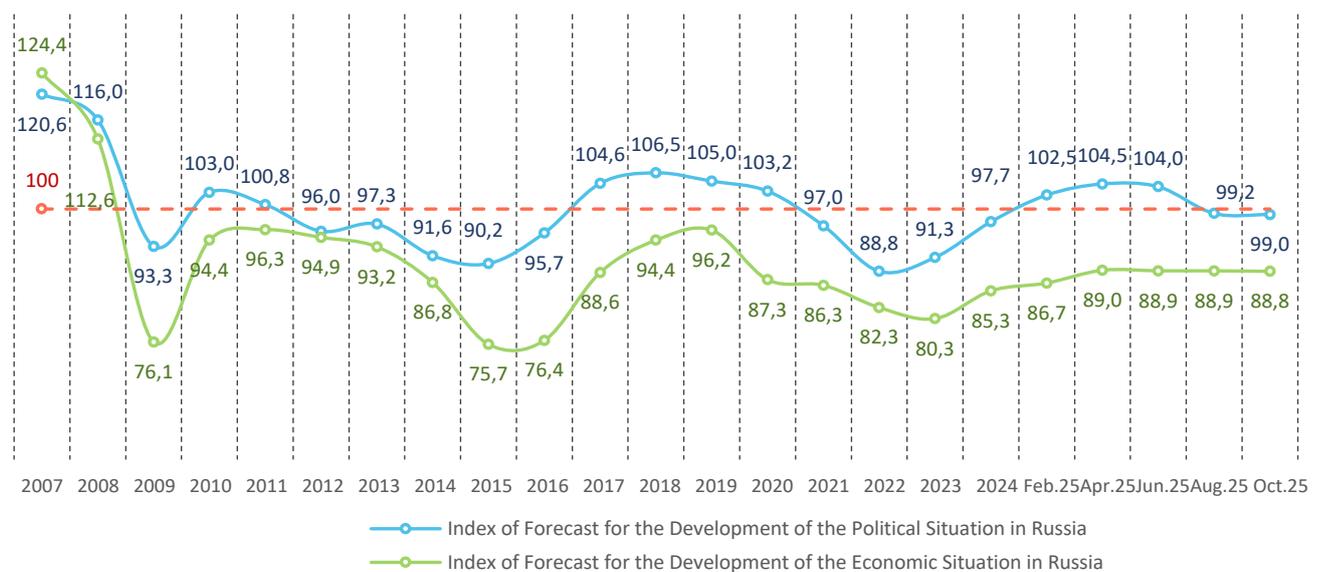


Figure 8. Indices of Forecasts for the Development of the Political and Economic Situation in Russia, points*

In October 2025, the values of the indices forecasting the development of the political and economic situation in Russia are similar to the August figures (99 and 98 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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